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ABSTRACTS & AUTHOR INDEX

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Cardiovascular and Interventional Radiological Society of Europe

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PART 1

Special Sessions
Foundation Courses
Honorary Lectures
Hot Topic Lectures

Abstracts of
special session,
foundation course,
honorary and hot topic lectures
sorted by presentation numbers

Cardiovascular and Interventional Radiological Society of Europe

CIRSE

Foundation Course
Postpartum haemorrhage

101.1

Aetiology, common causes and when to embolize

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Learning Objectives:
1. To understand the arterial anatomy relevant to post partum haemorrhage
2. To describe the etiology and common causes of post partum haemorrhage
3. To describe the indications for embolization in post partum haemorrhage

No abstract available.

101.2

Placement of prophylactic occlusion balloons: why, when, how?

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Learning Objectives:
1. To understand the rationale for the use of occlusion balloons in the management of post partum haemorrhage
2. To describe the indications for prophylactic occlusion balloons in the management of post partum haemorrhage
3. To describe the technique of prophylactic balloon occlusion in post partum haemorrhage including results and complications

The incidence of placenta praevia and accreta is increasing in proportion to the rise in caesarian deliveries (1). Traditionally these were treated by caesarean hysterectomy. As placenta preavia and placenta accreta may be diagnosed before childbirth, prophylactic balloon occlusion is being used increasingly.

Prophylactic placement of occlusion balloons seems a good idea but the evidence in favour of this technique is slow to emerge, and like many interventions can cause harm to the mother and foetus (2,3). Placement of occluding balloons should be performed in Radiology and I recommend that the epidural catheter is inserted before the patient comes to Radiology so that patient movement is minimised after placing the occluding balloons. The tips of the catheters should not be in the uterine arteries but are inserted so that they are just into the anterior division of the internal iliac or just into the internal iliac above the anterior/posterior bifurcation. The benefit of the latter approach is minimal manipulation and avoidance of spasm in the uterine arteries. Movement of the patient when they go to the obstetric theatre could dislodge the catheters from the internal iliac and so their position should be checked. The occlusion balloons are inflated immediately after delivery of the baby and deflated just before skin closure. If haemorrhage occurs embolization may be performed in theatre. If it is feasible, with the balloons inflated, the patient should be transferred to the IR suite for embolisation. Arterial sheaths are usually left in situ for a further 24 hours in case further embolization is required.

Recent studies have shown that women with placenta accreta who had occlusion balloons placed before CS had 40% less blood loss and 52% less volume of blood transfused than women without occluding balloons (4). However, it is unclear whether the need for caesarean hysterectomy is reduced and if hysterectomy is undertaken whether blood loss during this procedure is reduced as there are several studies reporting conflicting results (5,6,7,8).

Every effort must be made to ensure women at high risk of post-partum haemorrhage are identified before delivery and prophylactic options are considered. More and larger series of patient outcomes are required to evaluate how effective prophylactic balloon occlusion +/embolization is in preventing massive blood loss and reducing the need for caesarian hysterectomy.

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101.3

How to embolize postpartum haemorrhage: embolics and technique

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Learning Objectives:
1. To describe logistical challenges of embolization in post partum haemorrhage
2. To describe the technique of embolization in post partum haemorrhage
3. To review the embolic materials used for embolization in post partum haemorrhage

Postpartum hemorrhage remains one of the most common causes of maternal mortality. It can be categorized into hemorrhage occurring early or late, and has different causes and may be treated differently. Early postpartum hemorrhage occurs within the first 24 hours following delivery, and late postpartum hemorrhage occurs more than 24 hours and less than 6 weeks after delivery.

Early postpartum hemorrhage is more common and is the cause of more blood loss. It is most frequently caused by uterine atony, but can also be caused by retained placental fragments, lower genital tract lacerations, uterine rupture, uterine inversion, or invasive placenta. Because there tends to be massive blood loss, this type of hemorrhage needs to be approached with rapidity. Ideally the patient is referred quickly to interventional radiology prior to the development of severe hypotension, potential myocardial ischemia,

and disseminated intravascular coagulopathy.
In most cases the bleeding will be from the uterus, either because of uterine atony, retained placental fragments, or an invasive placenta. A low abdominal aortogram is usually performed to evaluate the vascularity, and then selective and if possible supraselective catheterization is performed to evaluate the branches of the internal iliac artery. The uterine arteries are usually still large and can be catheterize, usually without the need for microcatheters. In most cases with placement of a 5 French catheter, a Gelfoam slurry or large Gelfoam pieces can be administered. A Gelfoam slurry can be produced by placing cut up pieces of Gelfoam in a 10 ml syringe and attached to a 3-way stopcock with another syringe containing contrast. The Gelfoam-contrast solution is passed back-and-forth until the pieces are broken down into a slurry and then the slurry is injected with small syringes through the catheter into the artery. This solution is injected until the artery is occluded. Then the opposite artery is catheterized and occluded. Gelfoam can also be cut into larger particles (torpedoes) and injected individually through the catheter until stasis is achieved. Although coils, PVA, and cyanoacrylate glue have all been used in postpartum hemorrhage, there is no reason in most cases to use these materials since just being able to temporarily slow down the uterine blood flow is the primary requirement of the embolization. Gelfoam slurry or pledglets have the potential for recanalization which is ideal in women who may desire future pregnancies.
In some cases the bleeding may be coming from vaginal or cervical branches due to lacerations from the delivery. Occasionally deep lacerations may cause a retroperitoneal hematoma, which can allow substantial blood loss leading to shock. In these cases catheterization of the more proximal uterine artery with embolization with a Gelfoam slurry can be performed, or a microcatheter may be used to more selectively embolize the bleeding vessel. Usually Gelfoam is most appropriate as an embolic, but potentially a small amount of particulate agent, or a microcoil could be used for the embolization.
If bleeding is occurring because of an invasive placenta, it is possible that the cervix, vagina, pelvic sidewalls and bladder may be involved in a placenta percreta. This may require supraselective embolization or less selective anterior division embolization if there are multiple bleeding sites.
If a hysterectomy has been performed, then bleeding maybe coming from an uterine artery (potentially a slipped ligature) but maybe coming from other branches of the internal iliac artery. Uterine artery supply can also rarely originate from a branch of the distal external iliac artery, or from the round artery that can originate from the inferior epigastric artery. In addition, it is possible that in the course of the postpartum hysterectomy that the ovarian artery has been damaged or there has been the development of collaterals from the ovarian artery. Since bleeding from this artery will not be identified on a pelvic angiogram it is important to have a high level of suspicion if the patient continues to show evidence of bleeding when no bleeding is identified on the internal iliac injections or following embolization. Bleeding can occur along the course of the ovarian artery since it may be caused by retractor injury.
In some cases extravasation of contrast may not be evident. Extravasation is more common if there is a vaginal or cervical laceration. Usually embolization is performed at least of the uterine artery even if bleeding is not identified. In some cases the arteries may be so small because of vasoconstriction due to hypotension, that it may not be possible to access the uterine artery and proximal anterior division embolization may be required. In these cases one should avoid embolizing the superior gluteal artery since buttock ischemia has been described as a complication of embolization for postpartum hemorrhage. Both uterine arteries, or anterior divisions should probably be embolized. If the superior gluteal arises as a very early branch and it is a risk for embolization, then there could be consideration of placing a proximal coil in the artery to prevent embolization of the buttock area.
Late postpartum hemorrhage, which by definition occurs more than 24 hours after the delivery, may still be caused by genital lacerations that manifest late, or retention of products of conception. These can usually be treated by Gelfoam just as if they were within the early time period. In addition, the bleeding maybe caused by the development of an AV fistula or a pseudoaneurysm that develops in the myometrium. Embolization in these cases is usually less emergent, as the bleeding is less. Embolization materials are different in these cases. The AV fistula may appear more like an AV malformation as it recruits multiple feeding vessels. In these cases a permanent embolization material is required. Depending on the flow patterns a particulate agent is not appropriate because of the arterial venous shunting. Cyanoacrylate glue or Onyx is a better choice because of the permanent nature of the embolization, and the ability to penetrate more distally. Since a pseudoaneurysm is usually more distally in the uterine artery, it is also usually better treated by glue embolization which allows the embolization to occur more distally. However, if the pseudoaneurysm is more proximal it might be embolized with a coil, again a permanent embolic agent. Both uterine arteries need to be evaluated in these conditions. It is not unlikely that both uterine arteries might require treatment because of the cross collateral nature of the blood flow in the uterus.
Recurrence after embolization can occur. In some cases there is recanalization. In other cases, ovarian collaterals have developed. If there is a recurrence, the first approach would be to study the internal iliac branches, but if there is no evidence of bleeding then evaluation of the ovarian arteries needs to be performed.
Complications of embolization can occur but with careful technique they should be minimized. Ischemic complications that have been reported include uterine necrosis, vaginal fistula, muscle pain, buttock ischemia, neurological damage (primarily sciatica) and perforation or occlusion of the external iliac artery. Post-procedural fever can also occur, but this seems to be more likely either a consequence of endometritis from previous manipulations, or a post-embolization syndrome.

101.4

Is embolization always successful? - How to avoid failure

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Learning Objectives:
1. To review results of embolization in post partum haemorrhage
2. To discuss complications of embolization in post partum haemorrhage
3. To understand how to maximise outcome of embolization in post partum haemorrhage and reduce complications

Pelvic arterial embolization is a reliable and safe procedure for postpartum haemorrhage (PPH) in haemodynamically stable patients. Success of the pelvic arterial embolization is defined as an arrest of a haemorrhage with no subsequent need for surgical or other treatment. The overall embolization success rate in patients with a normal clotting system ranges between 80% and 100%. The reintervention rate is reported to be necessary in 5% to 20% of cases and is usually satisfactory. The factors associated with ineffective embolization are related to technical aspects, arterial anatomy, course of haemorrhage, clinical status of the patient and mode of delivery. Technical failure of arterial embolization is rare. It is mainly due to unfavourable arterial anatomy, which makes catheterization of uterine arteries impossible. The uterine arteries are often prone to arterial spasm; however, that risk can be avoided using microcatheter technique. There are other arteries besides pelvic, such as ovarian arteries, which can contribute to bleeding, therefore examination should also include an abdominal aortogram. The different causes of PPH influence the outcome of embolization which is highly effective

in uterine atony, whereas vaginal and cervical tears show a tendency towards lower success rate. PPH following vaginal delivery is more readily controlled with embolization than that after caesarean delivery. This is mainly attributed to different causes of PPH after caesarean and vaginal delivery. Caesarean delivery is rarely complicated by uterine atony, compared with vaginal delivery. On the other hand, haemorrhages after caesarean are often due to abnormal placentation but only indecently after vaginal delivery. In patients with coagulopathy resulting from severe hemorrhage and multiple transfusions, embolization may fail to be effective. Likewise, patients in shock respond less favourably to embolization. Complication rates after embolization of pelvic arteries or balloon occlusion of iliac arteries are low, occurring between 5 and 10%. Most complications are minor such as groin hematoma, dissection or pseudoaneurysm and are mainly related to arterial puncture. Ischaemic complications are usually associated with non-target embolization. Single cases of bowel, uterine, vaginal and bladder wall necrosis have been reported. Lower extremity ischaemic complications are due to reflux of embolic material to the external iliac arteries. Delayed complications are rare and include ovarian failure, infection, buttock numbness. Complications after balloon occlusion of iliac arteries are usually due to an oversized balloon which can cause intimal damage and can contribute to thrombosis.

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Special Session
Aorto-iliac disease

102.1

How should we manage stenosis involving the aorta and the aortic bifurcation?

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Learning Objectives:

1. To learn about the specific problems of iliac stenoses involving the aortic bifurcation
2. To learn about the incidence of recurrent stenoses in this location
3. To learn the possible concepts of treating these lesions

Aortic occlusion begins with atherosclerotic disease at and around the aortic bifurcation. As this process becomes progressive, the aortic stenosis, slow flow, and turbulence promote thrombus formation that completes the occlusion proximally as far as a significant outflow branch, often the inferior mesenteric or renal arteries (1). Thus, the aortoiliac occlusion is a combination of juxta-bifurcation aortic wall plaque and organized thrombus. This extensive aortic wall disease with heavy thrombus burden presents a particularly difficult challenge for any catheter-based reconstruction and requires both, high operator skill levels and state-of-the-art endovascular tools. Therefore, at many institutions the traditional approach to revascularization in aortoiliac disease is still surgical.

Aortobifemoral bypass grafting was established over four decades ago as the intervention of choice for patients with aortoiliac occlusive disease (2). In patients fit enough to tolerate laparotomy, aortobifemoral bypass is the operation of choice. Patients at greater surgical risk are candidates for axillofemoral bypass grafting with acceptable patency rates, a less stressful procedure with a shorter recovery time (3,4).

The rise of endovascular treatment techniques for revascularization has resulted in innovative applications of this new technology to provide less invasive options for this patient population. In 1995 it was still stated after publishing initial experience with endovascular graft repair of complex arterial lesions that the obtained results justifies further use and careful evaluation of this technique for major arterial reconstruction (5) and some years later first data reporting primary stent implantation with the kissing balloon technique is safe and effective for the treatment of aortoiliac obstructions involving the aortic bifurcation as a true endovascular alternative to surgery became available (6). Today, there are no differences between the aortofemoral bypass and aortoiliac stenting groups with respect to long-term rates of mortality, amputation, or revision procedures (7).

Looking closer to data obtained from endovascular treatment, which should be nowadays kept in mind as an optional first treatment approach, technical success rates and cumulative patency rates are encouraging for a successful and lasting revascularization. Martinez et al published their results of aortic stenting in 24 patients, 6 of whom had total aortic occlusion (8). At 5-year follow-up, they had a cumulative patency of 100%. Stoeckelhuber et al had a smaller series with longer follow-up, also demonstrating 100% patency (9). Either the use of self-expanding stents or balloon-expandable stents is described.

A recent article comparing outcomes of covered kissing stent placement compared with bare metal stent placement in the treatment of atherosclerotic occlusive disease at the aortic bifurcation could prove that the use of covered balloon-expandable kissing stents for atherosclerotic aortic bifurcation occlusive disease provides superior patency at 2 years as compared with bare metal balloon-expandable stents (10).

Although there have been previous descriptions of endoprostheses for the treatment of aortoiliac disease (11,12). Even the reconstruction of the totally occluded aortoiliac bifurcation in patients suffering from Leriche syndrome by endoluminal means was shown to be feasible and safe and associated with excellent mid-term clinical outcomes (13).

In opposite to the conventional kissing stent technique, T-stenting may serve as an alternative with small protrusion technique (TAP-stenting) for stenosed aortoiliac bifurcations with small abdominal aortas. This technique is described as follows: a large, self-expanding stent was implanted from the lower aorta to one iliac branch, followed by deployment of a balloon-expandable stent in the contralateral iliac artery such that its proximal edge protruded a few millimetres through the struts of the self-expanding stent into the aorta [TAP (T And Protrude)-stenting technique] (14).

In case of dissections involving the aortic bifurcation or failures to get in to the true lumen at the level of the aorta can be handled today using so-called re-entry devices. The technical success rate is possible 100%, facilitated by the use of the Outback™ catheter for accurate wire re-entry (15).

When managing stenoses involving aorta and aortic bifurcation, repair of the concomitant femoral occlusive disease is often needed regardless of open or endovascular treatment and infrainguinal disease negatively affects the durability of the procedure and patient survival (16). Long-term data after aortoiliac kissing stent procedures showed in multivariate analysis, age <50 years and presence of iliac occlusion were identified as risk factors for reduced primary and assisted primary patency; a crossed configuration of kissing stents was identified as a risk factor for reduced primary patency (17). Last but not least, failure of kissing stents in the aortic bifurcation may be significantly increased by the overlap of the free proximal stent ends in the distal aorta (18).

Keeping this in mind endovascular management of stenoses involving aorta and aortic bifurcation is a suitable, less invasive alternative to aortofemoral bypass surgery for the treatment of aortoiliac occlusive disease. However, one has to keep in mind, these patients suffer from a high overall mortality due to other cardiovascular causes (19).

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102.2

Should IRs treat TASC C and D lesions?

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Learning Objectives:

1. To learn about the specific features of TASC C and D lesions
2. To learn about the result after endoluminal treatment of TASC C and D lesions
3. To learn about the surgical results in this type of lesions

Percutaneous interventional treatment of iliac atherosclerotic obstructions shows favourable results, with most studies reporting technical success of >90%, and five-year patency rates ranging from 54% to >93%. In a review of ~2,000 cases of iliac angioplasty mean primary patency 5 years after treatment was 72% (1). While focal disease in the common and external iliac artery responds well to balloon angioplasty alone, results for treatment of long stenoses, tandem lesions, or occlusions are less encouraging (2-5). Long segmental disease, chronic total occlusions and/or failure of angioplasty are widely considered as indications for stent placement in the iliac arteries. Today in many institutions, however, the threshold for stents is low even for shorter lesions. Clinical data seem to

support this notion, because stenting has shown to improve technical results without increasing the complication rates. Bosch et al. reported a 4-year success rate for iliac angioplasty of 44-65%, increasing to 53-77%, after stent placement (6). While most of the available studies do not stratify results according to lesion severity, even older reports have indicated that extensive iliac disease can be treated effectively by endovascular means. The TASC II document from 2007 categorizes iliac lesions according to their complexity, defines anatomic indications for percutaneous or surgical treatment and provides treatment recommendations that are based on clinical data available at that time. Briefly, for treatment of TASC A and B lesions endovascular therapy is recommended, while for TASC C and D lesions surgery is considered the first option (7). Because the TASC document is based on older clinical data and does not incorporate recent advances in recanalization techniques and balloon-/ stent technology; however, these recommendations seem outdated. With the availability of dedicated CTO devices (special wires, microdissection tools, reentry catheters) and stentgrafts, most experienced IRs do not see limitations for interventional treatment of the majority of iliac lesions. Newer clinical data support this view: Sixt et al. conducted a retrospective analysis of 375 symptomatic patients who underwent 438 interventions for aortoiliac arterial obstructions. Lesions were stratified according to the TASC II classification: 259 (59%) procedures involved TASC A/B lesions, while 113 (26%) were for TASC C and 66 (15%) for TASC D lesions. Acute treatment success was 100%, 96%, 93%, and 100% for TASC A, B, C, and D lesions, respectively. The primary 1-year patency rate was 86% for the entire study cohort. It was similar for all TASC classifications (89%, 86%, 86%, 85% for TASC A to D lesions, respectively). The 5-year event-free survival (70%) was not significantly better in the TASC A/B cohort compared to the C/D cohort (57%, p=0.124). Clinical outcome improved significantly in all TASC subgroups and was maintained up to 1 year. Stenting was an independent predictor for lower restenosis rates (p=0.008) (8). In another study with 436 patients, Koizumi et al. found differences in the initial success rates for Type-B and Type-D lesions when compared to endovascular treatment of Type-A lesions (P<0.05). Patency rates at 3, 5 and 10 years were significantly lower for advanced disease (Type-C/D lesions) when patients were treated by angioplasty alone. However, patency after stenting did not differ significantly between Type-C/D and A/B (9).

In the 2007 TASC II document it is stated that "patient´s comorbidities, fully informed patient preference and the local operator´s long-term success rates" must be considered when making decisions for iliac artery treatment. Thus, in many institutions considerable experience in treating more advanced iliac artery lesions has accrued. Recent data in the literature also suggest that success rates of interventional therapy are independent of the TASC II classification scheme. Technological advances in endovascular therapy have allowed excellent results and high safety, and today even class D lesions can be performed with sustained long-term outcome. Although differences in durability remain to be determined, endovascular treatment does not prevent later surgery, which is why it should be regarded as the first line treatment modality for most patients with advanced iliac disease.

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102.3

Results of bypass vs. interventional radiology for occlusive disease

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Learning Objectives:

1. To learn about the results of the available data in the literature
2. To learn about the role of surgery in these types of lesions
3. To learn about proper patient selection for IR and surgery

The major risk factors for atherosclerosis include age, smoking, diabetes, hypertension, hyperlipidaemia, elevated homocysteine, and raised C-reactive protein. Whilst some of these determine the distribution of disease the principal determinant is the presence of low wall shear stress. Atherosclerosis truly limited to the aorto-iliac region is only present on 5-10% of patients. However, aorto-iliac disease is a common component of the more frequent widespread disease pattern and as such plays a major role in the development of critical limb ischaemia (CLI) as well as claudication.

The decision to intervene always follows the management of the risk factors as this will delay the development of cardiovascular death, MI and stroke. Once as decision to intervene upon aorto-iliac disease has been taken the reasonable alternatives are conventional surgery or endovascular therapy.

Bypass surgery

The preferred surgical procedure for aorto-iliac disease is an aorto-bifemoral bypass graft. The handling characteristics of Dacron make it the material of choice for the prosthetic in the majority of cases.

The mortality from the procedure is around 4-5% (1-4). Clearly this is dependent upon the basic health of the patient such that in a young claudicant the mortality would be expected to be 0-1%. Other procedural complications are well recognised including haemorrhage (2%), acute limb ischaemia (1-3%), renal failure (1-8%), intestinal ischaemia (2%) and spinal cord ischaemia (0.25%) (1, 4). Overall 16% will have a systemic complication and local complication from surgery of 6% (2). A recent report reviewed the complications of surgery with contemporary anaesthetics but in patients who were not treatable by modern endovascular techniques. There was still a 3.7% mortality and 34% major complication rate (5).

The long-term patency of the aorto-bifemoral graft is excellent and remains the gold-standard for vascular intervention. The primary patency at 5 and 10 years is around 85% and 60%, respectively (1, 3, 4). However, 2 other factors need to be taken into consideration. There are long-term problems with the aorto-bifemoral graft. 21% of

long-term survivors will suffer a major complication which includes re-occlusion, false aneurysm (usually at the femoral anastomosis), infection and buttock and thigh claudication (6, 7). Many of these patients (perhaps 30-50%) will have had sexual dysfunction before surgery, it is estimated that up to 25% will have problems related to the surgery. In addition, the life expectancy of these patients is restricted compared to an age-matched control. At 5 and 10 years, 25% and 50% of patients will be dead (1, 4).

Extra-anatomical reconstruction has not found favour because of limited patency and higher infection rates. However, in sick patients and those with hostile abdomen there may be no alternative. Femoro-femoral bypass may be used when there is good inflow to the contralateral femoral artery. The surgery is fairly well tolerated with 30-day mortality of around 0-6% (4, 8-10). However, critical investigation demonstrates that other complications affect recovery in 22% of patients, in particular graft occlusion, re-operation, bleeding, wound infection, lymph fistula, femoral nerve numbness, penile swelling, DVT, MI, chest infection and stroke (11). Primary patency at 1, 3 and 5 years is around 90%, 75% and 70%, respectively (8-10). Graft infection remains a persistent concern occurring in around 6% of patients. Most patients will be treated for CLI and in this group 40% will be dead at 5yrs.

The donor iliac system frequently has significant disease. Whilst there is some debate as to whether donor iliac endovascular intervention affects patency of the graft, it is likely that if the disease is short segment (less than 5cm) then angioplasty probably does not affect outcome. However, where there is more lengthy disease then patency is expected to be reduced (12).

Axillo-bifemoral procedures are generally performed when nothing else is possible. Most patients will have been treated for CLI or infected intra-abdominal grafts. The 30-day mortality is reported as 2-18% with a 3-year patency of between 40 and 70% (10).

Endovascular intervention

From the early days of Interventional Radiology endovascular intervention upon the aorta and iliac arteries has been recognised as an attractive alternative to surgical intervention. Endovascular intervention is safe and the majority of patients can be treated as a day case. The BIAS registry reviewed 4295 cases of iliac intervention and demonstrated that in the UK the overall procedural mortality is 2%, but only 0.2% in claudicants. Other complications were rare including distal embolisation (0.5-0.8%), groin haematoma (1.2%) and unplanned surgery (0.7%). There were only 2 iliac artery ruptures (13).

Infra-renal aortic stenosis is uncommon and tends to occur in overweight heavy smoking short women. For a long time this has been treated with angioplasty or stent placement but, because the lesions are uncommon, the number of reported cases is small. Patency is high; 70-90% at 4 years (14).

Simple angioplasty for short iliac stenoses is a simple procedure with almost 100% technical success. The long-term patency at 1, 3 and 5 years is 75-95%, 60-90% and 60-80%, respectively (15-19). Whilst there are no randomised data to show that stents confer benefit over simple angioplasty when treating stenoses, a meta-analysis did show that stents improve the technical success rate, have a similar complication rate (also demonstrated by the BIAS registry) and have a 39% reduction in the risk of long-term failure (20).

Bilateral common iliac stenoses cause concern regarding the use of kissing balloon angioplasty or kissing stents. The incidence of prolapse of the atheroma from one iliac artery to another is actually very low but since both sides would probably require treatment anyway a kissing technique is probably required. Since there are no good data to show benefit of stents over simple angioplasty it is this author's preference to use kissing angioplasty. However, if kissing stents are to be used then the long-term data are also excellent with patencies at 1, 3 and 5 years of around 76-97%, 58-86% and 63-82% (21).

The Dutch Iliac Stent Trial is worthy of mention (22). Patients with claudication and predominantly iliac stenoses were randomised to either primary stent placement or angioplasty and subsequent stent placement if there was a residual gradient. Neither arm had clinical benefit but selective stenting was cheaper. The trial was based upon the premise that a residual gradient produces a worse long-term outcome and requires placement of a stent. Unfortunately there are no data to confirm that premise and therefore this was largely a trial of stent versus PTA.

Until stents became routinely available iliac occlusions were treated by simple angioplasty. Two large series show similar clinical and patency outcomes as when treating occlusions but there was a high rate of distal embolisation. When stents suitable for iliac arteries were developed they became routine use in occlusions with the hope of scaffolding back the bulk of disease and improving patency. There were, however, no good supportive data. Non-randomised data show a primary success of 92-97% and primary patency at 2 and 5 years of 75-87% and 75-65% (23-25). A number of factors have been demonstrated to adversely affect long-term patency, in particular CLI rather than claudication, external iliac occlusions, and female sex (20, 23, 24, 26-29). Since external iliacs are small and women have smaller arteries than men I suspect that the outcome is principally affected by the clinical presentation and size of artery treated.

The results of the STAG trial were released at CIRSE 2010. This trial randomised patients with iliac occlusions to either primary stent or angioplasty with stent placement only if there was no flow following deflation of the balloon. The study showed;

1. higher major complication rate following angioplasty alone, largely due to distal embolisation,
2. better long-term patency following stent placement (93% at 2 years),
3. the same clinical outcomes.

Because of the efficacy and safety of using endovascular techniques to manage simple disease (TASC A and B) practitioners have extended the range to include very complex disease (TASC C and D) (30). A recent systematic review has demonstrated that even in extreme disease the mortality ranges from 0 to 6.7% and the primary patency at 4 and 5 years are reported as 60 to 86% (31).

Despite the reduced patency rates compared to aorto-bifemoral grafts in complex patterns of disease endovascular intervention remains popular because;

1. Patency rates remain acceptable.
2. The procedural and long term complications are markedly reduced compared to open surgery.
3. Treatment can generally be done as a day case.

Recommendations

1. In general, patients with peripheral arterial disease are frail and carry a high co-morbidity. It makes sense therefore to treat patients, where possible, using endovascular techniques since these have a low procedural complication rate and acceptable patency rate when compared to open surgery.
2. Stents should be routinely used in iliac and aortic occlusions.
3. An aorto-bifemoral graft should be at least considered in the relatively young and healthy with a disease pattern that is difficult to manage with endovascular techniques, e.g. aortic occlusion, bilateral iliac occlusions, women with small arteries and diffuse disease.
4. Extra-anatomic surgery should be restricted to critical limb ischaemia when other treatment options have been exhausted.

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102.4

Iliac aneurysms: treatment concepts and outcome

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Learning Objectives:
1. To learn about the incidence of iliac aneurysms
2. To learn about the indication for treatment
3. To learn the technical aspects of treatment, results and most important complications

Although isolated iliac artery aneurysms (IAA) are relatively uncommon, comprising less than 2% of all aneurysmal disease, they are associated with significant risk of rupture and death. The incidence of this disease in the general population is believed to be about 0.03% (1). IAAs typically found in elderly men. An IAA is present if the common iliac artery measures >1.85 cm for a man and >1.5 cm for a woman (2). The vast majority (>70%) of isolated IAAs primarily involve the common ilic artery (CIA). Approximately 20% of aneurysms principally affect the internal iliac artery (IIA). For reasons not clearly understood, external iliac artery (EIA) aneurysms are exceedingly rare (1).

Iliac aneurysms may occur in multiple locations and on either side. Approximately two thirds of IAAs reportedly involve two or more segments of the iliac arterial pedicle, and in one-third of these cases, occur bilaterally. The vast majority of iliac artery aneurysms result from degenerative atherosclerosis. Other less common causes of IAAs include vasculitis like Behçet's disease, infection, trauma, iatrogenic injury, collagen vascular disease, and fibromuscular dysplasia.

Clinical presentation depends on the etiology, size and location of the IAA. Most IAAs are asymptomatic and diagnosed at the time of imaging for a different indication. Symptoms, when present, result

from compression or erosion of surrounding structures and rupture.
Unlike the well-documented progression of aortic aneurysms, there are no large-scale prospective studies that have investigated the natural history of IAAs. In the most comprehensive retrospective review of the natural history of IAAs, expansion rates were found to be slow for IAAs smaller than 3 cm (0.11 mm/year) and significantly greater and similar to the rate of expansion for AAA in that size range for IAAs 3 to 5 cm (26 mm/year) (1). The average size of the aneurysms at the time of discovery is 5 to 6 cm (1). As with aortic aneurysms, size appears to be the most important rupture determinant. In large series, the average size of ruptured IAA has been estimated to be 5.6 cm (3). Mortality from emergent repair for rupture in reports from the last 20 years is approximately 28%; ranging from 0% to 60%. In the same series, mortality for elective repair is approximately 5%: ranging from 0% to 50% (1). Based on the available data on the natural history of IAAs, aneurysms that are 3 to 3.5 cm should be carefully followed with ultrasound or computerized tomographic (CT) scanning at 6-month intervals, whereas elective repair should be considered for IAAs 3.5 cm or larger. Symptomatic IAAs and those larger than 5 cm should be expeditiously repaired (1).
Diagnosing isolated iliac artery aneurysms can be difficult. Frequently, the physical examination is unrevealing. Occasionally, abdominal and pelvic X-rays will reveal the calcified wall of an aneurysm in the lower abdomen. Abdominal and pelvic ultrasonography is an excellent non-invasive imaging modality to demonstrate iliac artery aneurysmal disease. The clinical utility of ultrasound is decreased in the presence of overlying bowel gas or iliac arteries located deep in the pelvis. Computed tomography angiography (CTA) and digital subtraction angiography are used widely to establishing the diagnosis and anatomical extent of the iliac artery aneurysms.
Open surgery has represented the traditional therapy for iliac aneurysms. An aorto-bi-iliac or aorto-bi-femoral interposition graft may be performed to treat patients with bilateral common iliac aneurysms. Operative treatment of patients with an isolated internal iliac artery aneurysm may consist of proximal ligation only, proximal plus distal ligation, aneurysmectomy with graft interposition, or endoaneurysmorrhaphy (2).
Endovascular repair of common iliac artery aneurysms has become increasingly popular and has been shown to be safe and durable at mid-term follow-up. Endovascular repair typically involves a combination of branch vessel coil embolization and aneurysm exclusion using a stent graft.
Before endovascular repair, a CTA of the aortoiliac vessels is obtained to measure the length of the proximal and distal neck, aneurysm size, degree of iliac artery tortuosity, and to determine the patency of the hypogastric arteries.
The specifics of the procedure are adapted based on anatomical considerations of aneurysm location and maintenance of adequate pelvic blood flow. Sakamoto et al. and Fahrni et al. each have proposed a working classification that combines anatomical characteristics and endovascular treatment options (4,5). For example, a common iliac artery aneurysm <2 cm from the aortic bifurcation (Fahrni Type Ib; Sakamoto Type IV) may be treated with a bifurcated stent graft or a combination of stent graft extending from aorta to non-aneurysmal iliac artery, coil embolization of the contralateral hypogastric artery, ligation of the contralateral external iliac artery, and a femoro-femoral crossover graft to preserve pelvic blood flow. In contrast, for unilateral common iliac artery aneurysm involving the hypogastric artery that has an adequate proximal neck (Fahrni Type Ia; Sakamoto Type III), the ipsilateral hypogastric is coil embolized and a stent graft deployed in the ipsilateral common and external iliac artery (2).
The reported technical success for elective interventional repair is 100%. Primary patency rates at 2 years vary from 81 to 95% and at 3 years from 86 to 97.5% (6). Reintervention for endoleak and graft/kinking occlusion varies from 0 to 26% (6).
Elective interventional treatment of asymptomatic IAAs is associated with an overall 0-5.5% mortality rate (6). The overall incidence of perioperative and delayed complications varies from 12 to 20%. The most common complication is buttock claudication, which resolves with time.
In conclusion isolated IAAs, while uncommon, require treatment when the aneurysm measures >3.5cm. Imaging with CTA is essential to determine the extent of disease and treatment planning. Endovascular treatment has evolved as the first choice treatment option with good mid-term results, for the patients with suitable anatomy.

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Special Session
Early stage HCC

103.1

Imaging and staging

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Learning Objectives:

1. To describe state-of-the-art techniques for liver tumour imaging
2. To discuss staging protocols
3. To analyse the results of the different modalities in detection, characterization and staging of HCC

Hepatocarcinoma represents the fifth most common cancer in the world and the third most common cause of cancer–related mortality. Its incidence is higher in the developing countries and its rising in Europe and United States equal that observed in Japan is expected in 20 years.
Cirrhosis is the main risk factor, and is clearly associated with hepatitis B virus chronic infection in Asia and Africa and hepatitis virus C in Western countries.
More recently, the metabolic NASH (non-alcoholic steato-hepatitis) related to diabetes and obesity has been considered to be an increasing risk factor for HCC in developed countries.
In the last three decades, surveillance programs and improvement in diagnosis have enabled clinicians to identify tumours at early stage when effective treatment is available and improvement in survival can be reached.
Early HCC was defined as tumours less than 3 cm . EASL and AASLD established that nodules larger than 2 cm which are hypervascular on any imaging method may be regarded as HCC and if two imaging techniques show hypervascularity in nodules between 1 and 2 cm it is also regarded as HCC.
But some nodules larger than 2 cm are not hypervascular and 10 percent of HCC are iso- or hypovascular. Otherwise some hypervascular nodules larger than 1 cm are not HCC. So recent studies have

used sequential imaging and biopsy of indeterminate small nodules to show that a substantial proportion of HCCs of fewer than 2 cm are missed when EASL criteria are applied.
Which technique for early HCC diagnosis?
US is less sensitive than CT and MRI, although there is some evidence that combining CT and US increases sensitivity.
Gd-enhanced MRI is superior to either CT as US. In addition to techniques relying on the parameter of arterial hypervascularity, other indicator of functional assessment using intracellular contrast agents in MRI (EOB-DTPA) was added. Some recent studies recommend to change the main diagnostic modality for HCC smaller than 2 cm from CT arterioportal angiography (considered as a standard) to CEUS and Gd-EOB-DTPA MRI with combined sensitivity as high as 94%.
HCC is two diseases in one, tumour and cirrhosis in most instances, so extent in underlying liver disease should be carried out.
Child-Pugh system is traditionally used but it considers only cirrhosis. Different staging systems have been developed to combine cancer-related parameters and the extent of cirrhosis: Cancer of the Liver Italian Program index (CLIP) used in Western countries or Chinese University Prognosis index in East Asian countries. The main limits of these systems are the lack of reproducibility in different ethnic populations and the lack of correlation with the treatment strategies available. The Barcelona Clinic Liver Cancer (BCLC) staging system published in 1999 by Llovet stratifies patients affected by HCC according to the extent of disease, performance status and underlying cirrhosis assessed by Child-Pugh score. So different stages (early, intermediate, advanced or terminal stages) are defined for which an appropriate treatment can be administered.
In conclusion, the topic of this lecture is 1) to review and summarize the state of the art imaging techniques used for detection of small HCC and 2) to indicate and explain the actual staging principles of this disease according to most popular staging method and especially BCLC staging which permits to stratify patients according to the best actual treatment.

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103.2

Segmental transcatheter approach to the early tumour

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Learning Objectives:

1. To present options of intra-arterial transcatheter therapy for early HCC
2. To discuss results of intra-arterial therapy in the early HCC
3. To understand the role of intra-arterial transcatheter therapy with respect to other surgical and ablative therapies

Early stage HCC can be curably treated or well controlled with local therapies like radiofrequency ablation (RFA) and transcatheter intra-arterial therapy. As the transcatheter intra-arterial therapy, both transcatheter arterial chemo-embolization (TACE) and hepatic arterial infusion chemotherapy (HAIC) are options can be selected. However, for the treatment of early stage HCC, the superselective TACE using a microcatheter system is the best way because of its stronger power to small lesions comparing with HAIC.
For good TACE, "The complete embolization of the entire tumor" must be needed. To achieve "The complete embolization of the entire tumor", techniques and knowledge as follows are needed. The first is to confirm the main feeding artery of the tumor. For this, we should limit the potential feeding arteries from angiogram via proximal side with stepwise manner. Immediate insertion of microcatheter system into a small artery without confirmation should be avoided. Also, angio-CT helps easing and smoothing the procedure. The second is to recognize that arterial blood to the tumor is never supplied via single artery. If the blood supply from the main feeding artery is stopped, the tumor must receive arterial blood via other small arteries. So, we should know the tumor is floating on the vascular network. This phenomenon occurs easily in hepatic segments border and bare area. Because of this, right sized embolic materials reaching intra-tumor vessels should be infused slowly to avoid making bigger cluster in proximal site before tumor vessels. Also, we should avoid the arterial occlusion or spasm caused by the inserted catheter.
When the superselective catheterization is impossible, there is another way to perform the superselective embolization. If arterial branches except the target artery are embolized with temporary embolic materials, we can infuse the embolic materials only into the target artery. For this, the gelatin sponge block adjusted for the proximal size of vessel should be used to avoid the peripheral embolization of the non-tumorous part. A permanent embolic material-like steel coils should not be used, because there is some possibility of artery to start feeding blood to the tumor in the future.
Confirming "The complete embolization of the entire tumor" just after TACE is another important issue to get the good outcome. For this, volume image like CT is more useful than DSA image. On CT, we must check any defect of lipiodol accumulation or contrast media in the tumor. With defects, the TACE is incomplete, then, we must seek other feeding arteries. The accumulation of lipiodol in the portal vein branches around the tumor means lower recurrence rates than its absence. Also, we should know the importance of not only complete embolization via the arterial side but also the complete blockage of blood supply to the tumor, because the tumor sometimes survives with blood supply via the portal vein when arterial supply is stopped.
Reported CR ratio of definitely hypervascular HCC are around 30-60% by superselective TACE with lipiodol for hypervascular HCC less than 5 cm. According to a nationwide survey by the Liver Cancer Study Group of Japan (LCSGJ), overall 5-year survival rate was 26% in patients with HCCs not indicated for surgery or RFA. From these data, we should recognize that hypervascular early stage HCC is the good candidate for superselective TACE, but non-hypervascular HCC is not good candidate for this treatment option.
With respect to other surgical and ablative therapies, the important point is that RFA and superselective TACE easily can be repeated because of their limited invasiveness. Therefore, RFA and TACE are good candidates for patients with potential to occur multiple lesions after local treatment. The selection of RFA and superselective TACE should be decided based on the tumor vascularity, location and size. When hypervascular HCC locates in difficult places for percutaneous RFA, TACE is the most suitable option.
In summary, the indication of superselective TACE should be decided by tumor vascularity and the difficulty of percutaneous RFA. The most important technical point to perform superselective TACE for early stage HCC is understanding of the feature of blood supply to the tumor and the arterial network of the liver, using adequate techniques and the confirmation of our procedure completion.

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103.3

How to ablate - current options

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Learning Objectives:
1. To describe techniques and devices used in ablation of HCC
2. To discuss results and limitations of ablation in the treatment of HCC
3. To understand the role of ablation with respect to surgical treatments in HCC

No abstract available.

103.4

Update on recent trials

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Learning Objectives:
1. To discuss design of recent multicenter clinical trials on HCC
2. To present results of recent trials on HCC
3. To understand the role of new therapies or combination of therapies in the management of HCC

The term "image-guided tumor ablation" is defined as the direct application of chemical or thermal therapies to a specific focal tumor (or tumors) in an attempt to achieve eradication or substantial tumor destruction. Although tumor ablation procedures can be performed at laparoscopy or surgery, most procedures aimed at treating HCC are performed with a percutaneous approach. Hence, several authors refer to these procedures as "percutaneous therapies". The concept of image guidance is stressed in the title to highlight that image guidance is critical to the success of these therapies. Over the past 25 years, several methods for chemical or thermal tumor destruction have been developed and clinically tested. More recently, new options that use novel, non-chemical non-thermal ablative techniques have started clinical investigation. The seminal technique used for chemical ablation of HCC has been percutaneous ethanol injection (PEI). RFA has been the most widely assessed alternative to PEI for local ablation of HCC. Five randomized controlled trials (RCTs) have compared RFA versus PEI for the treatment of early-stage HCC. These investigations consistently showed that RFA has higher anticancer effect than PEI, leading to a better local control of the disease. However, even in small tumors, the ability of RFA to achieve a complete tumour eradication appears to be dependent on tumor location. Histological studies performed in liver specimens of patients who underwent RFA as bridge treatment to transplantation showed that the presence of large (3 mm or more) abutting vessels result in a drop of the rate of complete tumor necrosis to less than 50%, because of the heat loss due to perfusion-mediated tissue cooling within the area to be ablated. MWA is emerging as a valuable alternative to RFA for thermal ablation of HCC. However, only one RCT has compared the effectiveness of MWA with that of RFA so far. It has to be pointed out, however, that MWA technology has evolved significantly since the publication of this trial. Newer devices seem to overcome the limitation of the small volume of coagulation that was obtained with a single probe insertion in early experiences. To date, few data are available concerning the clinical efficacy of laser ablation, as the treatment has been adopted by few centers worldwide. In particular, no RCTs to compare laser ablation with any other treatment have been published thus far. Cryoablation also had limited application in HCC. There are currently no RCTs that support the use of hepatic cryoablation for HCC treatment. New, non-chemical non-thermal image-guided ablation techniques are currently undergoing clinical investigation. These include irreversible electroporation (IRE) and light-activated drug therapy. These techniques promise to overcome some of the limitations of chemical and thermal-based techniques in the treatment of HCC. IRE is a method to induce irreversible disruption of cell membrane integrity resulting in cell death without the need for additional pharmacological injury. IRE is administered under general anesthesia with administration of atracurium, cis-atracurium, pancuronium or an equivalent neuromuscular blocking agent to prevent undesirable muscle contraction. IRE creates a sharp boundary between the treated and untreated area in vivo. This would suggest that IRE has the ability to sharply delineate the treatment area from the non-treated, and that treatment planning can be precisely performed according to mathematical predictions. In addition, IRE can effectively create tissue death in micro- to millisecond ranges of treatment time compared to thermal ablation techniques, which require at least 20 minutes to hours. Moreover, because IRE is a non-thermal technique, there appears to be complete ablation to the margin of blood vessels without compromising the functionality of the blood vessels. Therefore, issues associated with perfusion-mediated tissue cooling or heating (a significant challenge with thermal methods) are not relevant. Preclinical investigation focused on HCC has shown promising results. Light-activated drug therapy uses light-emitting diodes to activate talaporfin sodium, a small drug molecule which is synthesized from a chlorophyll derivative. Talaporfin sodium has the capacity to concentrate in tumors when administered intravenously. It is then activated by a thin light emitting activator which is percutaneously inserted intratumorally under imaging guidance. The drug is capable of absorbing long wavelength light resulting in singlet oxygen that causes apoptotic cell death through oxidation and permanent tumor blood vessel closure. Experimental studies suggest that singlet oxygen causes the destruction of all cells within the kill zone. Potential advantages of light-activated drug therapy with talaporfin sodium include the accurate prediction of the size of the kill zone by illumination time and fluence, the independency of treatment effect from tumor histotype and tumor location and the ability to treat large or multiple tumors in a single session requiring only mild sedation.

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Special Session
Radiation protection

104.1

Occupational radiation protection in IR: joint guidelines of CIRSE and SIR

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Learning Objectives:
1. To understand the importance of radiation dose management in interventional radiology

2. To learn how to measure radiation during procedures, to categorise them according to radiation dose
3. To be able to execute common procedures that constitute good radiation management and to advise support staff on how they can limit exposure to patients and to themselves

CIRSE and SIR published in 2010, a Joint Guideline on Occupational Radiation Protection in Interventional Radiology [1]. Prior to its publication, the CIRSE Executive Committee and the SIR Executive Council endorsed the document.

The benefits of interventional radiology to patients are extensive and beyond dispute, but many of these procedures also have the potential to produce patient radiation doses high enough to cause radiation effects and occupational doses to interventional radiologists high enough to cause concern. The guideline on occupational radiation protection (RP) is a complement to the existing on patient radiation management [2] and it is intended to help minimize occupational radiation dose. The radiation dose received by interventional radiologists can vary by more than an order of magnitude for the same type of procedure and for similar patient dose. Recently, there has been particular concern regarding occupational dose to the lens of the eye in interventionalists [3].

Occupational RP is especially important for image-guided medical procedures and requires both the appropriate education and training for the interventional radiologist and the availability of appropriate protection tools and equipment. Occupational RP are necessary for all individuals who work in the interventional fluoroscopy suite. This includes not only technologists and nurses, who spend a substantial amount of time in a radiation environment, but also anesthesiologists.

Measurement of Occupational Exposure

Dose limits to workers are expressed in terms of equivalent dose in an organ or tissue (HT) for exposure of part of the body and effective dose (E) for whole-body exposure. The SI unit for both quantities is the sievert (Sv). Equivalent dose and effective dose cannot be measured directly. They must be calculated from other, simpler quantities that can be measured with personal dosimeters. A typical personal dosimeter provides two values, Hp(0.07) and Hp(10). These represent the dose equivalent in soft tissue at 0.07 and 10 mm below the surface of the body, respectively, at the location of the dosimeter. Hp(0.07) from the collar dosimeter worn over protective garments (apron, thyroid shield) provides a reasonable estimate of the dose delivered to the surface of the unshielded skin and to the lens of the eye. Hp(10) from the dosimeter worn on the anterior chest inside protective garments is assumed to be a good estimate of the operator's effective dose. A single under-lead dosimeter does not provide any information about eye dose.

Uncertainties in Occupational Dosimetry

All formulas used to estimate E from dosimeter readings are based on certain assumptions about the wearer's radiation protective garments. Inaccurate dosimetry results arise from mistakes or omissions made by those involved in the overall logistical chain of events of the monitoring program. These include wearing the dosimeter inappropriately or in the wrong location on the body and leaving the dosimeter in a radiation environment. Individuals may also forget to wear or purposely not wear their dosimeter. These actions result in an incorrect value for E and make it impossible to determine the user's true occupational risk.

Dosimeter Use

Monthly monitor replacement is recommended for operators conducting interventional procedures. The International Commission on Radiological Protection (ICRP) recommends that interventional radiology departments develop a policy that staff wear two dosimeters, one under the apron and one at collar level above the lead apron [4]. Hand doses may also be monitored, using an additional dosimeter. For pregnant workers, fetal dose is usually estimated using a dosimeter placed on the mother's abdomen, under her radiation protective garments.

Dose Limits

Dose limits for occupational exposures are expressed in equivalent doses for deterministic effects in specific tissues and as the effective dose for stochastic effects throughout the body. The limit for effective dose is 20 mSv per year, averaged over defined periods of 5 years. For women who may be pregnant, the ICRP recommends that the additional dose to the embryo/fetus does not exceed about 1 mSv during the pregnancy. The current limit for the annual equivalent dose to the lens of the eye is 150 mSv. This limit is under review by the ICRP. The annual limit for the hands and feet is 500 mSv.

Risk Estimates

Effective dose (E) is intended to be proportional to the risk of radiation-induced cancer. Interventional radiologists are unavoidably irradiated in the performance of their duties. However, a busy interventional radiologist who takes all appropriate radiation safety precautions is unlikely to have an E exceeding 10 mSv/year and is more likely to have an E of 2–4 mSv/year.

Personal Dose Records

The information in a personal dose record will vary depending on the number, type, and location of personal dosimeters used. This record will contain information on the effective dose E, assessed from the readings of one or two dosimeters worn on the chest or abdomen under and/or over the lead apron, and may contain information on the equivalent dose to the lens of the eye from the dosimeter worn at the collar level over the apron or thyroid collar and the equivalent dose to the hand from a ring or bracelet dosimeter. Copies of these dose reports should be sent to each department and individual at least every year. The facility's Radiation Safety section or Medical Physics Service should review the personal dose records of individual workers regularly. The World Health Organization (WHO) recommends investigation when monthly exposure reaches 0.5 mSv for effective dose, 5 mSv for dose to the lens of the eye, or 15 mSv to the hands or extremities [5]. When changes to work practices are implemented, it can be helpful for the individual to wear a realtime dosimeter to provide frequent feedback of radiation dose levels.

Radiation Protection Tools

Radiation exposure in the work place mandates the use of protective tools in order to limit occupational radiation dose to an acceptable level. There are three types of shielding: architectural shielding, equipment mounted shields, and personal protective devices. Equipment-mounted shielding includes protective drapes suspended from the table and from the ceiling. Properly placed shields have been shown to dramatically reduce operator eye dose. Lens injuries have been reported in both operators and staff when systems which lack ceiling-suspended shields are used for complex interventional procedures [6-7]. Personal protective devices include aprons, thyroid shields, eyewear, and gloves. The vest/skirt configuration is preferred by many operators in order to reduce the risk of musculoskeletal/back injury [8]. Transmission of 70- to 100-kVp X-rays through 0.5-mm lead is approximately 0.5%–5%. Substantial operator eye doses can be reached in unfavorable circumstances (large patient, high-dose fluoroscopy/fluorography, gantry angulation), underscoring the importance of proper protection, particularly for the eyes.

Practical Advice to Reduce or Minimize the Occupational Radiation Dose

Decreasing patient dose will result in a proportional decrease in scatter dose to the operator. Therefore, techniques that reduce patient dose will generally also reduce occupational dose. Some of the key advices to reduce occupational doses are: Minimize fluoroscopy time, review the last-image-hold for study, use fluoroscopy loop recording to review dynamic processes, use the virtual collimation feature, minimize the number of fluorographic images, use a stored fluoroscopy loop instead of a fluorographic acquisition if the image quality is adequate to document the findings, use available patient dose reduction technologies (low-fluoroscopy-dose-rate

settings, low frame-rate pulsed fluoroscopy, spectral beam filtration, etc.), use of good imaging-chain geometry position the patient support so that the patient is as far as possible from the X-ray tube, place the image receptor as close as possible to the patient, position yourself in a low-scatter area, use protective shielding, adjust collimator blades tightly to the area of interest, use all available information to plan the interventional procedure, use power injectors for contrast material injections when feasible, and step out of the procedure room during fluorographic acquisitions (digital subtraction angiography) and obtain appropriate training in RP.

Management Responsibilities

Management should provide an appropriate level of resources, such as staff, facilities, and equipment, to ensure that radiation dose is adequately controlled. Facilities and equipment include, but are not limited to, shielding, radiation monitoring instruments, and protective clothing. Quality assurance is an essential component of any monitoring program. Occupational doses should be analyzed by each department; high doses and outliers should be investigated.

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104.2

Guidelines for patient radiation protection in the angio suite

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Learning Objectives:

1. To review the radiation risk for patients undergoing IR procedures
2. To answer to the radiation risk in patients
3. To learn what technological features are effective at limiting radiation dose

Interventional radiologists and cardiologists are among the most intensive users of X-rays in the medical profession. However, some of them are unaware that they may be exposing patients to relatively high levels of radiation during interventional procedures. While staff protection is definitely important, there are more serious issues of patient protection in interventional procedures using X rays. Despite being among the most active users of X-rays, many interventionalists and especially cardiologists have either no training or inadequate training in radiation protection [1]. When fluoroscopic-guided interventions began, specialist clinicians such as cardiologists became increasingly involved in performing such procedures; however, adequate training in radiological physics and radiation protection was not implemented. The International Commission on Radiological Protection (ICRP) states that interventional procedures are complex and demanding and tend to be operator dependant, thus it is particularly important that individuals performing the procedure is both in clinical techniques and knowledge of radiation protection [2]. In 2009, CIRSE Standards of Practice Committee and SIR Safety and Health Committee have published "Guidelines for Patient Radiation Dose Management" [3]. Recently, the American College of Cardiology/American Heart Association/American College of Physicians (ACC/ AHA/ACP) Task Force on Clinical Competence and Training published a report clearly delineating the need for the radiation safety knowledge base for cardiology staff [4]. In compliance with EC requirements, similar guidelines for specific training in radiation protection were developed in Europe [5]. The International Atomic Energy Agency (IAEA) has prepared educational material in the form of electronic presentations entitled "IAEA Training material on Radiation Protection in Cardiology" which is available for downloading at http://rpop.iaea.org/.

Guidelines for patient radiation protection

The basic principles of minimizing radiation exposure to the patient during interventional procedures include [3, 4, 6, 7]:

Minimize beam-on time, both for fluoroscopy and acquisition. The fluoroscopic beam should be on only when the dynamic information from the fluoroscopy image is being actively utilized. Never irradiate the patient unless the primary operator's eyes are on the monitor. The last image hold feature can be used to study many anatomic details without the need for ongoing radiation exposure. The number of acquisition runs should be held to the minimum consistent with accurate diagnosis and effective conduct of a therapeutic procedure.

Use optimal beam collimation. Collimation should be used actively to limit the X-ray beam size to the minimum area needed for effective procedure conduct. Fluoroscopy with the collimator leaves wide open delivers unnecessary radiation to both the patient and to clinical personnel.

Position the X-ray source and image receptor optimally. The X-ray system should be positioned so that the distance from the patient to the image detector is minimized. It is usually clinically desirable to position patient's area of interest near imaging system's isocenter. Having patient's area of interest in the isocenter facilitates keeping it at the center of the field despite changes in angulated views, without the need for prolonged fluoroscopy to adjust patient's position with each change in angiographic projection. Another benefit of having the patient positioned correctly straight on the table is that certain cardiovascular structures can be reliably found with respect to skeletal and tracheobronchial landmarks with minimal trial and error or wasted fluoroscopy. Given this constraint, the distance between the X-ray tube and patient should be practicably maximized (some designs permit the independent control of this distance, while others do not).

Do not use fluoroscopy to make changes to the patient/table position or collimators/shields. The patient should be moved first to the approximate desired location, then fluoroscopy should be used very briefly to check the position, followed by further patient adjustment, rather than using fluoroscopy constantly during patient movement. This is especially important when the patient needs to be moved by an assistant during the case (e.g., to reposition the arms in a different fashion). Do not apply fluoroscopy while the assistant is manipulating the patient. Many units have "virtual" markers that enable the positioning of collimators and partial thickness shields without the need for fluoroscopy by indicating their location on the screen. Even in units that do not have virtual markers, the collimators should still be moved first and checked for position with brief fluoroscopy; they should not be positioned during constant fluoroscopic visualization.

Use the least degree of image magnification required for accurate interpretation. For X-ray systems that use conventional image

intensifiers, the dose generally increases substantially with increasing magnification. Depending on operating parameters, flat-panel detector systems may have a smaller dose increment with magnification. The least degree of image magnification that is consistent with accurate interpretation should be used.

Understand and utilize the X-ray dose-reduction features provided by the X-ray unit. Employing a sophisticated unit's dose-reduction features can substantially reduce dose. Use the slowest fluoroscopy pulse rate and the lowest fluoroscopy dose rate that will produce satisfactory images. Use high-dose fluoroscopy only when the enhanced image quality it provides is absolutely necessary. Use the slowest acquisition frame rate that is adequate for diagnosis. Employ beamhardening filters whenever feasible.

Vary the site of the radiation entrance port. During procedures that require long fluoroscopy times, if clinically feasible, change the radiographic projection so as to minimize the dose to any particular portion of entrance port skin.

Record the estimated dose delivered to the patient. Current X-ray systems provide calculated estimates of entrance port doses. The dose at the interventional reference point (IRP) is a measure of deterministic risk. The DAP delivered to a patient during a procedure is both a measure of stochastic risk and a potential quality indicator. Physicians should be made aware of the exposures they deliver to their patients and how they compare to established norms. For older units that do not provide this function, the total fluoroscopy and acquisition times should be recorded. The purchase of accessory dose monitors should also be considered for such equipment.

Maintain X-ray equipment in good repair and calibration. A qualified medical physicist should periodically check equipment calibration (both radiation levels and image quality factors). Patient input doses for both fluoroscopy and acquisition should be set at the lowest values that are consistent with satisfactory image quality. A qualified medical physicist should periodically verify dose and image quality performance for fluoroscopy and acquisition as part of the laboratory's quality assurance program. These settings will produce images with detectable noise. Operators should recognize that a good image contains a degree of noise and should not request calibrations that produce completely smooth images. Aging image intensifiers have reduced light output for a given X-ray input dose. Thus, an aging image intensifier will automatically require the X-ray system to deliver an increased dose. Such image intensifiers should be replaced.

Select X-ray units with sophisticated dose-reduction and monitoring features. The International Electrotechnical Commission (IEC) has published a standard22 defining the minimum necessary safety equipment for interventional fluoroscopes. At the time of this writing, the FDA has proposed adding most of these elements to all newly manufactured fluoroscopic units. Additional radiation and other patient or staff safety components may be available. Their use is encouraged.

Operators should be well-experienced and well-rested. Efficient minimisation of radiation exposure in invasive cardiology requires both adequately experienced and well-rested interventionists. Radiation exposure to patients resulting from PCI is influenced by fatigue and significantly roses – due to more and longer radiographic runs – after the cardiologists workload amounts to more than 6 h. As a consequence, elective PCI should be scheduled for the first 6 h of workload whereas diagnostic interventions may be safely scheduled later.

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104.3

Paediatric interventions: how to deal with radiation exposure risk?

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Learning Objectives:

1. To evaluate potential risk from radiation exposure in a paediatric patient
2. To answer to the radiation risk in patients before IR
3. To learn about the different techniques (passive and active) to reduce the patient's radiation exposures

Dose management in pediatric population varies depending on the age of the child. In fact, it is more about the size and is very different from the dose management in adults. Pediatric interventional radiology specializes in minimally invasive diagnostic or interventional procedures using imaging guidance, in children. Interventional procedures in children should be absolutely justified and radiation exposure in young children must be lower than in adults (1).

Newborns are estimated to be 10 to 40 times more sensitive to radiation than adults. Mortality risk in newborn males is about 0.12% to 0.15% /10 mSv. Females are more vulnerable due to greater breast and thyroid tissue sensitivity. In addition, because of smaller body size, a greater portion of a child's radiosensitive tissues is in close proximity to the X-ray beam during fluoroscopy-guided interventions (2). Small body size is of some advantage as radiation penetrates small children more readily, keeping relatively low dose rates. The risk of inducing a cancer in a child following prolonged procedure with very long fluoroscopy time (60 minutes) and from an interventional cardiovascular procedure that delivers 60 min of fluoroscopy and equal dose from fluorography is very high between 0.1 and 1% reliant on the angiography system dose efficiency.

Variety of image-guided interventional procedures can be performed in children vascular and non-vascular. Vast majority is fluoroscopy-guided and some are CT guided. Clearly preprocedural imaging that does not require use of ionizing radiation, like ultrasound or MRI (MRA) should be preferred in all cases.

Good and well controlled sedation or general anesthesia should be a routine not only regarding the pain and anxiety management but also the dose management. Well controlled relax patient requires less fluoroscopy and less retakes during DSA runs. There was no correlation found between fluoroscopy time and measured entrance dose, but strong correlation between cumulative skin dose and patient weight (3,4).

Justification of Fluoroscopy and CT-guided interventions in children
The use of IR procedures in children is likely to expand and become more complex and time consuming. They should always be individually justified and accurately planned.
Clinically justified balance between the risk and the benefit is necessary. It is important to have a history of previous procedures. IR has to determine that the procedure is necessary relying on the natural history of the disease, and the risks and benefits of other available therapeutic options (5).
Whenever possible the US guidance should be preferred, especially in access and various drainage procedures, fluoroscopy should be kept to a necessary minimum.
Image gently campaign is aimed to change the IR practice by increasing awareness of the opportunities to lower the radiation dose in children (6).
Optimization (Passive and Active radiation protection)
We usually divide the radiation protection methods to passive and active. This terminology can be valid for both patient and staff protection.
Passive protection is about the available X-Ray system. Each angiography system used for pediatric patients necessitates appropriate settings and dedicated protocols for pediatric acquisitions in fluoro and cine/DSA imaging, like "virtual collimation" functionality, an option to archive fluoro runs in DICOM format and more.
Active radiation protection is based on the passive protection tools and requires adapting our behavior to the "hostile" environment in the fluoroscopy room. It obligates comprehensive knowledge and routine implementation of the basic protection rules and seeking for the measures to reduce the patient and personnel exposure.
Active protection tools for the personnel include protective drapes suspended from the table and from the ceiling. Table-suspended drapes hang from the side of the patient table, between the undertable X-ray tube and the operator. They should always be employed, as they have been shown to substantially reduce operator dose. Pediatric patients like small children generate less scatter than adolescents or adults and consequently less exposure to the staff.

Active patient protection tools

• IR has to select the proper fluoroscopy and acquisition mode.
• Begin with low fluoroscopy mode and not medium or high.
• Select pediatric and not the adult protocol.
• Set the fluoro or DSA runs as short as possible according to the target pathology.
• Maintain the image intensifier (II) or the flat detector as close as possible to the patient.
• Maintain a minimum distance from the X-ray tube focus to the patient's skin.
o Critical in biplane systems or in lateral projections.
• Accurate collimation is extremely important as it significantly reduces patient exposure and improves image quality.
o Some IR's might believe that the collimation is performed automatically by the system, which is not the case.

Summary

There is an increased radiation risks for pediatric patients.
Number of pediatric interventional procedures is increasing.

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104.4

Estimation of the radiation risk of diagnostic CT procedures

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Learning Objectives:

1. To review the radiation risk for patients undergoing IR procedures in CT
2. To review the radiation risk for the operator during CT fluoroscopy
3. To compare CT fluoroscopy exposure to 3D cone beam CT exposure

CT contributes about 50% in industrial countries of the medical radiation exposure. CT enables today a very fast 3D online imaging. The estimation of radiation risk in medicine has to be combined with the benefit for the patient. In the case of interventional procedures (IR) a risk-benefit calculation can be more easily done, but a critical medical indication has to be considered. Dose estimations are based on the fundamental two dose units for CT – the computed dose index ($CTDI_{vol}$, measured in a PMMA phantom) and the dose length product. Both units are representative for an exposure of the PMMA phantom (diameter 32 cm, body, or 16 cm, head). Using conversion factors you can estimate local or effective dose, but the values need further corrections.
The radiation risk for patients undergoing complex IR procedures is mostly twice. The risk to be damaged by deterministic effects and to get high statistical risk of receiving radiation-induced tumors. For CT interventions the normal state is that the dose length product is not extraordinary high due to the fact of short scan length. The stochastic effects are mostly not the problem. But the repetition of scans at the same body section can cause high local doses in some cases up to the range of some Gy. In the next future it will be mandatory that CT scanner will indicate the accumulated dose during one examination/procedure. In this way the radiographer or the radiologist will be primed to exceed tolerance doses.
The high dose rate of a CT can be especially a problem for the fingers of the radiologist during CT fluoroscopy. Depending on the type of scanner and the scan parameters the dose rate in the x-ray field of a CT can be in the range of 1 to 15 mSv per minute! If a radiologist has the fingers in the scan area, erythema is possible within some minutes. The annual dose limits of 500 mSv exceeded within 1 to 2 minutes CT fluoroscopy. This has to be considered in respect of some dozen examinations per year. Modern CT has possibilities to blank out the radiation. If the fingers are nearby the x-ray field the direct radiation and also the scattered radiation can be reduced very effectively. Radiation protection education, experience to use spacers and the optimal position of the fingers, the dose awareness and the individual dosimetry are basic skills for optimization radiation exposure of the radiologist. The necessity, if a radiologist has to stay in the examination room or if not is in many cases differentially considered. Ring-dosimeters should be used if CT fluoroscopy is a common procedure in the radiological department in the same way like in angiographic examination rooms.
The big difference between CT and digital volume tomography (DVT) cone beam CT is the examination or scan time. CT x-ray tubes are rotating in less than 1 second, whereas DVT needs about 10 seconds. So the dose rate is a factor 10 to 100 lower for DVT at the skin of the patient. The dose for the patient undergoing a DVT examination can be similar or a little bit higher to CT referred to image quality. But the possibility to get 3D information, e.g. internal bleedings,

during a fluoroscopic intervention can be a great advantage for the patient. During a rotation angiography the radiologist should have a distance to the isocentre of the C-arm of more than 1 m.

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Foundation Course
The role of IR in the trauma unit

201.1

Polytrauma imaging: how to do it and what to look for

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Learning Objectives:

1. To review the technique of CTA including contrast and timing
2. To understand what the IR needs to know about the mechanism of injury
3. To recognise the top 3 killer injuries relevant to the IR - solid organ, pelvic and aortic

The management of polytrauma patients has become a very relevant issue and one of the major challenges in the western countries. In the assessment of polytrauma patients, since the last two decades, radiological imaging tools have been increasingly used in order to provide a quick and thorough survey of cranial, cerebral, cervical, abdominal, pelvic and limb traumatic injuries. Among imaging modalities, conventional radiographs (CR) have precise and narrow indications. In many European hospitals, ultrasonography (US) represents the method of choice for patients referred following blunt abdominal trauma, namely in unstable patients, of women of fertile age and of pediatric patients. Multislice computed tomography (MSCT) evolved as a primary investigation tool as it provides a fully comprehensive assessment of their injuries and allows for their categorization according to the severity of traumatic injuries. Following advancements in CT technology, many emergency radiology departments are now equipped with multiple row detector CT scanners that allow for very rapid imaging and increased throughput of patients referred from the emergency room after polytrauma. Moreover, in many centers whole-body MSCT exams are becoming an important tool in the treatment decision algorithm. Availability and proximity of fully equipped radiological units to the ER, without interfering with scheduled outpatients is mandatory for an adequate imaging and management of traumatized patients. The main task of the emergency radiologist is to decide which imaging modality is most appropriate after initial patient presentation. Imaging algorithms for trauma patients should consider injury prevalence, radiation dose exposure and costs as relevant factors. CTA algorithm, including time and contrast parameters will be focused. CT features about the top 3 killer injuries relevant to the IR - solid organ, pelvic and aortic injuries will be addressed. Improved imaging techniques and advances in interventional radiology have led to a better selection of patients who are amenable to nonoperative management, namely transcatheter embolization and endovascular repair.

201.2

Thorax and supra-aortic vessels

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Learning Objectives:

1. To understand the relevant anatomy and mode of injury
2. To review the potential and results for stent graft in large and medium vessel trauma
3. To review the indications for embolization in smaller vessels using target vessel occlusion

The reduced physiological insult of interventional radiology (IR) techniques, along with high rates of bleeding control, has led to them becoming the treatment of choice for most thoracic and supra-aortic vessel injuries. Stent–grafts (SG) of 3mm to 46mm are now widely available to treat vessels ranging from the vertebral artery to the thoracic aorta and have become the dominant device for injuries in this territory.

Thoracic aortic injury (TAI) is the leading cause of death within 15 minutes of blunt and penetrating injuries. TAI occurs due to a complex of compression, horizontal shear and hydrostatic forces. Untreated the 10-20% pre-hospital survivors have a poor prognosis. The commonest injury site is at the aortic isthmus distal to the left subclavian artery but injuries to the aorta at the diaphragmatic hiatus should be looked for. A ductus diverticulum has obtuse angles and is readily distinguished from TAI. Great vessel injures may be coincident with TAI. Multislice CT has revealed the wide spectrum of injuries seen including intimal flaps, circumferential out-pouching (the group at highest risk of rupture), pseudo-coarctation and dissection. Not all require intervention. Even when intervention is indicated it should occur after control of other sites of active bleeding [1]. TAI is a potential site of catastrophic haemorrhage but rarely the cause of haemodynamic compromise in polytrauma patient. Young and female patients may have femoral arteries which are too small for SGs and iliac or abdominal aortic conduits may be necessary. Injuries to the iliac arteries on removal of SG systems are a significant cause of morbidity and mortality. Access for rapid balloon control must be available in every case. In lower risk TAI intervention can be delayed until the next working day if interval aggressive blood pressure control can be achieved this is not suitable for patients with traumatic brain injury who require augmentation of cerebral perfusion [2].

Smaller vessel injuries include active extravasation, pseudoaneurysms, dissection, complete transection with or without active bleeding, embolisation of metallic fragments and arterio-venous fistulation. The over-riding consideration for most great vessel injuries is to preserve ante-grade flow to vital structures whilst excluding the section of injured vessel from the circulation. SGs are the mainstay of endovascular treatment. Small subclavian branches and pulmonary arterial injuries can be treated by embolization. Uncovered stents may be used to treat occlusive dissections. Balloon tamponade may be used to control bleeding prior to IR or surgical treatment.

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201.3

Abdominal solid organ trauma

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Learning Objectives:

1. To review the indications and results of embolization in splenic trauma
2. To review the indications and results of embolization in liver trauma
3. To review the indications and results of embolization in renal trauma

The management of abdominal solid organ trauma has changed over the years, with the majority of these injuries now being managed nonoperatively[1], and endovascular embolization employed as a minimal invasive adjuvant in the nonoperative management (NOM) of these patients.

Solid organ injuries are routinely graded according to the AAST criteria[2].

Embolization in splenic trauma:

Thompson[3] proposed additional grading criteria based on CT findings related to major vascular findings associated with splenic injuries. According to Thompson[3] three findings correlated with the need for intervention: (a) devascularization or laceration involving 50% or more of the splenic parenchyma (AAST III – V), (b) active extravasation of intravenous contrast or pseudo aneurysm formation, and (c) a large haemoperitoneum.

NOM of splenic injuries in the hemodynamic stable patient has reduced the need for splenectomy[4]. The AEST report a NOM failure rate of 4.8% for grade I, 9.5% for grade II, 19.6% for grade III, 33% for grade IV and 75% for grade V injuries[6] (without the use of endovascular embolization). With the aid of endovascular intervention the success rate of NOM could be improved to 80% for grade IV and V splenic injuries, with a splenic salvage rate of 87%[4].

Embolization in liver trauma:

Monnin[7] suggested a classification, and subsequent management of patients, according to their hemodynamic status: (1) patients with unresponsive shock despite aggressive resuscitation underwent surgery without CT imaging, (2) haemorrhagic shocked patients who improved after high volume resuscitation (>2litre/hour) and (3) patients who were haemodynamically stable underwent CT scanning prior to further management.

Endovascular embolization was employed if the CT scan demonstrated active bleeding or where initial surgery failed to control the bleeding[7].

The success rate for arterial embolization in hepatic injuries vary between 85 and 100%[7, 8]. Embolization is not useful for venous injuries but there are a few case reports of venous reconstruction with stent grafts.

Embolization in renal trauma:

Kansas[9] proposed grouping together AAST grade 1 and 2 injuries as low grade, AAST 3 and 4 nonvascular injuries as intermediate and group IV with vascular injuries and group 5 as high grade. Isolated renal injury is rare9 and the degree of haematuria does not correlate with the degree of injury10. The low and intermediate group requires delayed endovascular treatment only if hematuria persists.

In the acute setting bleeding can be controlled with arterial embolization in 91% of cases[11] with an 82% clinical success rate.

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201.4

Pelvic bleeding: who needs treating and how to do it

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Learning Objectives:

1. To understand the CT findings in pelvic trauma
2. To discuss the indications and results of embolization and stent grafts in pelvic trauma
3. To discuss the complications of embolization in pelvic trauma

Traumatic pelvic fractures can result in significant hemorrhage that can be associated with significant morbidity and mortality. Patients with pelvic fractures that cause hemodynamic instability have a mortality rate that exceeds 50% in several series. Thus, hemodynamic instability indicates a poor prognosis, especially if it persists for a longer time period. Bleeding from pelvic fractures can be generated from several sources including arterial and venous injury, and bleeding from fractured cancellous bone within the pelvis. Bleeding from fractured bone within the pelvis can be controlled with prompt stabilization of the fracture, which also can tamponade and control venous bleeding. However, arterial bleeding cannot be controlled using these measures. Although the risk of significant arterial hemorrhage after pelvic fracture is clear, the incidence and predictors for needing therapeutic arterial embolization remain in debate. Criteria exist for obtaining pelvic arterial angiography in patients with severe pelvic fracture based on the presence of hemodynamic instability or the need for ongoing blood transfusion. However, early therapy avoiding massive transfusions, prolonged hemodymamic instability and abdominal compartment syndrome would be desirable. Contrast-enhanced MSCT during the arterial and venous phase provides important information allowing early indication for treatment. Predictors for massive arterial bleedings are: instable pelvic fracture with pelvic hematoma; contrast extravasation during MSCT in the arterial phase; drop of blood pressure and hemodynamic instability. Arterial embolization is indicated if arterial contrast extravasationcaused by fractured bone is demonstrated on CT. In hemodynamically instable patients, treatment has to be

performed on an emergency basis. Transarterial embolization (TAE) is highly effective (85-100%), repeat embolization to control hemorrhage has to be performed in less than 10%. The complication rate is low (4-8%). Stent grafts are very rarely indicated to control bleeding since most bleedings sites are located in the internal iliac territory. The common and external iliac artery are very rarely involved in pelvic trauma. If one of these arteries is lacerated, rapid control of bleeding by balloon tamponade and secondary repair (stentgraft, surgery) is frequently indicated.

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Special Session
Renal artery disease

202.1

Indications for renal PTA/stenting after recent trials

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Learning Objectives:

1. To overview recent trials for renal revascularization
2. To understand the pathophysiology of renovascular hypertension, ischemic nephropathy and other pathologies associated with RAS
3. To critically select cases for successful revascularization

No abstract available.

202.2

Technique and outcomes for transplant renal artery stenoses

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Learning Objectives:

1. To review the incidence and clinical signs of RAS in transplanted kidney
2. To review the technique and results of angioplasty and stenting
3. To discuss the incidence and management of restenosis

No abstract available.

202.3

Renal angioplasty in children

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Learning Objectives:

1. To explain the basic pathophysiology and incidence of infantile renovascular disease
2. To describe the technique and materials used for renal intervention in children
3. To overview clinical results

Anatomical considerations in paediatric renovascular hypertension

Although arterial disease is a relatively unusual cause of raised blood pressure in children, it is important to recognize because the alternative is life-long antihypertensive medication and the gradual accumulation of complications of either or both of the hypertension and its treatment. The distribution of disease is different to adults, with much more involvement of segmental or accessory arteries. It is currently impossible to exclude these lesions with non-invasive imaging, and therefore diagnostic angiography (with selective renal artery injections) remains an important part of the work-up of children with hypertension. In addition, a significant number of patients have midaortic syndrome (MAS) and/or cerebrovascular disease.

Pathogenesis

Atherosclerosis in children is essentially non-existent, but many known arterial diseases may cause hypertension, including neurofibromatosis type 1 (NF1), Takayasu's arteritis, Williams' syndrome and post-surgical stenosis (especially in renal allografts) (1). In most patients, however, no specific histological diagnosis is made. These children are usually said to have fibromuscular dysplasia (FMD), although the anatomical distribution and other features are often quite different to those of FMD in adults.

Other differences between adults and children

There are many other important differences, but most of them are obvious. Children are by definition immature, and this has many consequences. Most will require general anaesthesia for angioplasty. They have a longer life expectancy, and so have a longer time in which to develop radiation-induced malignancy. Crucially, the aims of treatment may be different from that in elderly patients with a short life expectancy. The inevitability of patient growth means that surgical options may not be as durable as in adults, and that angioplasty with the intent of delaying surgery (rather than cure) is sometimes a good idea.

Indications for renal angioplasty in children

All of these considerations mean that the indications and techniques for renal angioplasty are somewhat different to those in adults. Paediatric renal angioplasty is best performed in hospitals where there is considerable experience in managing children with complex medical conditions. A wide range of angioplasty balloons and stents should be available, including covered stents. An experienced surgeon should be on stand-by in case emergency surgery is required.

Technique for renal angioplasty

Nearly all procedures can be performed from a femoral approach. Careful angiography is essential, to show the abdominal aorta and its other branches, including selective angiography of all renal arteries in at least two projections.

There are three main technical options for angioplasty. A single long 4-French sheath is appropriate in some cases, especially in small children, where adequate post-angioplasty aortography can often be performed through the sheath or a small catheter introduced through the sheath alongside the guidewire (2, 3). Where this is not possible a pigtail catheter can be advanced to the abdominal aorta after a contralateral femoral puncture (the "2-sheath" technique). In larger children, a 6-French sheath and guiding catheter (2) or a long

5-French sheath may be used (3). This makes renal angioplasty much easier. Puncture site complications are extremely rare in children, but in certain unusual circumstances (for example, post-angioplasty treatment with both anticoagulation and antiplatelet agents) we have used closure devices. The 6-French Angioseal (St. Jude Medical, Minnetonka, MN) can be used in arteries as small as 4 mm (4). The diameter of the femoral artery should be measured at the time of arterial access if the use of a closure device is anticipated.
Axillary access is rarely required (5). In our practice we electively adopt this approach when the angle of origin of the renal artery is particularly acute, especially in patients with MAS.
We increasingly use coronary angioplasty balloons (with 0.014-inch guidewires), which are available in all relevant sizes. A wireless pressure-measuring guidewire (Aeris, RADI, Sweden) is particularly useful in children. Cutting balloons may be used if conventional balloons fail to dilate a tight stenosis (6).

Indications for stenting

We avoid stenting wherever possible, especially in small children, because small stents are particularly likely to develop neointimal hyperplasia. There are certain clear indications: irrecoverable arterial occlusion or near-occlusion (for example post-angioplasty dissection or re-thrombosis following successful recanalization of a complete occlusion), or persistent extravasation requiring a covered stent. We do not recommend stenting for recoil following angioplasty, unless there is a flow-limiting dissection, because the relationship between angiographic appearances and clinical response is unpredictable in children. Early recurrence following apparently successful angioplasty is probably an indication for repeat angioplasty rather than stenting, at least in the first instance. Stenting may also be considered for kinked transplant renal arteries with a significant pressure gradient.

Results of renal artery intervention

The published results of renal angioplasty are very variable, probably reflecting different referral patterns and patient selection. In general, most patients will have a useful improvement in blood pressure control. Angioplasty may be repeated if the first procedure is unsuccessful or if hypertension returns after an interval. Even if endovascular treatment eventually fails, postponing definitive surgery until the child is as close as possible to adult size may be a worthwhile goal in itself.

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202.4

How to manage non-atheromatous renal artery stenosis

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Learning Objectives:

1. To describe the indications, techniques and devices for non-atheromatous renal artery stenosis
2. To describe follow-up and main complications for non-atheromatous renal artery stenosis
3. To discuss, with clinical cases, tips and tricks in non-atheromatous renal artery stenosis

No abstract available.

Special Session
Intermediate-advanced HCC

203.1

Current approaches in TACE in HCC

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Learning Objectives:

1. To define techniques used for TACE in HCC
2. To discuss indications and contraindications of TACE in HCC
3. To analyse the results of trials on TACE with respect to other therapies

Chemoembolisation is the standard of care in the treatment paradigm of the majority of patients presenting with hepatocellular carcinoma. Meta analysis of the early studies of chemoembolisation, even from a literature limited by a variance in technique and patient selection, has confirmed a survival benefit. However, the last five to ten years have allowed hepatologists, surgeons and interventional radiologists to understand more clearly its importance in differing and defined classes of patients. Its value is established as a bridge in the treatment pathway of potential transplant candidates and those listed for transplantation in an era of limited organ availability. Furthermore, there is increasing recognition of how it may potentially downstage tumours to allow curative liver resection and may be used in conjunction with ablation techniques and biological agents with curative intent.
It is one of the interventional oncological treatments where patient selection is perhaps more important than the technique. The vast majority of these tumours arise in the presence of cirrhosis where the histological cascade that results in the development of hepatocellular carcinoma and field change disease is well described. The imaging characteristics of transformation to hepatocellular demonstrated on computed tomography or magnetic resonance imaging of enhanced arterialisation with portal venous washout can be exploited by any embolisation technique. The aims of chemoembolisation are to achieve complete tumour necrosis by embolisation but at the same time to deliver a high concentration of a chemotherapeutic agent to the tumour. Embolisation results in reduced intratumoural flow obstructing arterial and portal venous flow through the peribiliary plexus, creating ischaemia and increasing contact time between the chemotherapeutic agent and the tumour cells. Tumour cell ischaemia causes changes in the cell membrane resulting in increased retention of the chemotherapeutic agent. However, at the same time the technique should ensure accurate targeting of the tumour so as to reduce the risk of global ischaemia to the cirrhotic liver and hepatic decompensation that may occur.
The introduction of drub eluting beads as a development in the

technique is now being supported by an evidence base for their use in selected patients. Pharmacokinetic studies have shown that beads deliver a sustained slow release of doxorubicin for a period of up to 14 days post-delivery, and result in an increased level of doxorubicin and cell necrosis with lower systemic levels of doxorubicin depending on the bead size. Lower systemic levels reduce the chemotherapy-induced morbidity of this technique.

The most important contraindications revolve around measures of synthetic function with rising Childs Pugh, MELD or BCLC being the key determinants of appropriate patient selection. As a general principle the subset of patients that will not benefit from chemoembolisation is established. In broad categories these are Childs C patients with small tumours of less than 4 cm where the standard of care is liver transplantation. Chemoembolisation carries a high risk of decompensation and although neo-adjuvant therapy has the potential to keep an individual patient within transplant criteria, tumour progression outside criteria may also be a measure of unfavourable biology. The other groups are those patients with extrahepatic disease. However, combination therapies with chemoembolisation and biological agents particularly sorafenib are now under trial evaluation. A final group of patients are those with significant cardiac or renal comorbidities which may adversely impact on survival.

This presentation will review the current status of this technique placing a particular emphasis on the combined clinical and radiological decisions that dictate the therapeutic pathway.

203.2

Is radioembolization the IR solution to the problem?

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Learning Objectives:

1. To describe the main technical aspects of radioembolization
2. To analyse the indications and the role of radioembolization with respect to other therapies
3. To report the results from the available literature and from personal experience

Hepatocellular carcinoma (HCC) claims half a million lives across the globe each year. It is the sixth most common cancer in the world and is the third most common cause of cancer-related mortality. The incidence of HCC varies considerably across geographic regions with some areas reporting cases as high as 20/100,000 per annum.

In patients diagnosed with this lethal malignancy, less than 15% are candidates for surgical procedures. A survival benefit has been observed in patients that meet the rigorous criteria for curative resection or transplantation. For the remaining majority, various treatment options have become available without universal agreement on which treatment option offers the greatest survival benefit with the least toxicity.

The use of external beam irradiation has historically played a limited role in the treatment of HCC due to the radiosensitive nature of normal hepatic tissue. Investigators have shown that liver exposure to radiation doses greater than 40 Gy may result in a clinical syndrome characterized by ascites, anicteric hepatomegaly, and elevated liver enzymes weeks to months following therapy, called Radiation Induced Liver Disease (RILD). Given this limitation and the need for higher doses to inflict lethal injury to malignant tissue, minimally invasive intra-arterial devices have emerged. These devices, loaded with radioactive Yttrium-90 microspheres, can deliver very high tumoricidal doses without the development of RILD.

Yttrium-90 intra-arterial radiotherapy, also known as radioembolization, is a minimally invasive catheter-based therapy that delivers internal radiation via the arterial vessels that feed tumors. "Radio" refers to the radiation that is imparted to tissue; "embolization" refers to the microembolic effect. This technology takes advantage of the dual blood supply to the liver. Normal hepatic tissue derives greater than 70% of its blood supply by way of the portal system whereas malignant tissue is preferentially supplied by the arterial system. There are currently two commercially available Yttrium-90 microsphere devices. TheraSphere® (MDS Nordion, Ottawa, Ontario, Canada) is made of glass and SIR-Spheres® (Sirtex Medical, Sydney, Australia) is made of resin. These two devices are different in a number of important respects. TheraSphere® is a device consisting of 20-30 micron particles with higher specific activity (2500 Bq) and lower number of spheres (1.2 million microspheres/3 GBq). Conversely, SIR-Spheres® are consisting of 20-60 micron particles, with lower specific activity (50 Bq), and greater number of spheres (approximately 40-80 million spheres/3 GBq).

Clinical investigations into the use of radioembolization for the palliative treatment of unresectable hepatocellular carcinoma appear promising. This therapy potentially offers survival benefit with a low toxicity profile, making it an attractive tool in the battle against a uniformly fatal disease. In addition, investigators have shown favorable survival outcomes in patients with limited hepatic reserve and portal vein thrombosis. These patients were previously excluded from most therapeutic options. Furthermore, this therapy has successfully been used to bridge and downstage patients to resection, ablation or transplantation. Although phase II paradigms have provided useful data, there is a need to carry out randomized controlled trials comparing radioembolization to those accepted as standard of care for this patient population. These studies will then establish the role of radioembolization within the framework of other universally accepted first line therapies for inoperable disease. Finally, the development of targeted therapies at the molecular level represents the beginning of a new era in the treatment of HCC. Clinical investigations into combining the cytotoxic effect of radioembolization with the cytostatic mechanism of targeted therapies are currently in progress and will provide valuable safety and toxicity data that may translate into improved clinical outcome and overall survival.

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Disclosure
Speaker, SIRTeX Medical Europe GmbH

203.3

How to deal with tumours supplied by collateral arteries? How to treat hypovascular tumours?

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Learning Objectives:
1. To describe some challenging cases
2. To discuss imaging findings and indications of therapeutic approaches in intermediate-advanced HCC
3. To learn tips and tricks of therapies in intermediate-advanced HCC

How to deal with tumours supplied by collateral arteries?
Collateral supply from extrahepatic collaterals is more frequently seen in patients after a series of chemoembolization - with or without patency of the proper hepatic artery, patients with large tumors in the superior liver surface, or close contact with abdominal wall and liver capsule infiltration.

Safety
Selective catheterization is mandatory for the uncomplicated embolization of collateral supply to HCC. The rate of infusion should be slow to avoid turbulent flow and reflux and the endpoint of embolization is safer to be interruption of intratumoral blush instead of flow stasis in the feeding vessel to minimize reverse of flow. Coils or gelfoam may be used to occlude and protect the territory of the normal distal branches. Non-target embolization may complicate embolization of collateral branches; skin ischemia with itching, erythema, and necrosis may arise when skin branches are inadvertently embolized in cases of lower intercostals, internal mammary or lumbar artery embolization. Gastrointestinal erosion, ulceration, or perforation can be caused by gastric, omental, and colic branch artery embolization. Paraplegia may result from the inadvertent embolization of spinal branches arising from intercostal or lumbar collaterals. Embolization of the cystic artery may cause cholecystitis or gallbladder infarction while inferior phrenic artery embolization may result in shoulder pain, pleural effusion, with or without basal atelectasis, and diaphragmatic paralysis (usually unilateral).

Hemodynamics
Distal branches of adjacent extrahepatic collateral territories are anastomosed to each other and may need combined embolization of two territories and require attention because this may contribute to reverse flow and subsequent inadvertent embolization. In addition, in the long run, a recurrent tumor may be supplied from the adjacent territory in the follow up. Spasm in collaterals is often and can be managed with vasodilators.

Efficiency
There are no studies that present strong evidence that chemoembolization of the collaterals assists in prolongation of survival or quality of life.

The most common collaterals include:

Inferior phrenic artery (IPA)
It is the most common extrahepatic collateral that supplies HCC. Phrenic arteries usually originate from the celiac trunk or directly from the aorta as a common trunk or independent or separately. Other origins include renal or left gastric or hepatic arteries. Inferior phrenic can be seen in the arterial phase at CT in which the vertical segment can be identified especially if hypertrophied. On the right side most commonly this artery supplies HCC located in S7 in contact with the right hemidiaphragm, while on the left side HCC located in S2 or S3 can be supplied from the left inferior phrenic artery.

Omental branch
The omental branch (from the gastroepiploic artery or rarely from the dorsal pancreatic) is the second most common collateral vessel. Although normally this vessel is of small caliber when it serves as an HCC feeder it is hypertrophied and easily identified.

Internal mammary artery (IMA)
It may give collaterals to HCC when the lesion is located at the superior liver surface in contact with the diaphragm or abdominal wall. It arises from the medial segment of the subclavian giving branches to the anterior costophrenic sulcus and diaphragm and gives anterior intercostal branches (pericardiophrenic, anterior mediastinal, pericardial, and sternal). At the level of the manubrium it gives the musculophrenic and superior epigastric. The musculophrenic goes through the diaphragm and gives lower anterior intercostal branches (7th to 9th) and anastomoses with the inferior phrenic. The superior epigastric artery forms diaphragmatic branches that extend into the falciform ligament of the liver and anastomose with the hepatic artery. On the left side HCCs located in S8 or S4 are fed by the right IMA whereas HCC located in the left lateral segment are fed by the left IMA mainly through the pericardiophrenic or the musculophrenic branch.

Adrenal
HCC in the inferior surface of the liver can be supplied by adrenal arteries. The superior adrenal originates from the inferior phrenic, the middle directly from the aorta and the inferior adrenal from the renal artery. The normal adrenal gland blushing is triangular shaped and should be differentiated from tumor hypervascularity.

Renal and capsular
HCC in the inferior surface of the liver can be supplied by renal and renal capsular arteries. The superior capsular artery usually arises together with the inferior adrenal artery from the renal artery or may originate from arcuate and interlobular arteries.

How to treat hypovascular tumours?
The majority of HCC is highly hypervascular. However, there is a 10-18% of embolization naive HCC that presents diminished vascularity while a significant proportion of HCC will present reduced intratumoral vascularity after several courses of chemoembolization. Hypovascularity has been identified as an independent parameter of poor response. It clearly presents a difficulty for localization of the lesion and selective catheterization to better target the administration of the chemoembolization material (conventional chemoembolization or drug eluting beads), and in addition the diminished vascularity is an inadequate "road" to curry the material into the intratumoral vessels.

For the localization acquiring cross-sectional and 3Dimages during endovascular or procedures with high spatial and contrast resolution is now feasible with flat panel technology. The resulting angiographic CT (ACT) produces CT-like images are suitable to check if the area supplied by the vessel that is catheterized corresponds to the intended embolization territory.

Intraprocedural sonography (unenhanced and CEUS) performed before and during the procedure is a very good alternative if flat panel technology is not available. As Moschouris et al have shown the initial unenhanced US scan is performed after the placement of the catheter (or microcatheter) in the segmental or subsegmental tumor feeder. One or two scans can be performed in between the initial injections of the embolic suspension. In questionable cases a diluted contrast for ultrasound or bubble injection may easily assist in confirmation of the right vessel selection. For radiation protection, intraprocedural US is not performed during injection of the embolic agent. Newly appearing, high-level echoes, with or without acoustic shadow, are considered a sonographic change induced by (chemo) embolization (this method was performed with chemoembolization with DC Bead). This "echogenic alteration" (EA) confirms the right distribution of the embolic material. Increased EA score is associated with extended tumor necrosis. However, because the echoes that constitute EA are often ill defined and accompanied by multiple

artifacts, EA cannot accurately estimate the degree of the necrosis. A reliable differentiation between complete and almost complete necrosis cannot be based on EA. In contrast, a weak or moderate EA score does not preclude a good embolization result, as shown by the discordance between intraprocedural US and intraprocedural CEUS in five of the studied tumors. Intralesional hypoechogenicity is another "immediate" change detected on unenhanced intraprocedural US.

Intraprocedural CEUS is a feasible and safe method for rapid, on-site assessment of the right territory choice and the effect of TACE. The additional value of intraprocedural CEUS to selective angiography reflects the higher sensitivity of the latter in depicting tumor (micro) vascularity.

CEUS is useful during treatment of small and/or hypovascular tumors, selection of the appropriate tumor feeder. In such cases, the emergence of a strong echogenic response within the tumor could serve as a sign of successful embolization.

203.4

Current status of combined treatments

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Learning Objectives:

1. To describe synergies in interventional approaches in HCC
2. To analyse the results of trials using combination strategies
3. To understand the role of combined therapies in the management of HCC

Hepatocellular carcinoma (HCC) is the sixth most common cancer and the third leading cause of cancer-related death. Despite the widespread implementation of surveillance programs, more than half of the patients with HCC are diagnosed late, when curative treatments cannot be applied. In addition, in a high proportion of cases the disease recurs after a radical therapy. For patients presenting with multinodular HCC and relatively preserved liver function, absence of cancer-related symptoms, and no evidence of vascular invasion or extrahepatic spread – i.e., those classified as intermediate-stage according to the BCLC staging system – transcatheter arterial chemoembolization (TACE) is the current standard of care.

The recommendation for TACE as the standard-of-care for intermediate-stage HCC is based on the demonstration of improved survival compared with best supportive care or suboptimal therapies in a meta-analysis of six randomized control trials. However, there was considerable heterogeneity between the individual study designs (including inpatient populations and TACE technique) as well as the study results, with only two of the six individual studies that reported 2-year survival showing a statistically significant improvement compared with conservative management.

In fact, intermediate-stage HCC includes a heterogeneous population of patients, as suggested by a classification that can include patients varying widely in terms of tumour burden and liver function (Child-Pugh A or B). It has been therefore suggested that – while TACE improves survival for the intermediate-stage HCC class as a whole – not all patients with intermediate-stage HCC will derive similar benefit from TACE, and that some intermediate-stage patients may benefit from treatments other than or in combination with TACE.

Investigation of the combination of targeted agents with TACE with antiangiogenetic properties is important, because there is a rationale for potential synergy between these therapies. Systemic therapy with a multi-kinase inhibitor, sorafenib, is presently considered the therapy of choice for patients with advanced HCC. In two RCTs, this multi-kinase inhibitor with antiangiogenic and antiproliferative properties has been shown to prolong median overall survival and median time to radiological progression compared to placebo. In a study of tumor specimens from patients with HCC treated with TACE, the production of the proangiogenic vascular endothelial growth factor was higher than in samples from patients treated with surgery alone. Furthermore, in an experimental tumor model, hypoxia, caused by embolization of liver tumors, activated hypoxia-inducible factor 1-alpha, a transcription factor that, in turn, regulates other proangiogenic factors. Given the known antiangiogenic properties of sorafenib and the better tolerability of drug-eluting beads TACE (DEB-TACE), the combination of TACE with sorafenib holds promise and clinical trials investigating this therapeutic approach are ongoing (Sorafenib or Placebo in Combination with Transarterial Chemoembolization for Intermediate-stage HCC [SPACE] trial; ClinicalTrials.gov identifier, NCT00855218). Preliminary data analysis of a Phase II trial of sorafenib combined with DEB- TACE shows promising results in term of safety and efficacy (95% disease control rate according to EASL criteria).

Selected categories of patients classified as advanced stage HCC according to BCLC present with a limited disease. These include patients who have a branch vein tumoral invasion or those who have a limited extrahepatic disease. It is debatable if patients bearing vascular invasion limited to a venous branch, should be denied to intra-arterial treatments that are technically feasible and could represent a valuable option. This represents another important field of investigation and two phase III RCTs studies of sorafenib or placebo in combination with TACE, including patients with limited portal vein thrombosis, are ongoing (ClinicalTrials.govidentifier, NCT01004978; EudraCT: 2008-005073-36).

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Disclosure
Speaker for Bayer Pharmaceuticals

Special Session
Strategic plan for IR

204.1

Challenges of IR in European countries

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Learning Objectives:
1. To analyse the role of IR in the European medical community
2. To identify the most competitive specialties and define the overlap with IR
3. To project the chances of IR and how to make it irreplaceable

Interventional radiological procedures have become a standard in most European countries. Both vascular and nonvascular procedures are inevitable for standard-of-care diagnostic work-up and treatment. They replaced many open surgical procedures such as aortobifemoral bypass in most iliac artery obstructions, challenge established procedures such as hysterectomy for myomas and undermine current concepts of care such as interventional oncology.

As the future for interventional radiology looks bright, it does not so for interventional radiologists. Because the procedures become more and more in use, other specialities are trying - partly very succesfully - to get their share of the cake. The timing and the field of expertise differ from one country to another but is found in more or less all member countries.

While in Germany, for example, interventional uroradiology started in radiology, it now more or less disappeared into urology at least for nonvascular procedures. Biliary interventions have been frequently overtaken by gastroenterologists and biopsies are performed by merely everyone at least by ultrasound. Neurointerventions are - in some countries - predominantly performed by neurosurgeons, vascular interventions are partly in the hands of vascular surgeons in others such as Belgium, France and Italy.

Vascular interventional radiology is probably the largest field in many institutions and deals not only with recanalization of obstructions but also with embolization techniques which are especially required in emergency situations. Interventional treatment of stroke becomes more and more in larger hospitals but needs to be available 24 hours at 7 days. Proper training requires a minimum of procedures to train doctors in an adequate fashion and numbers; and recanalization procedures and diagnostic angioghraphic procedures are predominantly these procedures which give even trainees the chance to get in touch with standard tricks and techniques in a relatively safe environment. As now, many different specialities try to be involved into the field of vascular interventions, there is a risk of atomization of knowledge and experience putting a hospital in the risky situation that nobody is experienced enough to cover all situations adequately. Moreover, there is the chance of a significant cost rise as many different specialities needed to be available day and night to cover their interventional segment.

Safeguards to prevent wild and uncontrolled experimental interventional radiology by non-radiologists mainly deal with radiation safety regulations but are very different from one country to another. Also, standards for qualification are rarely regulated.

As money and influence give always a strong motivation for doctors to take over new inventions and techniques, lack of proper training is not a reason for them to stay away.

Interventional radiologists need to make sure that they are the best trained people in the field, have outstanding clinical and technical standards and offer their services in an independent decision making surrounding that allows the patient to trust on an unbalanced recommendation. Thus, establishment of cooperative vascular units and also business models are mandatory for interventional radiologists to survive. Diagnostic radiologists should become aware of the fact, that without interventional radiology, their survival as a clinical hospital-based entity will be questionable in the future and teleradiological take-overs become more likely.

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Disclosure
Consultant relations to differnt medical companies such as EV3, BSIC, Biotronik, Cook

204.2

Challenges of IR outside Europe

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Learning Objectives:
1. To analyse the role of IR in the American medical community
2. To identify the most competitive specialties and define the overlap with IR
3. To project the chances of IR and how to make it irreplaceable

Interventional radiology (IR) in the United States is growing and prospering; however, there are a number of specific challenges facing IR that must be addressed in order for the specialty to remain viable.
Challenges to IR can be parceled into three categories:
- Challenges related to health care reform.
- Economic challenge-related IR.
- Competition from other medical specialties.

Health care reform in the United States presents an ideal opportunity for IR because the less invasive nature of our specialty allows us to provide services that are potentially less expensive while having outcomes that are excellent. The safety profile of our procedures allows IR to often legitimately claim that IR procedures are safer as well. The major problem with these claims is that although most IRs recognize these claims to be true we do not have enough data driven outcomes to prove to payers and health care experts that this is in fact true. We are challenged in the US to improve data driven decision making and this requires doing more trials and to have better follow-up of our patients. Achieving this with a slumping economy and a growing uninsured patient population is very difficult. National registries for data collection must be instituted in order to track outcomes and monitor morbidity and mortality. Inferior vena cava filter placement using optional filters is a prime example of a procedure that is currently be scrutinized for over usage and without the data to support implantation of these devices government regulatory agencies may step in to limit usage.
In the United States we are also realizing a loss in clinical research because it is often cheaper and easier for device companies to do work overseas. The regulatory environment which is designed to ensure patient safety has had a secondary effect of slowing down research and delaying device approval. While intellectual property for new devices and IR-related ideas is at an all time high, much of the work to prove efficacy is now being done abroad. This may serve to deter the innovative nature of our specialty.
There are a variety of economic challenges that IR is facing including decreasing reimbursement for procedures being performed. The methods of reimbursement for surgical and IR procedures is currently changing and we are seeing more and more codes bundled into single codes for procedures. Ultimately, this may serve to prevent over utilization and abuse but it also serves to decrease reimbursement for physicians. Overcoming this is a steep obstacle for IR physicians. Using physician extenders and mid level practitioner has become common place in the US. These extenders allow for increased volume of cases and take significant burdens from the interventionalist on a daily basis.
New practice paradigms are being developed in IR and we are seeing a growing percentage of physicians breaking ranks from traditional hospital radiology groups. IR physicians are increasingly working in free standing facilities, multispecialty clinics or with other specialists including vascular surgeons, cardiologists and oncologists. These models are viable and often efficient models for IR practice but they present an array of new challenges including equity in salaries, case distribution and quality of outcomes.
Competition with other specialties (turf) has been a long standing issue with IR. This will continue to be a major issue as long as clinical training lags behind other specialties. The SIR has addressed this and has taken very proactive and meaningful actions to correct this issue with training programs and the fruits of these efforts are being realized. Areas of particular concern are the areas of PAD, venous interventions, dialysis interventions, spine and pain management interventions and stroke. New training requirements and possibly even a new board credential are serving to improve clinical competence and allowing IR to compete on equal ground with other clinical specialties.
Overall, despite the concerns discussed above the future for IR is bright and robust. New growth areas include
- Venous diseases
- Stroke
- Critical limb ischemia
- Women's health
- Interventional oncology
- Pediatric IR

204.3

The pathway towards an IR training curriculum and certificate

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Learning Objectives:
1. To explain the need of a dedicated IR training curriculum and certificate
2. To report on existing pathways of IR training in UK and Europe
3. To depict the political and structural benefit of certifications in medicine

The European Board of Interventional Radiology (EBIR) is the European qualification in Interventional Radiology.
The EBIR is organized by CIRSE and has the endorsement of the UEMS and the ESR.
The EBIR represents a recognized qualification in IR and should assist IRs in the promotion of their skills and experience in IR when dealing with other clinical colleagues and with the general public.

1. INTRODUCTION

1.1. The basis for the examination is the CIRSE interventional radiology syllabus (current Version 0.1 / 2008)
1.2. The examination consists of written and oral components
1.3. The certificate is particularly aimed at junior interventional radiologists

2. ENTRY CRITERIA

2.1. A **logbook** of IR experience
All candidates must present a logbook with a total record of their IR experience in the previous 24 months. The logbook should present the candidate's IR experience in Vascular and Non-vascular Interventional Radiology.
The candidate must have experience as first operator or first assistant in at least 150 IR procedures. (At least 25 procedures as first operator).
· Vascular - Experience as first operator or first assistant in at least 100 procedures.
· Non-vascular - Experience as first operator or first assistant in at least 50 procedures.
The logbook must be signed by the applicant and the candidate's IR programme director.
2.2. A completed EBIR **registration form**
A completed EBIR registration form must be submitted to the CIRSE office.
A **letter of support** from the candidate's IR programme director
The application must be accompanied by a letter of support from the candidate's IR programme director. This may be the head of the radiology department or the chief interventional radiologist in charge of the candidate's training.

2.3. A curriculum vitae
The CV should include a record of previous training posts in radiology and IR as well as all scientific and educational activities.
An **application fee** of €500
2.4. **European residency** is required (Only European radiologists residing within the boundaries of Europe as determined by the EBIR Board can apply.)
2.5. **CIRSE Membership** (Full or Junior) (in the year of the examination)
ESR Membership (in the year of the examination)
Applicants must register and provide documentary evidence of fulfilment of all entry criteria for the exam no later than 3 months before the exam. No refunds will be provided if an applicant withdraws his/her application. If a candidate cannot provide all entry criteria by the deadline, his/her registration for the exam will be cancelled.
Candidates judged to have satisfied the entry criteria will be eligible to take the examination.
From 2011 the exam will take place at least twice a year, the first exam will take place early in the year and the second, during or prior to the CIRSE annual congress.
2.6. **Entry criteria for senior IRs**, who wish to take EBIR:
a. The IR must have completed their IR training at least 10 years previously.
b. The IR must have been working as a trained IR for at least 10 years.
c. A logbook of experience is desirable but not mandatory.
d. An application fee of 500 euros.
e. Curriculum Vitae.
f. A supporting letter of reference from a Fellow of CIRSE.
g. The final decision regarding acceptance is at the discretion of the Examination Panel.
3. THE EXAMINATION
The examination will consist of written and oral components. The maximum score for the two parts will be 100%.
The MCQ examination will contribute 50% of the total score for the exam.
The oral examination will contribute 50% of the total examination score and will consist of an oral exam in two IR topics (25% each).
The pass mark threshold for the overall exam is 75%.
(It should be noted that candidates who do not attain a pass mark for the MCQ exam or the oral examination will be unlikely to pass the overall EBIR examination.)
All participants will take the full exam irrespective of their written exam scores.
3.1. **The written exam**
This will consist of 60 multiple choice questions.
· Single best answer format - (i.e. only 1 out of 4 possible answers correct).
· No negative marking for incorrect answers.
· The exam will last 90 minutes.
All candidates will be tested in
– Angiography/CT/MRI anatomy and diagnosis
– Clinical practice
– Pathology
– General interventional knowledge (Materials etc.)
– Image guidance
3.2. **The oral exam**
This will consist of two 30 minute oral examinations.
Candidates may choose two topics from the following list:
· General IR
· Vascular
· Non-vascular
· Oncology
Candidates will be asked to select their two topics at the time that they submit their application to take the exam.
Each candidate will be examined by a CIRSE Fellow, who will hold the EBIR diploma. .
The examiners will show each candidate a series of cases relevant to the topic selected.
The examiners will test the candidate's knowledge of all aspects of the cases under discussion – diagnosis, procedural details, equipment selection, outcomes, complications, etc.
Results
The results will be sent in writing to the participants. The results and consequent feedback will be not open to discussion. The results will be issued as Pass or Fail only, no percentage or score will be provided. CIRSE will publish anonymous statistics on the exam.
Participants may make four attempts to pass the examination.
3.3. **Examiner's meeting**
At the completion of the exam, an examiners meeting will be held. At this meeting, the results of both components of the exam will be added together to produce a total score for the examination for each candidate.
The scores for each candidate will be reviewed and potential fail candidates will be discussed. At the end of the meeting, a list of pass and fail candidates will be produced. Candidates will be notified of their results by email within five working days.
3.4. **Awarding certificates**
Successful candidates will be awarded a certificate and may add EBIR (European Board of Interventional Radiology) to their name.
Only European radiologists residing within the boundaries of Europe as determined by the EBIR Board can apply for CIRSE fellowship and EBIR.
Disclosure
1. Member of Medical Advisory Board for Navilyst Medical
2. Consultant for W. Cook, Europe.

204.4

Do we want to become a clinical subspecialty? Pros and cons

A. Adam;
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Learning Objectives:
1. To overview the clinical and financial role of IR in general radiology
2. To project the political meaning of separating IR from general radiology
3. To critically analyse the financial and structural autonomy of IR as a subspecialty

Interventional Radiology discipline has taken great strides in the last four decades and has replaced much of traditional surgery. However, it faces many challenges and frustrations, including erosion by other specialties. Happily, there are still areas of substantial growth in our practice, including tumour ablation, vertebroplasty and embolization procedures. These are fields of activity in which competition is either weak or non-existent. However, there are also areas from which interventional radiologists are largely excluded, which involve procedures that we can perform perfectly well, but are prevented from doing so by others, who may be less skilled, but have access to the relevant patients. Examples of such areas are the fields of tracheobronchial and gastrointestinal intervention, which, in most hospitals, are carried out by chest physicians and gastroenterologists. This is frustrating because, although endoscopy is useful in making the initial diagnosis, it is unnecessary in the performance of the therapeutic procedure, and simply increases the cost. Four factors determine who does what in practical disciplines: in ascending importance these are research activity, skills and training, the numbers of practitioners and, most important of all, clinical control of patients. Research is difficult to measure accurately but there are indications that the research activity of radiologists, in general, and interventional radiologists, in particular, is less than that of many clinical disciplines. Skills and training are our strength; interventional radiologists are well trained and

very skilled in the procedures they perform. In addition, they have a strong record of practical innovation. It is generally recognized that the numbers of interventional radiologists is small in comparison with most other disciplines. This has substantial implications for the way we practice, particularly in relation to out-of-hours care. The clinical control of patients is very important for the future of our discipline. Clinical practice has great benefits for individual interventional radiologists, as it allows us to consent our patients properly, to prepare them for procedures appropriately and to deal with complications more effectively. It also increases our credibility and secures our referral base. In the UK, Interventional Radiology is now a recognized subspecialty of Radiology, with its own curriculum. However, access to patients remains a problem. In order to gain access patients, Interventional Radiologists must demonstrate their ability to care for patients as their primary physicians. In order to do this it is necessary to have clinical knowledge extending beyond technical skills. For example, interventional radiologists engaged in the field of Interventional Oncology will have to acquire a rudimentary understanding of chemotherapy and radiotherapy, as well as diagnostic imaging and interventional procedures. If Interventional Radiology remains a technical discipline, its identity will continue to be ill defined. Furthermore, there will be more erosion by other clinical disciplines and continuing pressure to develop new procedures in order to survive. Partnerships with organ-based clinical specialties have advantages, including diffusion of conflict, increased referrals to Interventional Radiology, increased opportunities for research, and greater support for clinical activity. However, such partnerships must be based on equality. There is no going back for image-guided intervention. The essentials of interventional radiology are imaging and sophisticated technology and both of these are growing rapidly. In fact, imaging is becoming the major determinant of patient flow through modern hospitals, and this will benefit Interventional Radiology greatly. Our identity may have to change, but image-guided intervention has a very bright future.

Foundation Course Haemoptysis

301.1

Imaging of haemoptysis

***M.-F. Carette**, A. Khalil;*
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Learning Objectives:
1. To review the results of CTA in haemoptysis
2. To discuss the role of imaging pre angiography and embolization
3. To describe the main pathological features on CT

CTA in haemoptysis is able to precise the localization of haemoptysis showing alveolar condensation with/or ground glass opacity, the best around the aetiology (bronchiectasis, active or non active tuberculosis, fibrosis, carcinoma, aspergilloma). Visualization of systemo-pulmonary shunting or bronchial leakage is unusual. The extension of alveolar condensation can be prognostic, number of lobe involved been correlated to potential death. Differential diagnosis, as alveolar haemorrhage, can be eliminated when CT shows diffused regular ground glass opacities keeping clear subpleural spaces.

The main information before interventional radiology is to know the mechanism of the haemoptysis, leading in prime intention to pulmonary vasoocclusion (10% of cases) if pulmonary pseudo-aneurysm is observed or suspected on an underlying necrotic aetiology (active tuberculosis, abscess, necrotic tumour) or disease responsible for pulmonary aneurysm (Behçet disease) or pulmonary arteriovenous malformation (PAVM).

If bronchial artery embolisation is required (90% of cases), CTA shows, hypertrophic bronchial arteries well seen through the hilum, and potentially involved systemic arteries (internal mammary artery, inferior phrenic artery and/or triangular ligament artery). For bronchial arteries, it shows their origin in, typical (descending aorta at the level of the main left bronchus), atypical (floor or the aortic arch) or ectopic position (arising from other position but going through the hilum), which can help, especially in older patients. Anastomoses between bronchial arteries or bronchial to systemic arteries can be difficult to visualize. Coronary–CT can be useful for coronary arteries anastomoses. Dorsal anterior spinal cord artery arising from the right broncho-intercostal trunk, and oesophageal artery, which can arise from a left bronchial artery, are not yet detectable at CTA.

Considering the main pathological features: *In bronchiectasis, which diagnosis is perfectly seen on CT, sometimes with the help of MiniMIP; broncho-systemic hypertrophy is often very important, with bronchial artery aneurysm and bronchial to pulmonary shunting in reverse flow. *In non-active tuberculosis, broncho-systemic hypertrophy most often includes trans-pleural vessels, especially if cavities are complicated by aspergilloma. * in active tuberculosis, bleeding can be due to broncho-systemic hypertrophy but also to a Rasmussen pseudo-aneurysm seen as a circumscribed area of contrast media inside a necrotic area as for abscess. * In carcinoma, it could be only a moderate bronchial artery hypertrophy, without any shunting, or a pulmonary erosion in contact with a necrotic tumour area.

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301.2

Bronchial artery angiography: relevant anatomy

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Learning Objectives:
1. To review the anatomy of the bronchial arteries
2. To review the possible anatomical variants of the bronchial artery supply
3. To review the possible systemic branch supply of pulmonary pathology that may cause haemoptysis

Bronchial artery anatomy and its variants play a major role for interventional radiology and for thoracoscopic surgery. Computed tomography, magnetic resonance imaging and catheter angiography all are able to depict bronchial arteries. Surgeons can be helped by the a priori knowledge of the bronchial artery`s position in the mediastinum, especially in relation to the esophagus. Interventional radiologists need to know the different possible origins in order to perform selective catheter angiography of the vessels. There is a wide variance of origins of the bronchial arteries coming from the aorta. The right bronchial artery usually arises in a common intercostobronchial trunk; mainly it is located to the right lateral or anterolateral surface of the aorta. The left bronchial artery originates most often directly from the anterior aspect of the thoracic aorta. Being located at the aortic arch selective catheterization can become challenging. Sometimes there is a common trunk giving of the left and right bronchial artery. Most of the time the bronchial artery origin is located at the level T5 or T6. There are different classifications (Caldwell, Botenga, Uflacker) which describe up to 10 different types of aortic origins. Furthermore, the thyrocervical and brachiocephalic trunk, the subclavian, internal thoracic and phrenic artery – to name but a few - can give rise to a bronchial artery. A higher incidence of aberrant bronchial artery origins have been reported in patients with cystic fibrosis, but this might also be true for other chronic inflammatory diseases. In addition, variants in the form of collaterals to different vascular territories do exist and should be thoroughly checked for. In case of planned embolisation procedures collaterals to the anterior spinal artery (Adamkiewics; mainly from the right bronchial artery) and to the coronaries are those most important not to miss. But it has to be stressed that there are numerous other collateral pathways to the mediastinum, spine, neck and head. Four different types of venous drainage of the bronchial arteries have been described by Tanaka et al. (pulmonary vein, pulmonary artery with ante- or retrograde flow, bronchial vein), which can become important during particle embolisation of the bronchial arteries.

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301.3

Bronchial artery embolization: how I do it

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Learning Objectives:
1. To review technique of bronchial artery embolization
2. To review the results of bronchial artery embolization
3. To review outcome and complications of bronchial artery embolization

Anatomy

Bronchial arteries arise directly from the descending aorta as single right bronchial artery with two left bronchial arteries in 41%. Up to 20% may have an aberrant origin and in up to 10% they originate from the curvature of the aortic arch. Aberrant origins include subclavian, brachiocephalic, internal mammary, phrenic and coronary, or chest wall. A spinal artery may originate from a bronchial artery in up to 5% of patients with right side being more common than the left side.

Which arteries are considered pathologic?

Hypertrophied arteries/those presenting a vascular blush/or arteriovenous shunting/helical or lobulated morphology with or without microaneurysms or diameter larger than 3-4 mm. Abnormal systemic feeders (non-bronchial systemic collaterals) may arise from the internal thoracic artery, thyrocervical trunk, lateral thoracic artery subclavian and internal mammary arteries or intercostal branches.

Procedure

Selective catheterization with curved catheters (Cobra, Simmons 1or 2, Hink, or Judkins) of 5F in diameter. Microcatheters are useful to advance the catheter to a safe and distal position.

Embolic materials

The most commonly used is polyvinyl alcohol (PVA). Spherical embolic agents (Embozene - Celonova; Embospheres-Biosphere, Rockland, MA; Bead block - Biocompatibles-Terumo) are also used but there is no general consensus. Liquid agents are dangerous due to risk of small artery embolization while coils are absolutely contraindicated since they result in proximal embolization and preclude further embolization sessions in the future.

Size of particles

Most centers use particles of 250 to 750 microns – mostly PVA. The ideal size would be the same diameter with the distal ramification of the bronchial arteries. The large diameters are unlikely to penetrate through collaterals to the spinal circulation. Barben et al in young patients with cystic fibrosis have used polyvinyl alcohol particles of 150 to 550 µm. Bouchy et al showed that in dogs the use of microspheres of less than 100 µm in diameter induced hind leg paralysis while the use of larger particles induced only transient neurological symptoms.

Results

Immediate success is reported in 77%-95%. Rebleeding depends on successful embolization and underlying disease. Late rebleeding occurs in CF in 37-55% with a median time between embolizations ranging from 4 to 61 months.

Complications

The most severe complication is spinal infarction and paraplegia resulting from embolization of a spinal artery. Brown Sequard's syndrome without sequelae has also been reported. Minor adverse events include transient chest pain, fever, and dysphagia.

301.4

Pulmonary artery embolization: how I do it

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Learning Objectives:
1. To review the etiology of haemoptysis secondary to lesions of the pulmonary artery
2. To review the indications and technique of pulmonary artery embolization
3. To review results and complications of pulmonary artery embolization

Pulmonary artery vascular lesions are responsible for only a small fraction of patients who present with hemoptysis. The majority of patients with hemoptysis bleed from lesions supplied by the bronchial or other systemic collateral arteries. The most frequent indication for embolization of the pulmonary arteries is for patients with hereditary hemorrhagic telangiectasia (HHT). We perform prophylactic embolization of these lesions to prevent complications of stroke, brain abscesses, hemoptysis and hemothorax. We also embolize pulmonary AV fistulas to relieve the symptoms of the associated right to left shunt such as hypoxemia and decreased exercise tolerance. Since the saccular aneurysms associated with pulmonary AV fistulas are often located close to the pleural surface occasionally they rupture into the pleural space causing a hemothorax.

Other lesions for which we embolize the pulmonary arteries are Rasmussen aneurysms and pseudoaneurysms usually due to iatrogenic trauma. Rasmussen's aneurysm originally referred to an aneurysm of the small to medium pulmonary artery branches developing in the vicinity of a caseating necrotic lesion or a cavity from tuberculosis. However, any destructive lung process, irrespective of its pathogenesis, can destroy adjacent lung, weaken the arterial wall, or erode any vessel in its vicinity. Other causes of mycotic aneurysms are septicemia, bronchiectasis, lung abscess, and other inflammatory conditions. Aneurysms involving the lobar or segmental branches of the pulmonary arteries occur in Behçet's and Hughes-Stovin syndromes. These lesions often have dual blood supply from both pulmonary and bronchial arteries. Frequently it is necessary to embolize the bronchial supply in addition to the involved pulmonary artery. Iatrogenic traumatic pulmonary pseudoaneurysms are complications of over inflated Swann-Ganz pulmonary artery catheters or lung surgery.

An unusual lesion that often requires pulmonary artery embolization is a systemic artery to pulmonary artery fistula. These lesions most often have an aneurysm at the site of the fistula. They may be fed by several systemic arteries including the internal mammary artery, bronchial artery and phrenic artery. Principles for endovascular treatment of these include occlusion of both the systemic artery inflow and the pulmonary artery outflow.

Large vessel occluders are used for embolization of the pulmonary arteries. These include coils, Amplatzer vascular plugs and where available detachable balloons. The choice of the embolic material depends on the anatomy and blood supply to the lesion to be embolized and the goal of embolization. With proper procedural planning and performance, interventional treatment will achieve successful results in the majority of these cases.

Special Session
EVAR

302.1

Review of new EVAR devices: pros and cons

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Learning Objectives:
1. To discuss new devices
2. To describe how they are better compared with previous devices
3. To present the pitfalls of new devices

Endovascular techniques have driven the evolution of the management of thoracic aortic disease, enabling minimally invasive repair even in high-risk patients who are unfit for open surgery. The indications are expanding and the complexity of cases is increasing. The individual anatomy and pathology of the thoracic aorta alone and in combination create specific difficulties in stent graft delivery, deployment, and fixation.

Currently there are several commercially approved devices for thoracic aortic disease, including Gore TAG (Gore), Valiant-Captivia (Medtronic), Zenith TX1 or TX2 (Cook), Relay (Bolton Medical), Endofit (Endomed), E-Vita (Jotec), ranging between 20 and 50 mm, enabling the treatment of aortic sizes between 18 mm and 44 mm in diameter.

Most of these devices are composed of a preloaded stent-graft made of a polyester or e PTFE graft built onto a self expanding nitinol or stainless steel alloy skeleton. Each of these devices has different proximal and distal configurations, with or without barbs. Longer lengths, with a maximum of 250 mm, have been designed to minimize device exchange during deployment and to avoid type III endoleaks with multiple stent-grafts.

Modifications have been made to improve trackability, conformability, and deployment. The connecting bar has been removed or changed in the last device for improved conformability, especially in the arch. The number of bare springs at the proximal and distal ends of the device has been increased to improve circumferential force distribution and fixation along the aortic wall.

The aim of this paper is to briefly discuss the different concepts regarding design and deployment.

Regarding design, devices with proximal bare stents and non-bare stents do exist. The idea of bare stents has been enhancing stabilization of the prosthesis. However, adverse events associated with bare stents such as retrograde type A dissection have been reported. If this association is causal or observational bias has to be left open. To date there is no evidence that one or the other concept is superior.

Regarding deployment, there are devices with and without a tip-capture system on the market. It is without doubt that the availability of a tip capture increases safety as blood-pressure or anatomy-dependent migration or displacement of the prosthesis during deployment is prevented. As such a system with a tip capture, the more proximal the deployment is intended (arch and cranial ascending aorta) as well as in difficult anatomies where stretching and bending may occur and lead to displacement during deployment could be recommended.

The assessment of these new grafts is difficult, due to the changing indications for their use and a lack of large-scale clinical trials. Although all devices are at risk, some failures are more specific to one device over another and can only be remedied with improvements in design and construction. Therefore, research and development in this therapy must be encouraged in both fronts. More sophisticated design as curved prostheses, branched or fenestrated stent grafts, which addresses the specific anatomic needs of each individual patient, is an exciting possibility which may reduce complications.

It is beyond the scope of this paper to address all manufacturers as well as their advantages and drawbacks.

Disclosure

Consultancy GORE, Medtronic, Bolton

302.2

What do the long term results of randomized controlled trials teach us?

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Learning Objectives:

1. To present the long term results
2. To compare the results vs. surgery
3. To learn how the results of the RCTs affect our practice

In the EVAR 1 trial 1252 patients with abdominal aortic aneurysms (≥5.5 cm in diameter) were randomly assigned to undergo either endovascular aneurysm repair (EVAR) or open surgical repair (OSR). To each group 626 patients were assigned. Patients were followed for rates of death, graft-related complications, reinterventions, and resource use. The mean time of follow up was 6 years. The mean age of the patients was 74 years and the mean diameter of the aneurysm was 6.4 cm. About 42% of the patients had a history of cardiac disease. The 30-day operative mortality rate was 1.8% in the EVAR group and 4.3% in the OSR group (adjusted odds ratio for endovascular repair as compared with open repair, 0.39; 95% confidence interval [CI], 0.18 to 0.87; P = 0.02) (1). The total numbers of patients who died during hospitalization for aneurysm repair were 14 of 614 patients (2.3%) in the EVAR group and 36 of 602 patients (6.0%) in the OSR group (adjusted odds ratio, 0.39; 95% CI, 0.20 to 0.76; P = 0.006) (2). At the end of follow up 42% of the patients were dead in both groups. Aneurysm-related death was observed in 5.7% vs. 6.3% **in the EVAR vs. OSR groups, respectively. Graft-related complications were observed in** 282/626 (12.6 %) patients in the EVAR group and 78/626 patients (2.5%) in the OSR group. However, endoleaks were counted as a complication in the EVAR group. Any other complication such as wound complications (delayed healing, infection, seroma, hernia) were not reported in the OSR group (2). During 8-year of follow-up, the total average cost of aneurysm-related procedures in the EVAR group was £3,019 ($4,568) more than in the open-repair group (mean costs, £15,303 [$23,153] and £12,284 [$18,586], respectively) (2).

In the DREAM trial 178 patients were randomly assigned to undergo OSR and 173 to undergo EVAR. The mean age of the patients was 70 years, 44% had concomitant cardiac disease (3). The median follow-up was 6.4 years. The 30-day mortality rate was 1.2% versus 4.6% in the EVAR versus OSR group, respectively. Severe complications were observed in 4.7% versus 9.8% the EVAR versus OSR group, respectively. Six years after randomization, the cumulative survival rates were 69.9% for OSR and 68.9% for EVAR (difference, 1.0 percentage point; 95% confidence interval [CI], −8.8 to 10.8; P = 0.97). The cumulative rates of freedom from secondary interventions were 81.9% for OSR and 70.4% for EVAR (difference, 11.5 percentage points; 95% CI, 2.0 to 21.0; P = 0.03). After OSR the most frequent reintervention was correction of an abdominal incisional hernia, whereas EVAR reinterventions were most often performed because of an endoleak and endograft migration (4).

In a third randomized, multicenter clinical trial (OVER) of 881 US veterans with abdominal aortic aneurysms were treated by either EVAR or OSR. Mean follow-up was 1.8 years. The mean age was 70 years, the mean aneurysm diameter was 5.7 cm. Perioperative mortality (30 days or inpatient) was lower for EVAR vs. OSR (0.5% vs 3.0%; P=.004) (5). Patients in the EVAR group had reduced median procedure time (2.9 vs 3.7 hours), blood loss (200 vs 1000 mL), transfusion requirement (0 vs 1.0 units), duration of mechanical ventilation (3.6 vs 5.0 hours), hospital stay (3 vs 7 days), and intensive care unit stay (1 vs 4 days). There were no differences between the 2 groups in major morbidity, procedure failure, secondary therapeutic procedures, aneurysm-related hospitalizations, health-related quality of life, or erectile function. There was no significant difference in mortality at 2 years (7.0% vs 9.8%, P=.13). The aneurysm-related mortality rate was 1.4% in the EVAR group and 3.0 % in the OSR group. Post-repair aneurysm-related interventions were observed in 108 EVAR patients and 86 OSR patients. The 61 secondary therapeutic procedures in the EVAR group included 42 endovascular procedures, 3 explantations of the graft with conversion to open repair, 9 other arterial procedures with an open component, 5 groin wound procedures, and 2 amputations (both legs of 1 patient). The 55 secondary therapeutic procedures in the OSR group included 24 incisional hernia repairs, 7 aortic graft procedures, 4 procedures for wound complications, 4 amputations (1 toe, 1 leg, and below and above knee on same leg), 4 laparotomies for bowel obstruction, 2 laparotomies for hematoma, 2 procedures to relieve claudication, and 8 miscellaneous minor procedures. Incisional hernia was reported in 30 patients who had open repair, resulting in secondary therapeutic procedures in 21 patients (4.9%), all of whom had undergone an anterior surgical approach in the original open repair (5). In the EVAR group, there were 134 endoleaks in 110 patients (25%), resulting in 21 secondary therapeutic procedures in 18 patients (4.1%) (5).

In the EVAR II trial 404 patients that were considered to be physically ineligible for OSR with large abdominal aortic aneurysms (≥5.5 cm in diameter) were randomly assigned to undergo either EVAR or no repair (6). The mean age was 76.8 years and the mean aneurysm diameter was 6.7cm. Patients were followed for rates of death, graft-related complications and reinterventions, and costs. The 30-day operative mortality was 7.3% in the EVAR group. Of the 207 patients who were assigned for non-intervention 70 (34%) had later an aneurysm repair after a mean follow-up of 244 days. The overall rate of aneurysm rupture in the no-intervention group was 12.4 (95% confidence interval [CI], 9.6 to 16.2) per 100 person-years. The overall aneurysm-related mortality was 3.6 deaths per 100 person-years in the endovascular-repair group and 7.3 deaths per 100 person-years in the non-intervention group (adjusted hazard ratio, 0.53; 95% CI, 0.32 to 0.89; P = 0.02) (7). This advantage did not result in any benefit in terms of total mortality (adjusted hazard ratio, 0.99; 95% CI, 0.78 to 1.27; P = 0.97). A total of 48% of patients who survived EVAR had graft-related complications, and 27% required reintervention (mostly endoleaks) within the first 6 years. During 8 years of follow-up, EVAR was considerably more expensive than no repair (cost difference, £9,826 [U.S. $14,867]; 95% CI, 7,638 to 12,013 [11,556 to 18,176])(7).

In summary, all 3 randomized trials which compared EVAR and OSR demonstrated a significantly lower 30-day or in hospital mortality rate after EVAR. However, this survival benefit was lost after 2-6 years of follow-up. The aneurysm-related mortality rate during the follow-up for up to 6 years was low 1.4%-5.7% for EVAR and 3.0%-6.3% for OSR. Reinterventions were observed in the EVAR group primarily because of endoleaks and graft migration. The most common cause of reintervention in the OSR group was incisional hernia. In the EVAR 2 trial in which patients not fit for OSR were randomized to EVAR versus observation placement of an endovascular graft led to a significant reduction in aneurysm-related mortality, primarily through prevention of late aneurysm rupture.

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302.3

Trials update for small AAAs and ruptured AAAs

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Learning Objectives:
1. To review the previous data for the treatment of small AAAs.
2. To review the current data for EVAR for ruptured AAA
3. To report on ongoing and future trials and trends

TRIALS UPDATE FOR SMALL AAAs

In the era of decision making the diameter of an abdominal aortic aneurysm (AAA) is considered the most important variable predicting rupture. The **UK Small Aneurysm (UK)** Trial and the VA's Aneurysm Detection and Management **(ADAM)** Trial have demonstrated that there is no benefit from early surgery versus regular ultrasound or CT scan surveillance for AAAs that are < 5.5 cm[1,2,3]. These trials demonstrated a 30-day operative mortality for elective open repair ranging from 2.7% in the USA up to 5.5% in the UK and both indicated that the rupture rate of small AAA was very low, less than 1% per annum. The findings of these two trials were summarized in a recent Cochrane review (at 6 years HR 1.11 [95%CI 0.91-1.34]), showing the safety and hence benefits of a policy of surveillance for aneurysms 4.0-5.5 cm in diameter[4].

The evolution in the endovascular area has influenced the management of AAA. A reasonable controversy arising is that much of our present decision making is based on studies comparing open repair to surveillance. The efficacy of endovascular repair (EVAR) compared with open surgical repair (OR) has been tested in four randomized trials, the **EVAR I**, the **DREAM**, the **OVER** and the **ACE** trial[5,6,7,8]. Three of these trials had similar results and showed an initial survival advantage in the endovascular technique (30-d mortality rates after EVAR compared with OR EVAR I: 4.7% vs. 1.7%, DREAM: 4.6% vs. 1.2%, and OVER: 3% vs. 0.5%)[5,6,7]. The 8- and 6-year follow-up results of the EVAR I and DREAM trials demonstrated similar survival rates between patients treated with OR and EVAR, but patients with EVAR in long-term follow-up were associated with increased rates of graft-related complications and reinterventions[5,6]. The Anevrysme de l'aorte abdominale: Chirurgie versus Endoprothese (ACE) trial was recently published after several years of delay, due to financial difficulties related to stent graft approval for the EVAR procedure. Interestingly, the trial showed that there was no difference in-hospital mortality (0.6% vs 1.3%; P = 1.0) and survival between the two groups. The authors concluded that in patient with low to intermediate risk factors, open repair of AAA is as safe as EVAR and remains a more durable option.

The early lower mortality rate observed after EVAR has also reopened the threshold of AAA diameter for recommending surgical repair**. EUROSTAR** data cited evidence that patients with smaller aneurysms following EVAR may be associated with a reduced long-term mortality and graft complication rates[9]. Two randomized trials, the **CAESAR** trial and the **PIVOTAL** trial, have investigated whether EVAR might be justified in patients with small aneurysms[10,11]. A difference between these two studies was that the PIVOTAL trial, focused only on the 4.0-5.0 cm diameter range (CAESAR: 4.0-5.5 cm diameter range). The two trials had clearly defined intervention policies for the surveillance groups in addition to reaching the threshold diameter. Both studies in a follow-up of three years concluded that there is no benefit to early endovascular repair of small abdominal aortic aneurysms in comparison to surveillance[10,11].

ESVS AND SVS GUIDELINES FOR ANEURYSM SURVEILLANCE

Published guidelines from the Society for Vascular Surgery (SVS), emphasize that surveillance is recommended for most patients with a fusiform AAA in the range of 4.0 cm to 5.4 cm in maximum diameter (Level of recommendation: Strong, Quality of evidence: Moderate)[12]. Recently reported guidelines by the European Society for Vascular Surgery (ESVS), taking in account the results of CAESAR and PIVOTAL trials, highlight that a policy of ultrasonographic surveillance of small aneurysms (4.0-5.5 cm) is safe and advised for asymptomatic aneurysms (Level 1a, Recommendation A)[13].

An issue for debate is whether surgical intervention is justified in case of females with small AAAs or in subsets of younger low-risk patients, with long life-expectancy. In the UK trial, the estimated adjusted hazard ratios were in the direction of greater benefit of early surgery for younger patient, but this benefit did not reach a statistical significance[2]. Females appear more likely to suffer AAA rupture at smaller aortic diameters and three or four times more likely to rupture whilst under surveillance than males[1,14]. Unfortunately, none of the randomized trials was designed and powered to detect differential effects for older or younger cohorts and female patients. In the absence of individual patient data meta-analysis, the ESVS guidelines suggest that aneurysm repair should be considered at a maximum aneurysm diameter of 5.2 cm in females (Level 3b, Recommendation C)[13]. The SVS guidelines suggest that young, healthy patients, and especially women, with AAA between 5.0 cm and 5.4 cm in maximum diameter may benefit from repair (Level of recommendation: Weak, Quality of evidence: Low)[12].

TRIALS UPDATE FOR RUPTURED AAAs

Case series and Trials for emergency EVAR (eEVAR)

Rupture of an abdominal aortic aneurysm (AAA) carries a high morbidity and mortality despite vast improvements in the care of critically ill patients over the past two decades. The overall mortality rate of patients is still extremely high ranging from 70 to 90%[15]. Mortality rates from open repair of ruptured AAAs have not improved significantly. Endovascular treatment of ruptured AAA has recently become popularized due to its minimally invasive approach.

The literature has become enriched with cohort studies and case control studies reporting significant benefits associated with eEVAR compared to open surgery. **Rayt et al.** in a meta analysis reported an operative mortality rate of 28% after treatment with EVAR for rAAAs[16]. **Karkos et al**. in his systematic review represent the largest collective experience of endovascular repair for rAAAs in the literature and documents the pooled mortality from 29 published series with 897 patients who underwent endovascular repair. The pooled mortality after endovascular repair for rAAA was 24.5%[17]. A total of 19 studies provided mortality data for contemporary open repair

during the same period with a mortality of 44.4%[17].
The majority of observational studies have revealed improved outcomes after emergent EVAR for ruptured AAA than those traditionally reported in the literature for open repair. However, these values should be balanced through the understanding that in these studies there were publication bias and significant patient selectivity according to hemodynamic instability, suitability for EVAR and surgeon's preference. Another factor for these favorable results might be the differences in operative technique and experience. Also, the open surgery group for rAAA is likely to contain more complex cases, such as those with pararenal diseases and more unstable patients, unfit for imaging delay.

Randomized Controlled Trials

The first randomized control trial (**Nottingham Trial**) on emergency EVAR (eEVAR) failed to complete and was suspended due to slow recruitment and over-optimistic power calculation[18]. On an intention to treat basis the 30-day mortality rate was 53% in the EVAR group and 53% in the open repair group, failing to support superiority of EVAR over open repair of ruptured abdominal aortic aneurysms (RAAAs).
Three RCTs comparing EVAR with Open Repair for ruptured AAAs are currently in progress: the Amsterdam Acute Aneurysm Trial (AJAX Trial), the French Endovascular versus Conventional Aneurysm Repair Trial (ECAR Trial), and the Immediate Management of the Patient with Rupture: Open vs Endovascular Repair (IMPROVE Trial)[19-21].
The **AJAX** trial started recruitment in 2004 randomizing stable patients following a CT scan to decide anatomic suitability[19]. The proposed EVAR protocol included local anesthesia, controlled hypotension and a simple aorto-unilateral system. The primary endpoint of the study is combined mortality and severe morbidity. While the initial target was 80 patients, due to new power calculations, in 2009 the protocol was amended to increase recruitment to 120 patients. The enrollment phase was extended and final analysis is awaited by the end of 2011.
The **ECAR** trial started recruitment on January 2008 randomizing stable patients following a CT scan to decide anatomic suitability, similar to the AJAX trial[20]. The trial investigators plan to recruit a total of 160 patients (80 to each group). The primary outcome is mortality at 1 month. Results on mortality/morbidity are not yet available.
The **IMPROVE** trial has started to recruit patients from 2009. Compared to AJAX and ECAR, this trial will attempt to compare an endovascular repair first to an open repair first strategy[21]. Non-moribund patients with varying degrees of hemodynamic stability will be randomized to the endovascular or open arm once a clinical diagnosis is made. Then those randomized to the endovascular arm will undergo urgent CT scanning to determine anatomic suitability followed by endovascular repair if possible, with open repair as the default option: CT scanning is optional in the open repair arm. A total of 600 patients will be enrolled in the study. The study will also address whether an endovascular first strategy with a CT-scan introduces unacceptable delays into the patient pathway with adverse clinical sequence.

Guidelines for the treatment of ruptured AAAs

Regarding the role of EVAR for ruptured AAAs, the ESVS guidelines emphasize that there is lack of evidence to support its superiority than open repair in an unselected population of patients who present with rAAA. EVAR should be considered as a treatment option for ruptured AAA, provided that anatomy is suitable, the centre is appropriately equipped and the team experienced in emergency endovascular aneurysm procedures (Level 2b, Recommendation B)[13]. There is evidence for the need of a multidisciplinary approach and a standardized protocol to treat effectively the critical condition (Level 2C, Recommendation A)[13]. The United Kingdom National Institute for Clinical Excellence (NICE), in its consensus document published in February 2009, stated that EVAR was not recommended for rAAA, except in the context of research[22]. Further, more robust evidence is required to convince this independent national guidance organization.

Conclusions

According to the available data, surveillance remains the preferred policy for small aneurysms 4.0-5.5 cm in diameter. Young, fit patients, and especially women, with AAA between 5.0 cm and 5.4 cm in maximum diameter may benefit from repair. The decision making depends on the balance of risks and benefits and medical advice for the treatment of an abdominal aortic aneurysm should be individualized. The role of EVAR in the management of rAAAs is still obscure. High standards of organization are needed from specialized centers to manage the urgent nature of rAAAs. EVAR in emergency settings requires a dedicated and readily available multidisciplinary staff with trained experience as well as dedicated specific technology. Results from the ongoing randomized trials will probably elucidate the role of EVAR in ruptured aneurysms.

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302.4

Imaging follow-up: what modality, how often, do we still need it?

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Learning Objectives:
1. Which is the best follow-up modality?
2. Is ultrasound better than CT?
3. What is the role of MRI?

Endovascular aneurysm repair (EVAR) is a well-established technique for the treatment of abdominal aortic aneurysms (AAA). It can reduce perioperative mortality, complications and hospitalization but patient surveillance and early complication detection are crucial to determine long-term performance of EVAR devices.

Consensus guidelines by Chaikof recommend obtaining a computed tomographic angiogram (CTA) every 5 years for open surgical repair of an abdominal aortic aneurysm while EVAR requires yearly surveillance for endoleaks and device migration. During the first postoperative year, CTA – the current gold standard – at 1 month and 1 year is recommended unless an endoleak is detected. If a type II endoleak is discovered, CTA at 6-month intervals is suggested. In case of no endoleak and of no aneurysm sac expansion, yearly duplex ultrasound can be considered sufficient.

The best way to keep the situation under surveillance, in terms of imaging modality and follow-up time, has been discussed for long and is still being discussed.

After stent-graft implantation contrast-enhanced CT is generally considered the gold standard in patients' follow-up because it has shown high sensitivity to endoleak detection, the most frequent complication of EVAR, with a sensitivity of 92% and specificity of 90%. In addition, CTA allows a clear picture of graft integrity and morphologic evaluation of the aneurysm.

The European Collaborators on Stent/graft Techniques for Aortic Aneurysm Repair (EUROSTAR) Registry recommends a follow-up consisting of CTA examinations performed at 1, 6, and 12 months after the procedure and subsequent annual investigations, unless complications develop. However, the lifelong requirement for patient surveillance accentuates certain drawbacks of CT angiography, including ionizing radiation burden and nephrotoxic contrast agent load. As recently reported, and also suggested by the American College of Radiology, the dose of unnecessary radiation needs to be reduced in diagnostic imaging.

Following these issues and using safer and more reliable new generation stent-grafts can surely optimize the follow-up protocol after EVAR.

Several authors have pointed out the usefulness of other imaging techniques, such as magnetic resonance angiography (MRA), color duplex ultrasound (CDUS) and contrast-enhanced ultrasonography (CEUS).

MR examination is based on the use of T1 and T2 weighted imaging followed by a contrast enhanced sequence using either standard Gadolinium contrast agent or blood pool agents. Advantages are the absence of radiation and contrast-induced nephrotoxicity, disadvantages are higher costs and artifacts due to the metal skeleton of the stent-graft. Moreover, nephrogenic systemic fibrosis can be induced by the use of Gadolinium contrast agent.

Recent studies have demonstrated that MR shows a sensitivity higher than CTA in the detection of endoleaks.

A number of articles in the literature has indicated that color duplex ultrasound (US) can be used for post-EVAR surveillance. Ultrasound follow-up regimen speaks of decreased cost, lower radiation exposure and similar rates of endoleak detection as benefits of ultrasound versus CTA.

Non-contrast-enhanced US correlates with CT angiography in determining a change in AAA sac size over time but it shows low sensitivity and positive predictive value in endoleak detection when compared with CTA.

Sonographic contrast agents enhance the capability of color duplex imaging to detect endoleaks. Second-generation contrast agents consist of stabilized microbubbles of sulphur hexafluoride gas, which is eliminated through the respiratory system, surrounded by a phospholipid shell. These microbubbles improve blood flow echogenicity by resonating with low-intensity US which increases backscatter and consequently the detected signal. Bubble destruction during imaging is minimized and real-time scanning is possible for several minutes. No adverse events, such as nephropathy, have been reported.

The clinical applicability of US investigation may be limited by operator-dependent variability as well as by patient-related limitations such as obesity.

In the detection of endoleaks the sensitivity of contrast-enhanced ultrasound (CEUS) can considerably vary from 42.9% to 97% presumably because results depend not only on the skill and experience of the operator but also on the patient's habitus and level of cooperation.

CEUS imaging significantly improves the diagnostic performance of CDUS imaging in endoleak detection in patients with endovascular aortic stent grafts. Its sensitivity and negative predictive value are similar to multislice CTA (97.5% and 97.3%, respectively). Its specificity and accuracy are satisfactory (81.8% and 89.3%) but not ideal because the false-positive rate is nearly 10%.

The use of US as the preferred imaging modality in the follow-up of

patients can reduce the biologic hazards associated with CT angiography. First, the EVAR procedure and lifelong annual CT follow-up carry, in fact, a substantial ionizing radiation burden: patients receive a total effective dose of approximately 60 mSv within the first year after EVAR, taking into account procedure-related fluoroscopy and follow-up CT angiography. The mean effective dose of CT angiography for EVAR follow-up is approximately 15 mSv. The stochastic risk of a fatal radiation-induced tumor is estimated to be 5%/Sv radiation. Therefore, the risk of cancer induction of one CT angiography procedure is approximately 1 in 1,500, indicating the relevance of reliable alternatives to annual CT angiography for post-EVAR follow-up particularly in younger patients. Second, CT angiography requires the administration of iodinated contrast agents, which are associated with nephrotoxic effects. Renal dysfunction is a comorbidity found in 80% of patients with aneurysms and is the most important risk factor for contrast agent-induced nephrotoxicity. No major side effects, including nephrotoxic ones, have been reported for US contrast agents.

To reduce false-positive diagnoses an accurate baseline US examination before contrast medium injection should be performed, mainly to assess the morphology of the aneurysmal sac.

Recent data suggest that CEUS imaging is more specific than CTA in endoleak classification thanks to longer duration of enhancement, lack of metallic artifacts and angio-dynamic evaluation of the leak during the dynamic phase.

On the other hand, CEUS imaging has also some limitations. Patient's habitus (obesity) and bowel gas can interfere with imaging, US results are operator-dependent and good quality images presume training and specific skills.

As CTA provides superior information related to graft anchoring and integrity, aneurysm morphologic changes or visceral vessels patency (renal arteries), CEUS could replace CTA at 6-month follow-up and annually thereafter.

In fact the rationale of post-EVAR follow-up at 1-month and 12-month follow-up should be not only to detect endoleaks but also to evaluate intraprocedural and periprocedural complications related to stent graft anchoring and visceral vessels patency as well as postprocedural complications related to stent-graft migration and integrity, visceral vessels patency and aneurysm morphologic changes.

On the basis of this opinion, a suggested follow-up after EVAR is based on CTA at 1 and 12 months and CEUS imaging performed at 6 months and annually thereafter, if no complications are detected.

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Special Session
Colorectal hepatic metastases

303.1

Techniques and results of ablation in liver disease

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Learning Objectives:

1. To describe techniques and devices used in ablation of colorectal hepatic metastases
2. To discuss indications and results of ablation in hepatic metastases
3. To understand the role of ablation with respect to surgical and medical treatments in colorectal liver metastases

The liver is a common site for primary malignancy and hematogenous metastasis. Although surgical resection of metastatic hepatic tumors is generally regarded as first-line therapy, the majority of patients with hepatic malignancy have disease that is not amenable to surgical resection because of tumor location, poor hepatic reserve, or medical comorbidities. This has led to significant interest in the development of nonsurgical image-guided therapies, including radiofrequency ablation (RFA). Percutaneous thermal ablation is an emerging treatment option for many tumors in patients which are no candidates for conventional treatments – mostly surgical resection. During a thermal ablation procedure, an electrode, antenna or an applicator with a small diameter is put into the target tumor under imaging guidance. Most often CT fluoroscopic guidance is used; however, ultrasound and even MRI guidance is applied by different groups. Beside radiofrequency, there are various energy sources which can heat biological tissues. Microwaves, laser light and ultrasonic waves are the most common other techniques used for tumor destruction. During RF ablation, alternating electrical current of a high frequency (~500 kHz) produces ionic agitation and therefore frictional heating around the interstitial electrode. In monopolar systems skin surface electrodes (ground pads) has to be used to complete the electrical circuit, while in bipolar systems both poles are on the same needle. Depending on the time, the current is applied, tissue temperatures can rise to cytotoxic levels (above 60 °C) and can create ablation volumes of up to 5 cm in each direction. RF ablation is used for nearly 20 years, with good results for local tumor control, extended survival and low complication rates. However, there are some drawbacks in RF. The ablation volume is hampered by local blood flow (so called heat sink effect) and high electrical impedance tissues. The advent of microwave ablation can alleviate some of these problems by producing faster, volumetric heating. In microwave ablation the heat is caused by a fast rotation of water molecules and is therefore less influenceable by large vessels. To create larger or conformal ablations, multiple microwave antennas can be used simultaneously while most RF systems available on the market require sequential placement, which limits their efficiency. Early

experiences with microwave systems suggest efficacy and safety similar to, or better than RF devices. An alternative to heat is to freeze tumors. The so-called cryoablation freezes the target tissues to lethal levels (-20 to -40 °C). Percutaneous cryoablation has been shown to be effective against RCC and many metastatic tumors, particularly colorectal cancer, in the liver. Thermal tumor ablation can be performed at open surgery, laparoscopy or using a percutaneous approach. When performed percutaneously, the ablation procedure relies on imaging for diagnosis, planning, applicator guidance, treatment monitoring and follow-up. Ultrasound is the most popular modality for guidance and treatment monitoring worldwide, but computed tomography (CT) and magnetic resonance imaging (MRI) are commonly used as well. Contrast-enhanced CT or MRI are typically employed for diagnosis and follow-up imaging.

303.2

Techniques and results of Irinotecan drug eluting beads

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Learning Objectives:

1. To present technical details of chemoembolization with Irinotecan
2. To discuss indications of chemoembolization with Irinotecan in colorectal metastases
3. To analyse results from the literature and from personal experience

No abstract available.

303.3

Radioembolization for colorectal metastasis

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Learning Objectives:

1. To describe the main technical aspects of radioembolization of colorectal metastases
2. To analyze the indications and the role of radioembolization with respect to other therapies
3. To report the results from the available literature and personal experience

Radioembolisation of colorectal liver metastases involves the endovascular delivery of microspheres labeled with Yttrium 90 into the hepatic arterial circulation (usually via a radiologically inserted arterial catheter).

Loco-regional therapies are attractive in the treatment of colorectal liver disease. It is unclear why liver is often the only site of metastatic disease. Any treatment that relies totally on imaging for targeting can only be considered a local treatment. Surgery, external beam radiotherapy and radiofrequency ablation are local treatments applicable only to visible disease. The proportion of micrometastases increases disproportionately (? exponentially) with increase in number of visible metastases. Even in the best surgical cases (<3-4 metastases) patients are likely to relapse and usually in the liver. Even with the addition of chemotherapy, in the best operable cases, 50% of patients relapse by 18mths and usually in the liver (1). Thus, combination treatments are attractive particularly if they combine systemic treatments with loco-regional therapies (hepatic arterial chemotherapy, drug-eluting beads, and radioembolisation).

External beam radiation therapy has an established role in the treatment of primary rectal carcinoma where it has a synergistic effect with chemotherapy. Normal liver tissue, however, is very sensitive to radiation. Radiation-induced liver disease occurs 3 weeks to 3 months post-irradiation and presents with detoriation in hepatic function and ascites. Thus, targeted delivery of radiation therapy is mandatory, external beam or the endovascular injection of radiolabelled particles.

Tumour angiogenesis results in increased blood flow to liver tumours. Tumours greater than 2cm in diameter obtain 80% of their blood supply from the hepatic artery. Intra-arterial injection of radiolabelled microspheres means that they are preferentially deposited in the tumour microvasculature. Yttrium emits β radiation with limited penetration. Thus, high radiation doses to liver tumours of the order of 200Gy are achieved whilst limiting the dose to surrounding normal liver (order of 20Gy) (2).

Suitable patients have unresectable liver disease, no or stable/limited extra-hepatic disease and normal liver, renal and haematological function.

Preparation prior to treatment involves cross-sectional imaging, Positron Emission Tomography (PET) studies and visceral angiography to assess and prepare the hepatic arterial circulation. The arterial circulation may require manipulation to allow safe delivery of the radiolabelled material. Awareness of the arterial anatomy variations is prerequisite (3, 4). Radiolabelled macro aggregated albumin is injected at this time to allow a nuclear medicine scan to be performed to measure the liver to lung shunt. A shunt over 20% precludes treatment. Injection of the therapeutic material usually takes place a week later. The dose delivered depends on the shunt study and the degree of liver involvement. Following the therapeutic injection a further Nuclear Medicine scan is performed to assess the Bremsstrahlung radiation emitted by the inter-reaction between the β radiation and the liver tissue to obtain an indication of the anatomical distribution of the injected material.

Potential complications include hepatic failure/portal hypertension, pancreatitis, pneumonitis, gastro-intestinal ulceration or bleeding, cholecystitis, infection/abscess. Radiation dermatitis in a peri-umbilical distribution is possible if microspheres get deposited in this anatomical area via a patent falciform artery.

High risk patients are those with limited hepatic reserve, high or low tumour load, previous liver resection, previous biliary intervention or endovascular therapy. Increased toxicity is potentially possible with co-existent treatment with certain chemotherapeutic agents (Capecitibine. Gemcitibine).

Assessment of response is with cross-sectional imaging and PET. Tumour response can be difficult to assess on cross-sectional imaging. PET appears to provide a more sensitive indication of response (5).

Best results appear to be obtained in conjunction with chemotherapy (6). Response on PET imaging is also an indicator of survival (7). Improved survival or disease control (time to progression or objective response rates) have been demonstrated in the first line setting (6, 8, 9), after second or third line chemotherapy (10, 11) and in the salvage setting (7, 12, 13). Even in advanced disease it can be possible to downstage patients so that they become resectable (9, 12).

Further, larger randomised studies are in progress. The FOXFIRE study is a randomised phase 2 design of radioembolisation in conjunction with chemotherapy (Oxaloplatin) against chemotherapy alone.

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Disclosure

Have acted as a medical consultant for SIRTEX Medical manufacturer of SIR-spheres the therapeutic material used in radioembolisation.

303.4

Combination therapy

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Learning Objectives:

1. To describe synergies in interventional approaches in colorectal liver metastases
2. To analyse the results of trials using combination strategies
3. To understand the role of combined therapies in the management of colorectal liver metastases

Introduction

Colorectal cancer (CRC) is one of the most common causes of cancer death in the Western world. In the case of colorectal cancer metastatic disease, the liver is the only metastatic site in 20%-30% of patients. Therefore, the liver involvement becomes a life-threatening factor. Surgical resection has long been considered the only treatment able to offer prolonged survival to patients with hepatic tumors. Unfortunately many patients are not candidates for surgery because of the extent and/or distribution of the malignancies or the underlying chronic liver disease. The role of image-guided locoregional therapies in the management of patients with liver cancer has vastly spread in the last decade. Such therapies, which rely on imaging guidance for tumor targeting, include various percutaneous and catheter-based ablative techniques. Radio-frequency thermal ablation (RFA) produces a coagulative necrosis via an alternating high-frequency electric current, which is delivered through an electrode placed in the centre of a lesion. However, RFA is inherently limited by the volume of tumor that can be effectively ablated. In small lesions (<3 cm), complete necrosis can be achieved in more than 80% of patients, but local failure rates increase rapidly as the tumor diameter exceeds 3 cm. For lesions with a diameter between 3 and 5 cm, the percentage of complete necrosis varies between 50 and 70%. The inability to reliably creating adequate volumes of coagulation necrosis reduces the technical indications for RFA in treating large hepatic tumors. The cooling effect coming from the liver blood flow (the so-called "heat sink effect") usually affects the radial heat distribution, reflecting the biophysiological limitations in achieving large volume of heat-induced coagulation necrosis. Liver neoplasms, both primary and metastases, are supplied almost entirely by the hepatic arteries, and the abundant arterial blood flow within and outside tumors, leading for the cooling effect, may reduce the effectiveness of RFA in treating large tumors. Several Authors have been able to increase RF-induced coagulation necrosis volume by occluding blood flow to the liver during ablation procedures in animal models. Transcatheter arterial embolization (TAE) consists of the intrarterial administration of embolic microparticles in order to obtain the blood flow shut down. TAE may therefore reduce hepatic arterial blood flow, attenuating the heat sink effect during liver RFA. Recently, many clinical studies have shown that combination of RFA and TAE is effective on large hepatocellular carcinoma (HCC). However, current literature is mainly focused on HCC rather than on liver metastases.

Our 5-year experience at European Institute of Oncology demonstrated that combination of TAE (performed with very-small spherical microparticles) and percutaneous RFA, both performed during the same session, is really feasible, well tolerated and effective even in treating patients affected by liver metastases technically or clinically unresectable.

Material and methods

From May 2006 to April 2011, 41 patients affected by single or multiple (not more than two stable lesions) unresectable liver lesions underwent a combined treatment with TAE followed by RFA, in the same session, for a total of 55 treated lesions. Among these lesions 17 were metastases from colorectal cancer (size ranged between 18 and 70mm- average 35mm) in 16 patients.

All cases were previously discussed within a dedicated tumor board. Patients previously received chemotherapy, and in some cases multiple liver surgical resections and developed progressive liver only disease not eligible for further surgery.

Preliminary routine physical examination, laboratory tests and image studies including unenhanced and contrast medium-enhanced three-phase Computed Tomography (MDCT) were performed before treatment in all patients.

All interventions were performed under general anaesthesia. With right transfemoral artery access, superior mesenteric and hepatic arteriography was obtained, in order to assess all the arteries feeding to the tumor. After a stable selective catheterization of tumor feeders was obtained, small calibrated (100 m) microspheres (Embozene^{TM}; Color-Advanced Microspheres Celonova BioSciences) were injected until blood flow was arrested. Then percutaneous embolization was performed by mean of RFA multitined expandable electrode (Le Veen needle) sized according to tumor size and shape. Percutaneous electrodes were then connected to the generator (RF 3000, Boston Scientific) and RF energy was applied till roll-off was acheived.

In two patients, after TAE, underwent RFA ablation under ultrasound (US) guidance within the angio room; two patients underwent TAE in the angio-room, then were transferred in the operating room, where RFA was performed with laparoscopic approach under US guidance; seventeen patients were treated in a dedicated CT room, using simultaneously a CT scan (Hi-Speed; General Electric) coupled with a portable digital C-arm (Moon Ray; Simad). In these cases TAE was performed by inserting the microcatheter into feeding arteries under fluoroscopy, then CT scans were acquired during intrarterial contrast media injection, in order to confirm the appropriateness of the catheter position for the right embolization. Again in these cases the RFA needle was inserted under US guidance, and its correct position was confirmed by CT. The day after the interventions, all patients underwent a MDCT scan, in order to assess preliminary results. Once discharged, patients were evaluated both clinically and with MDCT on regular basis at 30 days, three months, and every six months after treatment.

The early treatment efficacy was defined by assessing the extension ablated area. Complications were classified according to the Society of Interventional Radiology (SIR) Standards of Practice.

Results

Technical success, intended as the completion of both TAE and RFA, was achieved in all patients. Non-enhancing hypodense areas at MDCT, performed 24 hours after treatment, ranged from 37 to 104 mm in maximum axial diameter, measured at the corresponding MDCT slide of the pre-treated lesion maximum diameter. Safety margins, calculated as the difference between the maximum diameter after and before treatment divided by two, MDCT images, ranged from 2 to 30.5 mm (average 16 mm). Follow-up (MDCT) average is 19.6 mos. No patients have been lost at follow-up. Complete response (CR) intended as the complete devascularization at MDCT follow-up controls of the treated lesions has been obtained in all patients, in a maximum follow-up period of 12 months. Indeed, in a patient, with a single CRC liver metastasis, at one year follow-up MDCT, tumor relapse was observed. One patient died six months after treatment for an unusual neurologic, Alzheimer's like, disease induced by previous chemotherapy. Three patients developed extra-hepatic disease during follow-up, and they are under

chemotherapy. Nine patients affected by liver metastases are disease free after treatment with a follow-up ranging from 1 to 32 months.

Two major complications have been observed: one sub-capsular hematoma and a biliary injury.

Discussion

Surgery is considered the only treatment that offers the prospect of cure for CRC liver metastases. Until recently, only far less than 20% of these patients were considered suitable for attempted curative resection; the remaining patients being offered palliative and symptomatic therapies.

Thus in very well selected patients, new forms of minimally invasive treatments aimed to improve survival are needed. Promising minimally invasive techniques include laser-induced thermotherapy, RFA, microwave ablation, or cryoablation.

When compared with other ablative techniques, RFA emerged as the best option because of its better overall survival rate and its lower morbidity and mortality. Indeed, RFA is very effective in small tumors (i.e. diameter of 3 cm or less), but in intermediate tumors (i.e. diameter of 3 to 5 cm) the percentage of complete necrosis falls down to 50% to 70%. The main reason leading to these poor results in intermediate and large lesions is probably the so-called "heat sink effect", i.e. the cooling effect of parenchymal blood flow, which reduces the lethal heat diffusion to the periphery of the lesion.

Based upon many other similar published studies, the hepatic artery has long been considered the predominant source of blood supply for CRC liver metastases. However, targeted therapies based on arterial blood supply to the tumor have been usually disappointing. Local tumor control is rare, and the impact on survival is minimal. Recurrences eventually occur at the tumor periphery.

In some series reporting the treatment of huge HCC, it has been well demonstrated how the association of TAE/TACE with RFA increased dramatically local results achieving larger ablated areas and reducing peripheral recurrence. The arterial blood flow shut down to the liver area, where the lesion is located, may probably reduce the "heat sink effect", allowing for a better heat diffusion in the liver parenchyma previously embolized. The synergistic effect of the two treatments may lead for a bigger treated volume of the embolized area with a shorter exposure time to RFA and a possible reduction of the applied energy, as already demonstrated in animal models.

In our experience, we observed huge complete treated areas after the combined approach in all patients. MDCT non-enhanced hypodense areas were always biggest than the diameter of the employed electrodes. Our goal was to obtain a disease free margin around the treated lesion properly as recommended surgery resection. Indeed, conventional teaching advocates a margin of at least 10mm clear of microscopic disease and this approach is supported by the results from several series which document a statistically significant poorer overall and disease-free 5-year survival in patients with margins less than 10mm. Authors demonstrated that there is no significant difference in patient survival rates up to 10 years between patients with resection margins of 10mm or greater and those with margins of just 0-9 mm. Recently, a 2mm minimum margin has been proposed but in appropriate circumstances an even narrower margin may be acceptable.

In our series we obtained complete devascularisation of all the treated lesion, with an average safety margin of 13,6 mm at MDCT. The shape of non-enhanced area at MDCT, as a result of heat diffusion in both the lesion and its surrounding parenchyma, reflects the morphology beads distribution during TAE.

In our experience we did not use any drug and TAE has been carried out only with very small microparticles (100 mm); RFA was then performed immediately after TAE, in order to avoid that hypoxic effect could be reduced by the opening of collateral feeding arteries to the lesion.

Conclusions

Results from our series demonstrate that single-session combined therapy is an effective and safe treatment for liver metastases not available for surgical resection. This approach provided good local tumor control and did not increase complications. Additional advantages of the single-session therapy include the ability to treat tumors that are not feasible for stand-alone RFA. However, our experience, like the series reported in literature, is limited to few patients and further prospective studies should verify efficiency, safety, and cost-effectiveness of single-session combined therapy for liver metastases.

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Special Session
Ongoing research in IR

304.1

Intra-arterial delivery of stem cells: a new treatment for chronic diseases

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Learning Objectives:
1. To understand the potential of stem cell therapy
2. To explain the technique and indication of stem cell delivery
3. To overview recent results of stem cell therapy and future indications

Background: Stem cells have a remarkable potential to develop into many different cell types in the body. When a stem cell divides, each new cell has the potential to either remain a stem cell or become another type of cell with a more specialized function, such as a muscle cell, red blood cell, or brain cell, among others. The broad categories of stem cells in clinical or experimental use include embryonic stem cells, those derived from blastocysts, cord blood cells and adult stem cells, which are found in adult tissues. As these grow in damaged, hypoxic tissues, they gradually become stimulated by the surrounding cells and environment to become new cells similar to those cells they come in contact with. As they grow and become specialized, they are able to transform into new blood vessels, neurons, muscle, eye, pancreas, kidney, liver, bone marrow among others, depending on the local tissue influences. The animal and human studies using human umbilical cord or autologous bone marrow-derived stem cell treatments in various clinical disease states have shown encouraging early results.
Purpose: We have evaluated the safety and efficacy of endovascular delivery of bone marrow-derived stem cells in treating patients with disease states, including critical limb ischemia, diabetes mellitus, cerebral palsy, chronic renal failure, muscular dystrophies, dilated cardiomyopathy and spinal cord injury, among others.
Materials/Methods: We treated 353 patients (245 males, 108 females), mean age, 37 (1-72) years over a 40-month period. Ethical clearance from Institute board and informed written consent were obtained. The group included patients with critical limb ischemia, cerebral palsy, chronic renal failure; muscular dystrophies, dilated cardiomyopathy, diabetes mellitus and spinal cord injury, in all of whom conventional medical and/or surgical management had failed to provide relief of symptoms or was contra-indicated. Bone marrow aspiration was done from the iliac crest from the individual patient. The stem cells were isolated under aseptic conditions and were injected into the same patient on the same day. Each patient received injections of a pre-determined dose of stem cells intra-arterially at the site of disease, such as the occluded arterial segment in critical limb ischemia, in the pancreatico-duodenal artery in diabetes mellitus, in the spinal artery in spinal cord injury, in the coronary artery in dilated cardiomyopathy, in the extremity artery in muscular dystrophy, in the renal artery in chronic renal failure and in the distal internal carotid artery in cerebral palsy in addition to the optimal medical and/or surgical treatment. Follow-up was done at 1, 3 and 6 months with pre-determined end points. As an example, the end-points in patients with critical limb ischemia included healing of ulcer, relief of rest pain, safety of treatment, pain free walking distance, imaging evidence of collateral vessel formation, and quality-of-life assessment.
Results: All procedures were technically successful, without complication. No problem was encountered at the site of bone marrow aspiration, at the site of arterial access or at the site of stem cell injection in any patient. In addition, no systemic side-effect of this therapy was observed in any patient, thereby, establishing the safety of this treatment method, irrespective of the underlying disease state or the site of stem cell delivery. All patients were followed for a minimum period of 6 months for adverse effect evaluation. Clinical outcomes were variable in different disease states. As an example, clinical and angiographic improvement was seen in 78% patients with critical limb ischemia with avoidance of amputation in most situations. Improvement in control of diabetes was observed in majority of patients with a significant decline in the dose of insulin required for control of blood sugar levels in the short term. However, the response was not encouraging in patients with muscular dystrophy and variable in patients with chronic renal failure and cerebral palsy. It was observed that patients under 12 years of age with cerebral palsy responded better to this therapy than the older patients. Beneficial response to this therapy was also seen in some patients with chronic neurological deficits due to spinal injury.
Conclusion: Intra-arterial delivery of bone-marrow derived stem cells is safe irrespective of its site of injection and produces no deleterious effects at the site of aspiration or injection in the intermediate term. This form of therapy has the potential to produce striking clinical response in some disease states, such as critical limb ischemia, diabetes mellitus and chronic spinal injuries, even in situations where conventional medical surgical therapies have failed or are contra-indicated. It remains to be established whether the immediate clinical benefit is sustained over time at long-term follow up.

304.2

Anti-angiogenic drugs and resorbable microspheres: what is the promise?

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Learning Objectives:
1. To overview modern methods of cytotoxic therapy in IR
2. To explain differences between pharmacologically and mechanically induced apoptosis
3. To report on recent studies and results in antiangiogenic therapy and resorbable microspheres

The fundamental role of angiogenesis in tumor progression was first suggested by Folkman et al in a classic study describing that tumors cannot grow beyond 1 or 2 mm without the formation of new blood vessels. This complex process facilitates tumor progression and eventually tumor metastatic spread. Several factors, including tumor hypoxia, growth factors, cytokines, oncogene activation, and other mutations interact to stimulate angiogenesis. Therefore, targeted inhibition of angiogenesis can be achieved at any of these levels with various treatments designed to bind growth factors with monoclonal antibodies (mAbs), inhibit the downstream signaling from tyrosine kinase receptors, or disrupt the interaction between proliferating endothelial cells and matrix components.
Theoretically, following anti-angiogenic treatment, the tumor vasculature may undergo morphologic changes, whereby immature blood vessels are pruned, blood vessel tortuosity and dilation decrease, and a closer association between pericytes and endothelial cells is induced. As a result, tumor blood vessel leakage, vascular permeability, and interstitial fluid pressure decrease. If chemotherapy is administered after anti-angiogenic drug-induced vascular changes, it can be quite advantageous since it would result in increased intra-tumoral drug delivery as well as an increase in the number of tumor cells that are sensitive to chemotherapy. A recent study showed that there is improved penetration of the chemotherapy into the tumor upon vessel normalization.
Until recently, there was no standard systemic therapy for unresectable hepatocellular carcinoma (HCC). The introduction of anti-angiogenic therapy such as the multikinase inhibitor sorafenib has

changed the management algorithm of patients with advanced disease. As antiangiogenic drugs are generally cytostatic rather than cytotoxic, combinations involving conventional cytotoxic chemotherapies with anti-angiogenesis drugs may be useful for maximizing therapeutic efficacy. Moreover, given that HCC presents as hypervascular tumor(s), combining therapies that inhibit angiogenesis on a molecular and mechanistic level seems particularly attractive. Finally, given the fact that TACE directly causes angiogenesis through activation of the hypoxia-mediated pathway (hypoxic changes in the tumor directly up-regulate angiogenesis via VEGF) thereby potentially limiting its efficacy, it was logical to combine TACE with agents that directly counteract this angiogenic activity. The administration of anti-angiogenic therapy in conjunction with locally delivered chemotherapy can help improve penetration of the chemotherapy into the tumor upon vessel normalization.

One of the most critical and specific factors for blood vessel formation is vascular endothelial growth factor (VEGF). VEGF is an endothelial cell mitogen that regulates proliferation, permeability and survival of endothelial cells through inhibition of apoptosis. HCC is one of the most vascular solid cancers, associated with a high propensity for vascular invasion and a high expression of VEGF. Upregulation of VEGF has been correlated with increased tumor invasion, intratumoral microvessel density, disease recurrence, and poor prognosis. One approach to inhibit angiogenesis is to use monoclonal antibodies directed at VEGF.

Bevacizumab is such a humanized monoclonal antibody that through its binding to VEGF prevents the interaction of VEGF with its receptors on the surface of endothelial cells. When unblocked, this interaction may lead to endothelial cell proliferation and new blood vessel formation. VEGF expression is known to play an important role in the development of HCC and the degree of its expression is reported to be associated with tumor size and histologic grade. Several studies have explored the potential therapeutic role for bevacizumab in patients with HCC. The results of the first US Phase II study combining anti-angiogenic therapy with TACE were recently presented. Tumor response and safety of concurrent bevacizumab and TACE were evaluated in 26 patients with unresectable HCC (ECOG status 0-2, Childs-Pugh stage A-B, BCLC B-C). These patients received bevacizumab 10 mg/kg every two weeks, in addition to TACE, in a 6-week cycle (on average, 1-3 cycles). Primary endpoint was tumor response, assessed by MR imaging at baseline, and 3 weeks post-TACE, using size (RECIST), and contrast-enhancement (EASL). Secondary endpoints included safety and survival. On follow-up imaging, index lesions had a mean decrease in size of 13% ($p < 0.0005$). Using RECIST, eight (35%) achieved partial response, fifteen (65%) had stable disease. Targeted tumors demonstrated mean decrease in contrast enhancement of 69% ($p < 0.0005$). By EASL criteria, fourteen (60%) patients had complete or partial response, and nine (39%) had stable disease. The disease control rate was 100% using either criteria while undergoing treatment. Median overall survival was 13.5 months with 10 patients still alive. Fifteen (58%) patients experienced grade 3/4 toxicities possibly related to either therapy with most toxicities resolving within 2 months of therapy. Overall, the combination therapy of bevacizumab and TACE was reasonably well tolerated in unresectable HCC patients, with 100% disease control rate by imaging criteria and median overall survival of 13.5 months.

The rationale for combining anti-angiogenic drugs with TACE is abundantly clear. If this combination is proven to be safe and found to increase time to tumor progression, it is very likely that it will become common clinical practice. The data have so far been promising. It should, however, be stressed that further research is necessary to demonstrate a clear survival benefit. This new prospective in the management of patients with unresectable HCC has opened the door for translational studies in order to identify potential predictive markers of response to this combination therapy and guide patient selection. By the end of 2011, we should have the results of several clinical trials that are currently underway that will hopefully lead to a more effective treatment for this highly lethal cancer.

Disclosure

Consultant: Biocompatibles, Bayer HealthCare, Guerbet, Nordion Grant Support: Biocompatibles, Genentech, Bayer HealthCare, Philips Medical,Nordion, Context Vision, CeloNova and RSNA. Founder and CEO PreScience Labs, LLC.

304.3

Bioabsorbable and cell-coated stents

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Learning Objectives:

1. To describe the need and potential benefits of bioabsorbable and cell-coated stents
2. To explain physical prerequisites of bioabsorbable and cell-coated stents and mechanical considerations
3. To report on recent results and explain the possible role of bioabsorbable and cell-coated stents in future

Stent implantation has revolutionized angioplasty and is well established for coronary and peripheral arteries. Stenting is an effective measure to treat elastic recoil and dissection following balloon angioplasty. As bare-metal stents revealed to create relatively high rates of restenosis due to intimal hyperplasia, the drug-eluting stent was developed. Drug-eluting stents are coated by a thin polymer layer, containing an antiproliferative drug. Gradual release of the drug successfully prevents restenosis, which led to a widespread implementation of this technology. A disadvantage, associated with reduced cell proliferation, is the prolonged ingrowth of the stent mesh into the arterial wall, which, in turn, may be responsible for subacute and late stent thrombosis. At least, late stent thrombosis remains a concern, despite prolonged antiplatelet therapy. In addition, some coating and carrier polymers of drug-eluting stents may cause chronic vessel inflammation. Furthermore, arterial stenting may cause other possible long-term disadvantages. Due to positive remodeling of the vessel a mismatch in diameter might result. Arterial side branches may be partially occluded by stent struts. Consecutive bypass graft surgery may be hindered, especially in stented coronary arteries. Non-invasive coronary artery imaging of the in-stent lumen by computed tomography and magnetic resonance imaging is often impaired due to artifacts.

All that is reason enough to inspire R&D for searching for better solutions.

In order to address the initial advantages of a metal/polymer-coated stent, regarding sealing of intimal dissections, prevention of elastic recoil and additional delivery of pharmacological agents to prevent restenosis in the first six months, and in order to avoid the above mentioned medium and long-term shortcomings, the concept of a bioabsorbable stent appears attractive. Bioabsorbable stents might provide all of the features of a metallic stent but disappear from the artery once "their job is done", obviating the need for long-term antiplatelet therapy. In recent publications the term "bioabsorbable stent" is eventually replaced by "bioresorbable scaffold", which might be more appropriate and better differentiates these new approaches from conventional stent technology.

Requirements of an ideal bioabsorbable stent (or bioresorbable scaffold) are adequate radial force to prevent early elastic recoil, a certain scaffolding ability to avoid constrictive late vessel remodelling and restenosis, biocompatibility of material to prevent vessel inflammation, and especially for coronary application, reduction of artifacts, to allow for noninvasive imaging modalities such as CT or MRI. In addition, the stent or scaffold may also be used as a vehicle to deliver antiproliferative agents to suppress neointimal hyperplasia.

Current bioabsorbable stents/bioresorbable scaffolds are made

from polymer or magnesium. Most polymeric bioabsorbable stents are composed of poly-L-lactic acid (PLLA). In comparison to metallic stents, the radial strength of PLLA is lower and may result in early recoil post-implantation. The bioabsorption rate is relatively slow and may still result in restenosis. In addition, PLLA stents are radiolucent, which may impair accurate positioning using fluoroscopic guidance. In contrast, magnesium stents have higher radial strength due to their favourable Young's modulus.

Several bioabsorbable stents/bioresorbable scaffolds are currently undergoing preclinical and clinical trials, following the pioneering Igaki-Tamai PLLA Stent. Among them are the Abbot Vascular everolimus-eluting bioresorbable vascular scaffold (BVS, Abbott Vascular, Santa Clara, CA, USA), the REVA Poly (Iodinated Desaminotyrosyl-Tyrosine Ethyl Ester) Carbonate Stent (REVA Medical, Inc, San Diego, CA, USA), the IDEAL Poly (Anhydride Ester) Salicylic Acid Stent (Bioabsorbable Therapeutics, Inc. Menlo Park, CA, USA), and, as the only metal stent concept, the balloon-expandable AMS-1, -2 and -3 (Biotronik, Berlin, Germany). The AMS-1 is composed of 93% magnesium and 7% rare earth metals. The newest generation (AMS-3) comprises a modified magnesium alloy, reduced strut thickness, and a bioresorbable matrix for the controlled release of an antiproliferative drug.

Preliminary results indicate clinical advantages of the new technology over currently available drug-eluting stents, but this has to be confirmed in further investigations. Furthermore, arteries treated by bioabsorbable stents have demonstrated the recovery of the responsiveness to vasoactive agents such as nitroglycerin. However, a potential shortcoming of bioresorbable polymer scaffolds may be the occurrence of strut fractures.

The cell-capture stent represents an alternative approach to overcome the shortcomings of the drug-eluting stent technology. After the discovery of endothelial progenitor cells (EPCs), the GenousTM EPC capture stent (OrbusNeich, Florida, USA) was developed which provides a proprietary coating, containing antihuman CD34 antibodies. These antibodies are supposed to capture circulating EPCs, aiming at rapid recellularisation of the artificial stent surface. Nevertheless, the porous nature of stent structures is still enabling the ingrowth of myofibroblasts to the luminal side.

A novel concept of a cell-coated stent ("BioStent") is based on the complete embedding of a self-expanding stent into a tissue engineered vascular graft. The aim of this concept is the complete exclusion of the thrombogenic atherosclerotic plaque by a solid tissue layer on the one hand and the luminal coating with a functional endothelial cell layer on the other hand to guarantee a physiological hemocompatibility and to protect the underlying cell layer with regard to uncontrolled cell proliferation.

The creation of the BioStent follows the principles of tissue engineering and starts with the harvesting of autologous tissue (fatty tissue, venous tissue, e.g. great saphenous vein). The endothelial cells and the vascular smooth muscle cells (vSMC) are cultured to a sufficient number. In parallel, the components for an autologous fibrin-gel are isolated from the patient's blood. An injection moulding technique based on a cell suspension of vSMC in fibrin-gel allows the complete integration of the self-expanding stent structure into a viable tissue, followed by a luminal endothelial cell lining. After a pre-conditioning of the seeded cells within a custom-made bioreactor system at physiological flow, pulse and pressure conditions, the newly formed tissue withstands the force of crimping and release without a significant damage of the endothelial layer.

The BioStent concept presents a platform technology. By exchanging the embedded and luminally seeded cell types, e.g. the combination of fibroblasts with urothelial cells for stenting of ureter and urethra, the use of respiratory epithelium for endo-bronchial stenting or the lining with mucosa cells for a gastrointestinal application. Due to the production time of up to 6 weeks the BioStent is not available for emergency interventions. The autologous cell lining is strictly limited to an individual patient. Nevertheless, the cell-coated, "personalized" stent structure offers a novel opportunity for the treatment of lesions with high risk of restenosis in the future.

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Disclosure

Co-inventor of BioStent (Participation in patent rights)

304.4

Islet cell transplantation

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Learning Objectives:

1. To summarize the pathophysiological basics of diabetes
2. To explain the indications, materials and mechanisms of percutaneous islet cell transplantation
3. To report on clinical results of islet cell transplantation and address its role in future

Introduction

Pancreatic islet transplantation (PITx) represents an optional treatment in selected Type 1 diabetic recipients who suffer from hypoglycemia unawareness syndrome. The therapy attracts attention of diabetologists due to minimal invasive approach and low rate of complications in comparison with organ transplantation. Islets suspension is infused through the catheter percutaneously inserted into the portal vein. The aim of the study is to evaluate our radiologic technique with regard to the rate of serious adverse events, patient survival and islet function.

Methods

Islets were isolated from cadaveric donor pancreases, which did not fulfill the criteria for organ transplantation. Organs were perfused

with HTK solution and retrieved from donor with no touch technique. After brief trimming of the organ, two catheters were inserted into the pancreatic duct through the small incision between the pancreatic head and cauda. Distension was made with 150 ml of collagenase/neutral protease. Distended organ was divided into 10-14 pieces and placed into the chamber. After digestion with collagenase in shaking chamber, islets were separated in COBE 2991 using Biocoll continuous gradient. Isolated islets were placed into the transplantation bag with 160 ml of transplantation medium containing 35 IU/kg of heparin.

Radiologic approach

The portal vein was approached percutaneously through right liver lobe using thin needle puncture under local anesthesia and mild sedation. An Accustick system (Boston Sci.) was introduced via peripheral branch of portal vein and a 4 F pigtail catheter was manipulated to the portal vein centrally from its branching and islets were transfused. Portal pressure was monitored continuously during the infusion. In case of portal pressure exceeding 16-20 mmHg, the infusion was stopped and the liver perfused by saline until the pressure dropped back to normal level. After transplantation the catheter was removed and the tract embolized by surgical sponge.

We evaluated patient survival, rate of serious adverse events and diabetes compensation. The follow-up was 12 months. Functioning islets were defined as fasting c-peptide level higher than 0.02 ng/ml. Serious adverse event was defined as event requiring surgery, admission to hospital or prolongation of current stay in the hospital. Diabetes compensation was measured by fasting c-peptide level, HbA_1c value and daily dose of insulin before and 1 year after transplantation.

Results

Since 2005 19 Type 1 diabetic recipients underwent 34 PITx. All recipients were alive at the time of follow-up. We observed 5 severe adverse events (4 bleedings, 1 vasovagal syncope). In two cases of bleedings patients required surgery and laparotomy to evacuate hematoma. All other complications resolved spontaneously. Mean (±SD) fasting c-peptide level increased from 0.02±0.02 to 0.2±2 ng/ml. Mean daily dose of insulin decreased to about one-third of the pretransplant dose (from 37±11 to 15±7 IU). Mean HbA_1c decreased from 7.6±1.8 to 5.3±0.9%. One recipient remained insulin free at the time of follow-up.

Conclusions

In our cohort islet transplantation resulted in significantly better metabolic compensation with HbA_1c near to normal values. None of the recipients suffered from severe hypoglycaemia after transplantation. The therapy is complementary to pancreas transplantation alone and seems to be safe with minimum serious adverse events.

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Special Session
Image guidance and assessment of tumour therapy

305.1

Contrast ultrasound and fusion imaging

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Learning Objectives:

1. To discuss the role of ultrasound and fusion imaging in tumour diagnosis
2. To discuss the role of ultrasound and fusion imaging in tumour therapy
3. To discuss the pros and cons of the current methods

No abstract available.

305.2

Robot-assisted CT guided interventions

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Learning Objectives:

1. To learn about the latest developments in robotic intervention
2. To deliver the techniques and utility
3. To learn about the potential of assisted intervention

Various interventional procedures can be done in the CT room if one can place a needle with precision within the body and many of these procedures have been extensively studied and published. The approaches commonly practiced are free hand technique with or without the use of fluoroscopy. Many radiologists are hesitant to use CT fluoroscopy because of the radiation involved and the free hand technique without the use of fluoroscopy is not very popular with beginners as they warrant a long learning curve to build confidence. Precise and accurate positioning of a needle for any such CT-guided interventions requires the perfect selection of entry site/point on the patient's body surface and accurate calculation and execution of the depth and angle in two planes (orbital and Z axis). Even slight variation in the point of entry or angulations of the needle can result in missing the target point. The patient's respiratory variation adds to the difficulty in getting the needle to the desired point.

These factors result in increased number of needle adjustments and passes to get the needle tip at the desired position in free hand procedures leading to increased tissue injury thereby contributing to increased complications. The more the number of needle adjustments increases the need for additional axial CT image acquisition to check the needle's position. This, in turn, increases the total radiation dose to the patient and also considerably increases the duration of the procedure.

This paper presents the advantages of application of robotics for assistance in medical interventions under CT guidance. Our experience with the robotic system (PIGA CT from Perfint, India) proves its ability to achieve greater accuracy for needle placement on the target point with minimum needle passes and manipulations thereby reducing tissue injury, the total procedural radiation dose and the total duration of procedure.

PIGA CT, Robotic Assistance for CT-guided soft tissue interventions is an electromechanical device with planning station that assist interventional oncologists in needle-based CT-guided interventions like Biopsy, FNAC, RFA, drug delivery in cancer therapy and management of pain and many more innovative patient friendly procedures. The device consists of a planning station that receives the DICOM images from the CT. The clinician can view the CT image and plan for the procedure by plotting the target and entry point through

the tools provided by the PIGA software. The clinician can also choose to target the lesion by entering from a different slice cranially or caudally whenever a Z axis angulation is required. The software indicates the planned trajectory and allows the user to modify or re plan. Once the plan is done, the software automatically calculates the plan parameter including trajectory angle, depth and sends the coordinate value to the robot. On request from the clinician, the robotic arm positions the guide over the patient providing the angulations and entry point such that the clinician can insert the chosen needle though the guide into the patient body. Once the needle is inserted the device can be disengaged allowing the clinician to perform a confirmatory scan before proceeding for the actual procedure.

This paper presents our experience with the robotic device at our institution. The paper also shares the user experience data from different geographies of the world and indicates how the robotic assistance is helpful to the beginners by increasing their confidence level and to the already practicing clinicians to access points thought to be difficult and dangerous by free hand.

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305.3

MRI assessment of necrotic vs. viable tumours

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Learning Objectives:

1. To discuss the clinical value of differentiation
2. To discuss the different techniques available
3. To learn about future imaging potential and developments

Knowledge of tumor response after loco-regional therapies, as thermal ablation and chemoembolization, is crucial for assessing tumor response (1,2). Imaging modalities including computed tomography (CT) and magnetic resonance (MR) imaging have been used to monitor treatment response. A change in tumor size at CT or MR imaging is the accepted criterion for assessing response after chemotherapy, according to Response Evaluation Criteria in Solid tumor (RECIST) (3,4). Target lesions are measured using a single linear summation. These criteria were primarily designed for evaluation of cytotoxic agents that induce cell death. Hence, assessment based on changes in lesion size can be misleading when applied to other drugs or interventional procedures. In the early post-treatment period after loco-regional therapies tumor necrosis does not often result in change in size. In 2000 a panel of experts convened by EASL (European Association for the Study of the Liver) recommended response criteria for hepatocellular carcinoma (HCC) be amended; they proposed to take into account tumor necrosis induced by the treatment rather than tumor size (5,6). Viable tumor was defined as contrast uptake in the arterial phase of CT, MR or contrast-enhanced ultrasound (CEUS). In 2010, the guidelines endorsed by EASL and AASLD (American Association for the Study of Liver Diseases) were adapted and published by a group of HCC experts (7). The proposed amendments to RECIST criteria in the evaluation of tumor response for HCC target lesions are based on lesion enhancement in the arterial phase of imaging modalities. Complete response is defined as the disappearance of any intratumoral arterial enhancement in target lesions. Partial response is considered at least 30% decrease in the sum of diameters of viable target lesions, taking as reference the smallest sum of diameters of viable target lesions. Progressive disease is the appearance of one or more new lesions, as for RECIST. A new lesion can be diagnosed as HCC if it is at least 10 mm in diameter and if it shows the typical imaging pattern in dynamic imaging studies (hypervascularization in the arterial phase with wash-out in the portal or late phase). In a recent study, Authors evaluated loco-regional therapies response with RECIST criteria and with amended criteria; they concluded that RECIST missed all the complete response and underestimated the extent of partial response (8). Further studies are needed to confirm the role of functional and molecular imaging. Advances in MR imaging techniques, that include diffusion MR imaging and apparent diffusion coefficient (ADC) maps, can provide in vivo metabolic information. Recent studies demonstrated that water diffusion can be used to differentiate viable and cellular regions from necrotic area in the tumor, regardless morphologic or dimensional changes. Viable tumors have intact cells that restrict the motion of water molecules, reducing ADC value; on the other hand, necrotic regions allow free diffusion of water molecules and increase ADC value. This additional information could enhance the morphologic findings of baseline and dynamic MR study. Moreover, new classes of antitumor therapy have been developed that have an antiproliferative effect, inducing a delay in tumor shrinkage. Diffusion MR imaging can be promising in this clinical setting as a biomarker to predict early response to systemic chemotherapy (9,10).

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therapeutic response to hepatic arterial infusion chemotherapy of liver metastases from colorectal cancer using diffusion-weighted MR imaging. Cardiovasc Intervent Radiol. 2009 32:638-646.

305.4

Cone beam CT in chemoembolization

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Learning Objectives:
1. To present the state of the art in chemoembolization with cone beam CT
2. To present practical applications where cone beam CT is superior
3. To assess possible future use of cone beam CT in tumour therapy

Transarterial chemoembolization (TACE) is a minimally invasive palliative treatment for patients with hepatocellular carcinoma (HCC) or hypervascularized liver metastases, who are not candidates for surgical resection, thermal ablation or liver transplantation. TACE allows delivery of a high concentration of chemotherapeutic agents and embolic particles into the lesions causing ischemic cell death. To increase efficacy of TACE and to minimize injury to the surrounding liver tissue, selective administration of chemoembolic material is desired.

Selectivity of TACE mainly depends on vascular anatomy and on the correct identification of tumor feeding vessels. Until now, TACE is typically guided by digital subtraction angiography (DSA) providing two-dimensional (2D) projection images, which depict hepatic arteries superimposed on one another. This might lead to misinterpretation with consequent incorrect or suboptimal positioning of the catheter. Correct identification of tumor feeding vessels is more difficult in tumors that are not hypervascularized and in liver parenchyma with inhomogeneous density and contrast.

So far, the limitation of conventional DSA has been overcome by acquisition of multiple oblique projections, which, however, lead to increased contrast medium volume and radiation dose as well as prolonged examination time.

A novel approach for increased detection of tumor feeding vessels is cone-beam computed tomography (CBCT), which permits assessment of complex vascular anatomy after a single injection of contrast medium in a main or segmental hepatic artery. Dedicated reconstruction of the volume data set provides not only 2D slices but also three-dimensional (3D) vessel models such as MIP, MPR, VRT, SSD etc. CBCT offers the option of selective perfusion imaging and comparison to baseline cross-sectional imaging to evaluate if tumors are covered completely by local treatment and to change the catheter position if necessary. In addition, CBCT allows post-interventional evaluation of the accumulation of embolic material within the tumor. Furthermore, dual-phase CBCT (obtained during arterial- and portal venous-phase) has shown to provide sufficient image quality to detect HCC lesions. The sensitivity of CBCT for detection of HCC lesions seems to be much higher compared to DSA and almost equal compared to MRI.

However, there are also some limitations. The field of view is spatially limited to the dimension of the flat detector, i.e. in some cases whole coverage of the liver might be difficult depending on the size of the detector and the organ. Other problems are artifacts arising from respiratory/bulk motions or high-density objects. In addition, it remains unclear if CBCT results into lower contrast medium volume, radiation dose and shorter examination time compared to conventional DSA.

In conclusion, the use CBCT during TACE provides essential information, which directly influences the procedure. CBCT allows the acquisition of CT images to assess arterial perfusion and accumulation of embolic material without the need to change the modality, thus increasing safety, accuracy for identification of tumor feeding vessels, and treatment efficacy. This information gain is of particular importance in hypovascularized and central lesions.

Foundation Course UFE

801.1

Imaging pre- and post-UFE

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Learning Objectives:
1. To review imaging features of fibroids and main differential diagnosis
2. To review the role of imaging pre UFE including contrast enhanced MR
3. To review the role of imaging post UFE including contrast enhanced MR

Uterine artery embolization (UAE) for symptomatic uterine fibroids has evolved into a well-established alternative to hysterectomy worldwide [1]. UAE induces infarction of leiomyomas resulting in ischemic necrosis, hyaline degeneration, and size reduction with up to 95% of patients experiencing resolution or major symptom relief after treatment [2]. Imaging plays a crucial role to determine which therapy can be offered to a women suffering from fibroid disease. Ultrasonography is the primary imaging modality for establishing the diagnosis of leiomyoma as the cause for hypermenorrhea, dysmenorrhea or bulk symptoms. Magnetic resonance imaging (MRI) is superior in determining the location, size, and number of fibroids and determing which therapeutic approach is feasible [3]. Moreover, it offers unique information on fibroid tissue composition, vascularity of the fibroids and arterial supply. It is more reliable than ultrasound for the detection of adenomyosis or coexisting endometriosis which may cause similar symptoms. CT does not play a role in assessing the extent of fibroid disease or ruling out other pathology that may mimic fibroid-related symptoms.

Imaging prior UAE includes transvaginal ultrasound by an experienced operator. MRI should be considered in all patients being evaluated for UAE since it provides considerable additional information compared with ultrasound and affects clinical decision making in a substantial number of patients [4]. MRI is especially useful for the assessment of a multifibroid or significantly enlarged uterus, in cases with clinical suspicion of adenomyosis and endometriosis, inability to assess the ovaries by ultrasound and in those women, were the option of uterine sparing surgery must be weighed against UAE as the primary treatment. Ultrasound imaging is useful to depict fibroid shrinkage but reduction in uterine and fibroid size is not strictly correlated with clinical success. Even marginal reduction in size of the treated fibroids may result in significant improvement in the fibroid-related symptoms. If patients do not report improvement and/or complain about recurrent/new symptoms at any time after UAE contrast-enhanced (ce) MRI (including MR Angiography) is recommended. The role of MRI in this setting is to assess uterine integrity, the position, viability of fibroids and detect collateral supply. MRI can depict the changes associated with sloughing or expulsion of fibroids, cavitation or fistula formation, endometritis, and uterine necrosis [5,6,7,8]. Persistent perfusion of leiomyoma may lead to regrowth of leiomyoma tissue and recurrence of symptoms. Complete infarction of leiomyomas indicates technical success of UAE and is associated with longterm clinical success [9,10].

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801.2

Periprocedural pain management

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Learning Objectives:
1. To review etiology of pain during and post UFE
2. To review the drug regimens for pain control post UFE
3. To discuss new approaches to pain control including nerve block and other new techniques

Background:
Uterine fibroid embolization (UFE) is a minimal invasive treatment for symptomatic uterine fibroids. One of the few drawbacks is the periprocedural pain. Reducing this pain would render UFE even more attractive. NSAID has been established to minimize post-embolisation syndrome, however, for the immediate post-UFE pain NSAID are not strong enough.
A possible answer is a regional block which can be applied during the UFE procedure by the interventionalist.

Superior hypogastric nerve block (SHNB):
The use of a SHNB for pain management after UFE was first described by Rasuli et al in JVIR 2004; 15:1423-1429. Despite good results in a prospective single arm study this technique has not yet been used by many interventionalists. I have been using the SHNB for more than three years in every UFE with very good success.
The superior hypogastric nerve plexus is part of the sympathetic nervous system and collects the sympathetic nerves from the pelvis including the innervations of the uterus. The superior hypogastric plexus is typically located in front of the 5th lumbar vertebral body just below the aortic bifurcation. The idea/concept of the SHNB is to block this nerve plexus with a long- acting local anesthetics such as ropivacain 0.75% (Naropin) or bupivacain 0.5% (Carbostesin). Both anesthetics provide a regional nerve blockage of 6- 10 hours.
The technique of the SHNB is quite straight forward. After embolisation of the contralateral uterine artery the catheter is filled with contrast to mark the aortic bifurcation. A 21G needle is advanced "down-the- barrel" in the midline aiming below the aortic bifurcation. The needle is advanced till it hits the anterior aspect of L5. Once the needle reaches the bone contrast is injected to confirm the correct location of the needle tip in the pre-vertebral space. Then 20ml of local anesthetics is injected under fluoroscopic control. The time needed for the SHNB, starting with cutting the whole in the drape till pulling the needle, is only 7-10 minutes.
Rasuli et al. found that all patients could be discharged home within 6 hours of the procedure with only 6% re-admission. I tend to keep the patients over night for better observation. Typically the women have no pain for several hours following UFE. After the SHNB wears off patients start to have mild to moderate pain.

Conclusion:
SNHB is easy, quick and safe and therefore should be adapted by IR.

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801.3

Technique, choice of embolics and how to know when to stop

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Learning Objectives:
1. To review step by step technique of UFE for fibroids
2. To discuss choice of embolics available for UFE for fibroids
3. To review end points of embolization in UFE for fibroids e.g. pruned tree, stasis, total occlusion

Although a technically advanced procedure, uterine fibroid embolization is well within the skill set of most well trained interventional radiologists. The procedure can be broken down into several segments. First is selective catheterization of the uterine arteries. This is usually done sequentially, first left then right. Most experienced operators use micro-catheters, at least in small vessels, to avoid flow-limited spasm. The initial 4 or 5Fr catheter is placed in the internal iliac artery either at the origin of the uterine artery or above it. It is used like a guiding catheter for the subsequent selective placement of the micro-catheter into the uterine artery, usually to the level of the transverse segment of the vessel.
Next, embolization is performed. The choice of embolic is discussed in detail in the presentation. Beyond the choice of embolic, embolization is performed under fluoroscopic guidance, with intermittent injection. The embolization should be free-flow as the embolic material will flow to the fibroids first. Fibroid vessels are larger than normal myometrial branches and generally have more rapid flow than normal branches. This allows for preferential occlusion of the fibroid vessels in the initial part of the embolization procedure. It is important to ensure a stable endpoint of embolization after the procedure and generally we wait for 5 minutes to ensure no revascularization of the fibroids. The endpoint of embolization has been defined in qualitative terms but not yet quantitatively. For most embolics, an endpoint of near stasis is recommended, while for trisacryl gelatin microspheres, less occlusion is recommended, usually described as slow forward flow forward. The endpoints will be demonstrated in the presentation.
Finally, angiographic imaging is usually performed immediately after embolization to document the level of vessel occlusion. Many operators then routinely do an abdominal aortogram to assess for ovarian collateral flow, although it is detected in only about 5% of cases. Ovarian collateral flow is more likely in patients with a large uterus, large fundal fibroids, and those with a history of prior pelvic

surgery, including tubal surgery. In rare cases, ovarian embolization is required to adequately treat the fibroids.
With proper attention to technique and embolic choice, uterine embolization for fibroids is a very safe, effective and easily tolerated procedure.

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Disclosure

I am a consultant for Cook Inc. and Merit Medical Systems. I have also been a consultant in the past 24 months for Celonova Biosciences and Boston Scientific.

801.4

How to avoid complications

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Learning Objectives:

1. To review aims and objectives for UFE in fibroids
2. To discuss how to minimise non target embolization in UFE
3. To discuss how to minimise complications in UFE for symptomatic fibroids

To err is human and therefore medical errors will never be completely prevented. It is, however, the task of every physician to learn from mistakes and to organize his practice in such a way that the risk for errors is reduced to a minimum. The first and important step is to deal with problems in such a way that doctors are willing to show and to discuss their errors. The local department environment plays an important role in this. The basic understanding should be that no doctor ever wants to hurt a patient. The best way to deal with these problems is to understand that an error is part of a system error and the doctor is part of this system. Train the system. Training through medical simulation can be helpful in improving catheter skills, but will not prevent specific complication in relation to UFE.
There are 5 fields to be identified where complications in relation to UFE can occur.
1: Indication. Treating the patient for the wrong indication can be a reason for a serious complication. Misinterpretation of an endometrial cancer is rare but can happen when the patients are not also seen by a gynaecologist. Also, large intracavital myomas, when embolised, can cause serious complications like infection.
2: Anatomy. To know the anatomy is crucial in any embolisation procedure. Larger connections to the ovarian can cause infertility and acute menopause. But there are also rare anastomoses to the colon and the iliac artery. Not knowing and thereby not recognizing these anastomoses will lead to accidental embolisation of the non-target area; sometimes with devastating consequences.
3: Training. Image-guided catheter treatment might look straight forward, but proper training and maintaining the skills is essential in preventing complications.
4: Materials. Knowing your materials, and especially the embolisation endpoint of the materials, is very important. Too much material will cause massive necrosis, infection and has been seen to result in dead. Also, particle size is important to prevent shunting of material.
5: Organisation. Most complications, however, in medicine are due to bad organisation. No clear back-up system to deal with unexpected problems. During out of office hours patients being unknown to the physician on call.
Making a medical mistake is not malpractice, not learning from this and even repeating this is malpractice. Every complication should be an important learning moment.

Special Session Thoracic aorta

802.1

TEVAR for chronic type B dissection: indications, technique and outcomes

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Learning Objectives:

1. Which patients should we treat?
2. Is the technique different vs. acute dissection?
3. What are the outcomes?

The application of TEVAR to chronic type B dissection is a controversial subject. The indication is most commonly the presence of a thoracic false lumen aneurysm; however, the factors that influence the safety and effectiveness of this management are clearly different than those considered for patients with non-dissected, degenerative descending aortic aneurysms. The fundamental difference in TEVAR management for these two lesions is that the degenerative aneurysm is completely isolated from the circulation if no endoleaks exist while the aortic false lumen aneurysm remains partially exposed to systemic arterial pressure due to its contiguous relationship and lumenal continuity with the residually patent aortic false lumen below the endograft. In order to further examine this issue it is necessary to review some of the recent published reports. Multiple studies have demonstrated that 20% to 40% of patients with type B dissection who are initially managed successfully by medical therapy will eventually require intervention for aneurysmal degeneration of their chronically dissected aorta. Ultimately, the successful outcome of TEVAR management of chronic dissection is dependent on multiple factors, both anatomical and physiological, including characteristics of the individual dissection process such as the trajectory of the flap extension and its resultant influence on residual interlumenal aortic communications and flow patterns after stent-graft placement. A recent large single center study of 51 patients with chronic type B dissection with a mean aortic diameter of 6.2 cm reported no in-hospital/30-day deaths after TEVAR; no complications related to downstream branch vessels and an actuarial overall survival of 78% at 60 months with a mean follow-up of 27 months. Another report of a multi-national study of TEVAR for chronic type B dissection detailed a 30-day mortality of 0%. New data continue to emerge, but at this snapshot in time it appears that TEVAR results

are superior to open repair for chronic dissection cases in procedural mortality; early complications; all post-op events (treatment failure, death, stroke, and paraplegia), and 1- and 2-year mortality. A variety of complications have been detailed following TEVAR in the setting of chronic type B dissection, including progressive false lumen expansion below the distal margin of the endograft, conversion of the type B lesion to an acute type A process by retrograde extension form the proximal margin of the stent-graft, and rupture. Of note, the 1-year outcomes of the INSTEAD trial that studied management of chronic type B dissection by comparing medical therapy versus endograft placement concluded that elective stent-graft placement does not improve 1-year survival and adverse events despite favorable aortic remodeling. There was no difference in all-cause mortality with cumulative survivals of 97% for medical therapy and 91% for endovascular repair (P=.16). In considering optimal therapy for patients with chronic type B dissection, future investigations may better define improved selection algorithms that will help identify subsets of patients who are likely to benefit most from stent-graft management, as well as, those who may have disease patterns that are best treated by open repair or optimal medical therapy. One conclusion is clear, our current idea of best management of these patients is transient and will soon be replaced by improved understanding and insights provided by a legion of contemporary trials, the results of which are anxiously awaited.

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Disclosure

Medical Advisory Board member: W. L. Gore and Associates; Clinical trial research support: Cook Medical, W. L. Gore and Associates

802.2

Current status of branched endografts for thoracoabdominal aortic aneurysms

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Learning Objectives:

1. Describe the indications
2. Describe the deployment technique
3. What are the outcomes?

The treatment of thoracoabdominal aneurysms (TAAA) remains controversial. At the present time there are three treatment modalities, which must be evaluated and compared to define the optimum therapy for patients: open thoracoabdominal aneurysm repair, hybrid surgery (retrograde visceral revascularisation followed by conventional TEVR/EVR) and complete endovascular solutions which involve branched and fenestrated endografts.

The literature regarding thoracoabdominal aneurysms is relatively poorly populated and difficult to interpret. One of the main issues that must be borne in mind when evaluating results is the type of aneurysm treated. Thoracoabdominal aneurysms are traditionally classified using the Crawford classification. Aneurysms traditionally deemed high risk for adverse outcomes (mortality/paraplegia) are the extensive aneurysms type II and III, but series often contain variable numbers of type I, IV and V aneurysms.

There are numerous single centre series for the open treatment of TAAA that report excellent results. However, these results seem unable to be replicated in community series where peri-operative mortality rates approach 20%. In addition, it is difficult to define exactly how many patients are deemed unfit for open TAAA surgery. At the present time working figures for TAAA surgery would appear to be indicated that up to 40% of patients may be unsuitable for open procedures and that the operative mortality rate is approximately 20% in unspecialised centres.

The hybrid approach was popularised before total endovascular solutions became widespread. This approach uses traditional surgical techniques to debranch the visceral aorta using retrograde grafts from the distal aorta or iliac arteries. This debranching is then followed by TEVR/EVR. Early series of this technique did not appear to offer any significant improvements in outcome to the open techniques. However, in recent months several new series have been published that suggest the mortality rates for type II aneurysms is 15% with a lower paraplegia rate than open surgery. Approximately 80% of all patients may be treated by hybrid surgical techniques.

The total endovascular solution for TAAA has now become relatively widespread although reports are still sparse. The technique uses branched and fenestrated endografts to exclude the aneurysm and restore patency to the visceral vessels. Advantages to this technique are associated with the avoidance of open surgery, significant visceral ischaemia and reduction in blood transfusion requirements. The disadvantage of these complex endovascular techniques is the applicability to only a proportion of patients (maybe 60%) and the wait for a custom-made endovascular graft (3 months). The advent of non-custom-made solutions will significantly improve the current delay to therapy. In terms of results, the only large series is from the Cleveland Clinic. These results in a series of patients with more comorbidities than an open surgical cohort demonstrated a significant reduction in mortality although the paraplegia rate remained high.

At present it is the author's policy to consider totally endovascular solutions for the majority of patients with TAAA. In patients with chronic dissection, endovascular solutions are difficult and these patients may benefit from a hybrid approach, as may patients who cannot wait 3 months for therapy. The place of traditional open surgery is reserved in the authors practice for those with defined connective tissue diseases.

Disclosure

Consultancy and research funds Cook Medical

802.3

Branched endografts for aortic arch aneurysms - How close are we?

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Learning Objectives:

1. Which patients are suitable?
2. Where are we now with device design?
3. What is the experience so far?

No abstract available.

802.4

Management of endoleaks after TEVAR

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Learning Objectives:
1. Indications for treatment
2. How to treat endoleaks
3. The role of direct sac puncture

BACKGROUND

Endoleak definition
Flow outside the lumen of the endoprosthesis.

Endoleak classification
IA: Antegrade flow outside the endoprosthesis at the proximal landing zone.
IB: Retrograde flow outside the endoprosthesis at the distal landing zone.
II: Sac pressurisation from branch vessels such as the left subclavian artery or intercostals.
III: Sac pressurisation secondary to disconnection between endoprosthesis components in modular devices.
IV: Fabric porosity.
V: Sac pressurisation or endotension with no apparent source.

Incidence of endoleaks
Endoleaks after TEVAR have been reported to occur in 10.4% of patients at 30 days (range 4.8 – 25.9%).

Type I endoleaks are the most common unlike EVAR where Type II are the most common.

CLINICAL FINDINGS

Prevention of endoleaks
Type IA:
- Accurate sizing and graft deployment.
- Coverage of the left subclavian artery is associated with Type I endoleak (short/unfavourable neck).
- Large diameter of the transverse aortic landing zone.
- Abrupt angulation across the aortic isthmus.

Type II:
- Adequate occlusion of the left subclavian artery.

Type III:
- Adequate overlap of the segments when multiple stents are utilised.
- Building the stents from distal to proximal.
- Minimise number of stents deployed (use longer stents).

Which thoracic endoleaks should be treated?
There is unresolved uncertainty concerning the long-term effects of sac pressurisation after TEVAR. There is also uncertainty about the risk of endoleak-related aneurysm rupture and if there is an increase in aneurysm-related mortality.

Type I endoleaks:
These endoleaks have traditionally been treated aggressively but there are reports of spontaneous closure of acute type I endoleaks. Late type I endoleaks are often secondary to neck dilatation or endograft migration making them less likely to spontaneously close.

Type II:
The evidence for treating type II endoleaks is less robust and the risk of rupture is unknown. Data from the Eurostar EVAR database concluded that although the relationship between endoleak and rupture is not absolute, the correlation between endoleak and rupture was measurable. We have adopted a policy of closing type II endoleaks if they are associated with sac expansion of ≥10mm compared with pre-implantation sac size. This approach is consistent with the published experience for EVAR which we have extrapolated to TEVAR.

Type III:
As for type I.

Type IV:
Usually self-limiting.

Management of TEVAR endoleaks
Strategies for managing Type IA endoleaks:
- Balloon dilatation.
- Proximal cuff extension +/- extra-anatomical bypass.
- Proximal cuff extension with fenestration.
- Balloon-mounted metal stent.

- Cyanoacrylate embolisation:
1. Cyanoacrylate requires mixing with a radiopaque medium such as Lipiodol.
2. Setting time is influenced by the degree of dilution with 1 above.
3. Cyanoacrylate is usually injected through a microcatheter which is then withdrawn.
4. Cyanoacrylate may be used to close Type IA endoleaks by accessing the patent sac around the outside of the proximal endograft and filling the sac with glue and extending the glue ball to the leading edge of the endoprosthesis.
5. A similar technique may utilise direct transthoracic sac puncture.
6. Cyanoacrylate maybe used to close Type II endoleaks.

Type II:
- Observation with serial sac size measurements.
- Coil embolisation.
- Cyanoacrylate embolisation.
- Onyx embolisation.
- Transthoracic sac puncture.

Type III:
- Ballooning junction.
- Stenting across junction.

Type IV:
- Observation.
- May require correction of a coagulopathy.

Type V:
- Explantation.

Surveillance
Lifelong surveillance will allow the detection of endoleaks and more importantly sac expansion.
In our institution annual CT is performed until the sac is shown to be stable or reducing in size, then biennial PA and lateral chest x-rays are performed to reduce exposure to radiation and contrast and allow assessment of the endoprosthesis and give an indication of sac size.

Conclusion
Endoleaks after TEVAR are less frequent than after EVAR, with a greater incidence of type I endoleaks and fewer type II endoleaks.
There are many strategies for closing type I endoleaks as described above. There is less certainty about which endoleaks need treatment.

Special Session
Non-colorectal hepatic metastasis

803.1

When to refer a patient with non-colorectal liver metastasis for IR treatment

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Learning Objectives:
1. To present indications of IR treatments in patients with non-colorectal metastasis
2. To discuss factors that may affect selection of IR treatments
3. To analyze the role of IR therapies with respect to other available treatments

Technological knowledge are growing faster than the scientific one because before being accepted it needs to overcome the phases of feasibility, efficacy and comparison (phase I, II and randomized trials) to reach the highest level of evidence. Evidence quality can range from meta-analyses and systematic reviews of double-blind, placebo-controlled clinical trials at the top end, down to conventional wisdom at the bottom. The levels of scientific evidence, very well known by oncologists, make difficult answering the question: "when to refer a patient with non-colorectal liver metastases for inteventional radiology treatment." This is because there are no levels 1 of evidence, for any interventional radiology technique over traditional chemotherapy or surgery in this subset of patients. There are many techniques that are eligible to intervention radiology, and there are new molecular targeted drugs that further complicate the scenario. It is therefore necessary to suggest a new strategy to design the future trials to provide a shared response to the question.

It is important that radiologists do not see their new technique only with the eyes of love and that oncologists should not always await the classical randomized studies, whose results you have in years, to introduce in well selected patients new opportunities of therapy. Each of us has to take a step backward to really move forward.

At this time we will discuss how to approach this issue with an integrated or sequential strategy, combining some interventional techniques with traditional and intra-arterial chemotherapy, with particular attention for liver metastases from cholangiocarcinoma, gallbladder carcinoma, pancreatic cancer and ovarian cancer.

Until 1996 there was no established standard chemotherapy for patients with locally advanced or metastatic pancreatic cancer. After 1997 Gemcitabine became the standard one, but in more than 14 years no significant improvement was added to the results obtained with Gemcitabine alone. Until 2010 also biliary cancer had not an accepted standard chemotherapy. Now international guidelines indicate at least one chemotherapeutic line for biliary cancer, at least two chemotherapeutic lines for pancreatic cancer and at least four for ovarian cancer. In the first two cancers, prognosis is still dismal, with a median survival never exceeding 12 months; therefore, we must look for new integrated strategies because up to now nothing modified their natural history.

Among the different radiological techniques the following will be discussed: intra-arterial chemotherapy, chemoembolization with slow-release drug-eluting beads, radio-chemoembolization with Yttrium-90 microspheres and radiofrequency ablation. Also, the first data of hepatic chemosaturation therapy with a percutaneous hepatic perfusion procedure will be considered.

At first the results of interventional radiology AFTER the failure of the recommend chemotherapeutic lines will be discussed for each tumor. At second the results of interventional radiology BEFORE the failure of the recommended chemotherapeutic lines will be discussed for each tumor. At third the results from combined strategies like FIRST APPROACH will be discussed for pancreatic and biliary cancer.

The ONLY conclusion of my presentation is to underline again that if we do not start with multidisciplinary teams in every day work life, very few progresses will be appreciated.

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803.2

Melanoma liver metastasis

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Learning Objectives:
1. To discuss indications of interventional treatments in melanoma liver metastases
2. To present results from the literature and from personal experience
3. To analyse the role of interventional therapies with respect to other available therapies

Hepatic chemoembolization is a procedure usually reserved for patients with hepatic malignancies not amenable to surgical resection or local ablation. Hepatic tumors known to respond to transarterial chemoembolization (TACE) include hepatocellular carcinoma, intrahepatic cholangiocarcinoma, and metastases from neuroendocrine tumors, melanomas, colorectal carcinoma, and sarcomas (1).

Cutaneous melanoma accounts for more than 90% of all melanomas, whereas ocular melanoma is only encountered in 5%. Approximately 95% of ocular melanomas arise in the uvea and the remainder in the conjunctiva. Any part of the uveal tract can be affected, including the iris, ciliary body and choroid. Iris melanomas are less aggressive compared to ciliochoroidal tumors. Uveal melanoma is a rare tumor but is the most frequent primary intraocular malignancy in adults (2). It represents about 6% of all melanoma diagnoses (3). The incidence of uveal melanoma is 4,000 per annum in the United States or 4.3 cases per million (4). The 5-year overall survival for patients with ocular melanoma ranges between 50% and 70% (5). Molecular pathogenesis of uveal melanomas appears to differ from that of cutaneous and mucosal melanomas. Factors related to the primary tumor that influences prognosis include cell type and number of mitoses, lesion size location, scleral or extrascleral invasion, extension beyond Bruch's membrane and optic

nerve invasion (6).

Approximately 50% of patients will develop metastases (7). Uveal melanomas have a significant tendency for metastasis to the liver (2). Up to 40% of patients have been reported to have hepatic metastases present at initial diagnosis and the liver becomes involved in up to 95% of individuals who develop metastatic disease (8). The liver is the predominant site of metastases in more than 80% of patients, with metastasis occurring hematogenously (6, 7). Despite aggressive therapy, the median survival of patients after diagnosis of liver metastases is 2 to 7 months (9). The 1-year survival is estimated to be 10% (10). Controlling, therefore, hepatic metastases is essential to extending patient survival. Many systemic treatment strategies using immunotherapy, such as interferons and interleukin-2; chemotherapy, including dacarbazine, cisplatin, temozolomide, or lomustine or the antiangiogenic agent thalidomide, alone or in combination, have been used for patients with metastatic ocular melanoma (11, 12). However, they have shown exceptionally poor activity against metastatic uveal melanoma, and only 9% of patients with metastatic uveal melanoma are candidates for surgical resection. Furthermore, surgical approaches are not clearly indicated due to frequent liver relapses and distant spreading.

A number of locoregional treatment options directed to the liver are in clinical development for patients with ocular melanoma metastatic to the liver. Intrahepatic arterial chemotherapy and isolated hepatic perfusion have been shown to have some success in the local treatment of liver metastases (13), but no standard treatment protocol exists for patients with metastatic uveal melanoma. In patients with metastatic uveal melanoma, the response rates for chemoembolization (overall up to 66% with cisplatin) are higher than those for traditional systemic intravenous chemotherapies (generally less than 20%).

Several groups have reported their experiences with chemoembolization for patients with liver metastases from uveal melanoma (14-16). Hepatic artery chemoembolization combines hepatic artery embolization with simultaneous infusion of concentrated doses of chemotherapeutic drugs (17). Advantages of this technique include rendering the tumor ischemic, achieving high drug concentrations within the tumor and reducing systemic toxicity. The tumor becomes ischemic because the blood supplying macroscopic hepatic tumors is predominantly derived from the hepatic artery (18). Chemoembolization using a variety of chemotherapy agents may result in regression or stabilization of hepatic metastases. Although generally considered a safe intervention, liver chemoembolization can potentially be associated with complications such as hepatic failure, hepatic infarction, renal failure, tumor lysis syndrome, sepsis, and even death. Certain inclusion criteria apply for patients considered candidates for chemoembolization (19). Tumor burden should be no more than 75% of replaced liver parenchyma because of the high risk of postembolization hepatic failure in these patients.

In a retrospective review of 201 patients treated for hepatic metastases from ocular melanoma liver metastasis at the M. D. Anderson Cancer Center, chemoembolization using cisplatin-based regimens gave a response rate of 36 percent, compared to less than 1 percent with systemic therapy (20). However, the higher response rate may have reflected patient selection. Multivariate analysis identified serum alkaline phosphatase and metastasis-free interval as the main independent prognostic factors for survival, not the approach to treatment. Carrasco et al. (14) performed chemoembolization in patients with ocular melanoma metastatic to the liver using polyvinyl sponge material and cisplatin.

Mavligit et al. (15) treated 30 patients with chemoembolization using an admixture of cisplatin and polyvinyl sponge. The overall response rate was 46%, with one complete and 13 partial remissions, and a median overall survival of 11 months. Agarwala et al. (16) conducted a phase I trial of chemoembolization with cisplatin, thiotepa and lipiodol for primary and metastatic liver cancer, including three patients with ocular melanoma. In two of the three patients partial remissions were achieved that lasted 3 and 16 months, respectively. However, 4 of 30 patients in his series succumbed to complications.

Patel et al (18) performed chemoembolization with BCNU in 24 patients.

Vogl et al treated 12 patients with liver metastases of uveal melanoma with chemoembolization and reported that the procedure was well tolerated in all patients without any relevant side-effects (17). Three patients responded to chemoembolization, five patients had stable disease, and four patients had disease progression. They concluded that repeated chemoembolization offers a palliative treatment option in patients with oligonodular liver metastases from uveal melanoma. Fiorentini, et al performed chemoembolization using beads preloaded with irinotecan in ten patients (13). They concluded that their approach may have a better efficacy than previous chemoembolization regimens reported. Significant improvement was reported in eight of ten patients.

Recently, Yamamoto et al retrospectively investigated prognostic factors that were predictive of survival in patients with metastatic uveal melanoma who received either chemoembolization (CE) treatment with either 1,3-bis(2-chloroethyl)-1-nitrosourea (BCNU) or granulocyte macrophage colony-stimulating factor (GM-CSF) for immunoembolization (IE). Fifty-three patients with uveal melanoma were treated using CE or IE. They concluded that IE treatment with high-dose GM-CSF prolonged survival of patients with uveal melanoma who received embolization of hepatic metastases and possibly delayed progression of extrahepatic metastases (21). Finally, in a series of 32 patients with uveal melanoma metastases in the liver, Gonsalves et al reported median overall survival of 10 months using radioembolization after failure of immunoembolization or chemoembolization (22).

In conclusion, there are no effective long-term treatments for the majority of patients with ocular melanoma metastatic to liver. Chemoembolization and other locoregional therapies such as radioembolization have been implemented in selected patients, however, more studies need to be performed to standardize and refine the appropriate administered regimen and technique.

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803.3

Neuroendocrine tumours

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Learning Objectives:
1. To discuss indications and limitations of interventional treatments in neuroendocrine tumours
2. To present results from the literature and from personal experience
3. To understand the current management of neuroendocrine tumours

No abstract available.

803.4

Breast cancer

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Learning Objectives:
1. To discuss indications of interventional treatments in breast liver metastases
2. To comment results of interventional therapies in comparison with other treatments
3. To analyse the role of interventional therapies in the management of breast cancer

Breast cancer commonly metastasizes to the bones, lungs, and liver, at which point the cancer is considered a systemic disease and is associated with a poor prognosis. Importantly, liver metastases are present in the majority of patients; however, metastatic disease is confined to the liver in only 5%–18% of patients (1–3).

Although a variety of chemotherapy regimens have been tried, median overall survival time for patients with metastatic breast cancer involving only the liver, regardless of the degree of hepatic involvement, is 22–27 months (4-7).

Given the poor survival rates associated with the current treatments, there is increasing interest in the use of local therapies in conjunction with systemic therapy to improve the prognosis of patients with liver metastases from breast cancer. To treat hepatic metastases from breast cancer, local ablative techniques such as ultrasonography (US)- or computed-tomography (CT)-guided radiofrequency (RFA) ablation, highintensity-focused ultrasound (HIFU), microwave coagulation (MWC), laser-induced interstitial thermotherapy (LITT) and cryablation had been used.

Common inclusion criteria for liver metastasis ablation had been: fewer than five tumors, maximum tumor diameter of 5 cm or smaller, and disease either confined to the liver or stable with medical therapy. Patients usually had previously undergone chemotherapy, hormonal therapy, or both, often show no response or an incomplete response to the treatment.

Radiofrequency ablation

So far, the effectiveness of RF ablation in the treatment of primary liver tumors and unresectable colorectal liver metastases is well established (8-13, 25-28). Several studies have shown that percutaneous RF ablation is safe and effective in the treatment of liver metastases from breast cancer (12,13, 20).

Meloni et al reported complete tumor necrosis in 97% of tumors. Minor complications occurred in only 2 (4%) cases. Median time to follow-up from diagnosis of liver metastasis and from RFA was 37.2 and 19.1 months, respectively. Local tumor progression occurred in 25% of patients. New intrahepatic metastases developed in 53% of patients.

From the time of first RF ablation, overall median survival time and 5-year survival rate were 29.9 months and 27%, respectively.

From the time the first liver metastasis was diagnosed, overall median survival time was 42 months, and the 5-year survival rate was 32%. Patients with tumors 2.5 cm in diameter or larger had a worse prognosis (hazard ratio, 2.1).

Laser thermotherapy

To date, the largest study on the use of ablative therapies to treat breast cancer metastases was preformed by Mack et al (28), who treated 578 liver metastases from breast cancer in 232 female patients with magnetic resonance (MR)-guided laser thermotherapy. Mack et al achieved 3- and 5-year survival rates of 66% and 38%, respectively, from the time of treatment, with 1.5% of patients experiencing clinically relevant complications.

In the subset of patients eligible for surgery, Mack et al reported a median survival time of 3.7 years from the diagnosis of the

MR-guided laser thermotherapy–treated metastasis. MR-guided ablative therapy, however, is more expensive than RF ablation with CT and/or US guidance, both of which are more readily accessible than open interventional MR imagers and do not require non-ferromagnetic ablation devices.

Microwave ablation

Microwave ablation has also been used to treat breast cancer liver metastases. Abe et al (15) assessed the feasibility and efficacy of using MR-guided microwave thermocoagulation therapy in eight patients with liver metastasis from breast cancer, including patients that had bone metastases, lung metastases, or both at enrollment. At the end of the study, after a mean observation period of 25.9 months, five (62%) of the eight patients were alive, and all of them had new metastases. No procedure-related deaths or major complications were encountered. While Abe et al, however, found that MR-guided microwave ablation appeared to be a safe and feasible method for use in these patients, but more experience is needed.

High-intensity-focused Ultrasound

HIFU remains the only technique that is completely extracorporeal without percutaneous access (16-19). It does not require insertion of a needle into the target area, and damage of the tissue is obtained by the thermal effect and cavitation, which is caused by US energy. Acoustic energy is absorbed, and heat is generated by delivering high-acoustic intensity to the tissue. Because it is highly focused, acoustic intensity is high only within the focal region; however, outside the focal region the intensity is substantially lower, thus minimizing the risk of unintended injury to the surrounding structures. Unlike RFA, HIFU is completely noninvasive and can be used to reach tumors deep within the body, as in this case, provided there is an acoustic window to allow the transmission of US energy.

The limitations of this method is the fact that in most cases general anesthesia is required, that the ablation may not be radical, and that we still do not know the long-term results of this procedure.

Surgical resection

The results of several studies have shown prolonged survival in certain patients after curative resection (median survival time, 15–63 months) (20-24). Inclusion criteria are generally restricted to the absence of extra-hepatic disease or complete response of extrahepatic metastases (usually bone metastases) to systemic therapy, no brain metastases, normal performance status and liver function test results, and the possibility to perform curative resection.

The only significant factor identified was the time between primary breast surgery and the diagnosis of liver metastases, with a shorter interval being associated with a worse prognosis. However, the authors of a more recent series did not confirm this result (21). In many surgical series (20), there was a high rate of new hepatic metastases during follow-up that ranged from 59% (50 of 85 patients) to 67% (12 of 18 patients) and was comparable to results (53%) published by Meloni et al in 2009 (20) and expected, given the natural history of the disease. Adam et al (21) found that survival was worse when margins were macroscopically positive or small-volume disease remained in the remnant liver after resection. Adam et al concluded that surgery should be offered in combination with systemic therapy only to those patients with macroscopically resectable hepatic metastases.

When compared with surgical resection, RF ablation is less invasive, less expensive, and has fewer contraindications. Moreover, since many patients will develop liver metastases after surgery, the test-of-time approach, which has already been proposed for colon cancer liver metastases, could be used in patients with breast cancer liver metastases. This approach would help avoid unnecessary surgery in patients who would develop new metastases. The results of current available studies demonstrate that RF ablation can be used successfully in selected patients with liver metastases from breast cancer who have disease confined to the liver or who have stable extrahepatic disease to obtain local control of the disease.

The local tumor progression rate (25%) was not negligible, and the number of patients who developed new intrahepatic tumors was high (53%); however, both findings were expected, given the natural course of the disease.

The improved survival of patients in patients treated by RFA is likely due to the fact that RF ablation can be repeated if patients develop local tumor progression or new tumors. In addition, no treatment-related deaths or major complications were encountered, and the minor complication rate was 4%. Thus, RF ablation should be considered a first-line therapy with which to achieve local control in patients with metastatic breast cancer confined to the liver and in patients whose extrahepatic disease is stable with systemic chemotherapy.

In conclusion, current results show that survival rates for percutaneous thermal ablation in selected patients with breast cancer liver metastases, and those with disease confined to the liver or with stable extrahepatic metastases, are comparable to those obtained with surgery or laser ablation. Importantly, RF ablation is a safe technique that can be repeated if new hepatic metastases appear.

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Special Session
Controversies in vascular interventions

804.1

Endovascular is the first choice for long SFA occlusion in claudication: pro

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Therapeutic intervention in the SFA is one of the more challenging and complex peripheral vascular environments.
Multiple studies have been published reporting on the short- and long-term results of performing percutaneous angioplasty interventions and/or stenting for femoral artery occlusions in patients with PAD. Patency rates have been reported to range up to 93%. A meta-analysis of percutaneous angioplasty with provisional stenting compared to stenting alone for treatment of SFA lesions showed similar rates of target vessel revascularization, making both reasonable choices as endovascular treatments.
However, restenosis still remains as a major limitation of the clinical usefulness of PTA and stenting. Poor long-term results, especially after the treatment of longer lesions in the femoropopliteal region, have been reported. Here, the local application of the anti-proliferative agent paclitaxel for prevention of restenosis in femoral arteries via a stent delivery system or a balloon platform only have shown that these therapies successfully inhibit or reduce restenosis.
Especially, the use of paclitaxel-coated angioplasty balloons during percutaneous treatment of femoropopliteal disease seems to be associated with significant reductions in late lumen loss and target-lesion revascularization in short lesions. The use of re-entry systems in the superficial femoral and proximal popliteal arteries has shown promising early results to tackle long occlusions.
In summary, endovascular therapy is the first choice for long SFA occlusions in claudicants who have an insufficient response to walking exercise or as an adjunct to a training programme.

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804.2

Endovascular is the first choice for long SFA occlusion in claudication: con

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The management of the majority of claudicant patients is conservative. According to ACC/AHH practice guidelines endovascular procedures are indicated for individuals with a vocational or lifestyle-limiting disability due to intermittent claudication when clinical features suggest a reasonable likelihood of symptomatic improvement with endovascular intervention and (a) there has been an inadequate response to exercise or pharmaceutical therapy and/or (b) there is

a very favourable risk-benefit ratio (Hirsch et al 2006). Usually, invasive treatment is indicated only after unsuccessful trial of at least six-months of exercise program.

There are only a few small randomized trials comparing PTA and conservative treatment of intermittent claudication, and none that included only femoropopliteal disease. In Edinburgh trial (Whyman et al, 1996)) sixty-six claudicant patients, among whom there were short femoral stenoses in 47 patients, were randomized to either PTA plus medical treatment (daily aspirin, stop of smoking, and exercise) or medical treatment only. At six-month follow-up in the PTA group more patients reported no claudication, ($p<0.05$) and were asymptomatic at treadmill ($p<0.01$) compared to the control group. The AB pressure index was significantly higher and patients reported lower NNHP pain score in the PTA group. However, after two-year follow-up, the groups had comparable clinical outcomes (Whyman et al 1997). In a prospective observational study thirty-nine claudicant patients with unilateral femoral lesions undergoing PTA showed some short-term quality of life (QoL) benefit but at 12 months post-PTA did not approach QoL scores of an age-matched population (Chetter et al 1998).

The long-term patency rates of infrainguinal PTA vary largely in different studies. At 1 year, primary patency rates of 47% to 86%, at three years 27% to 69%, and at six years 23% to 36% are reported in the literature (Manninen H, 2008). In one prospective, single center study with 218 femoropopliteal PTAs on claudicant patients the primary patency at ten years was only 14% and reinterventions were required during the follow-up in one-third of the limbs including surgical revascularization in 35 limbs (Laxdal et al 2002). There are no comparative studies between the long-term results of intraluminal and subintimal recanalization for the treatment of chronic occlusions but also subintimal technique suffers from serious reocclusion problem. Primary patency rates of 22% to 62% at one year have been reported. Highly variable 1-year primary patency rates between 22% and 81% with various stents have been reported (Manninen H 2008). In three randomised studies, although the primary success rate of stent placement was higher than that after balloon angioplasty alone, the long-term patency was not improved using stents (Vroegindeweij D et al, 1997, Cejna M et al 2001, Grimm et al 2001). Midterm restenosis after long-segment femoropopliteal stenting remains a problem. In recent single-center observational study in which long segments (median length 16 cm) were covered by nitinol stent after initial failure of PTA, the primary patency was only 54% at one year. Especially poor result (22% one year patency) was obtained in diabetics (Sabeti S et al 2005). Stent in the femoropopliteal artery is exposed to unique long-term stress in the form of repeated compression, flexion and torsion and it is probably the reason why recent studies have revealed stent fractures in up to 50% of nitinol stents 1 year after placement (Scheinert D et al 2005) and in 19% of Wallstents a mean of 43 months after placement (Schlager O et al. 2005). The fractures seem to be associated with poorer patency and they are more common in longer stents.

Surgical bypass operation with autogenous vein graft is currently the standard reference for treating long SFA obstructions. Up to 81% two-year and 69% five-year primary patency rates can be appreciated after saphenous vein bypass above knee position. If PTFE graft is is used, the long-term patency is slightly worse but still 69% after two years and 49% after five years according to a systematic review (Klinkerts P et al 2004).

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804.3

Renal stenting is dead: true

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The first renal angioplasty was performed by Andreas Gruentzig in. This was a patient with hypertension and was reported in the Lancet in 1978 with great hopes of a "cure" for hypertension related to renal artery stenosis. Following the initial enthusiasm there has been increasing scepticism regarding the clinical effectiveness of this procedure. At the same time the pharmacological control of hypertension has improved with many new drugs (such as ACE inhibitors) appearing on the market. One of the first problems to beset renal angioplasty was elastic recoil and a consequent high restenosis rate. These mechanical limitations of renal angioplasty for atheromatous disease were largely overcome with the introduction of balloon expandable metallic stents (Palmaz) in the early 1990s. Early randomised trials carried out in Scotland, France and Holland were set up using hypertension as the outcome measure and all returned negative results. However, these studies pre-dated the stent era and were also criticised for being small and underpowered. A further randomised trial from Holland compared renal angioplasty with stenting and demonstrated clear technical superiority of stents but this was not matched by any clinical benefit. Cochrane review summarised the situation by stating that there was clearly no huge benefit associated with renal stenting but that a smaller but clinically important benefit could be present and missed by the previous underpowered studies. This paved the way for the next three trials. The STAR (n=140) and ASTRAL (n=806) trials encompassed the

stent era and were much larger studies. There was a move away from using hypertension as the outcome measure and renal function became the main point of focus. Put simply could renal stents improve renal function? The ASTRAL trial was appropriately powered for this outcome. Neither the ASTRAL nor STAR trials were able to demonstrate any useful clinical benefit from renal stenting. Other secondary outcomes which included hypertension, renal and cardiovascular events and overall survival also proved negative. Subgroup analysis including patients with critical lesions involving single kidneys also proved fruitless. On the downside both trials reported several serious adverse events which included both morbidity and mortality. These are disappointing but early results (5 year) and longer-term follow-up continues.

These trials have been criticised on both sides of the Atlantic. Most of the criticism comes from a misunderstanding of the "uncertainty principle" others are frankly biased. Randomised controlled trials remain the gold standard in evidence-based medicine and cannot be matched by retrospective or prospective case series, even less so by personal "expert opinion".

The third new trial is CORAL which is an American driven study. A composite outcome of both cardiovascular and renal events is the primary outcome. It has recruited approximately 1000 patients from several countries including the USA. Although recruitment has closed it has yet to report any results.

Although there may be some moderately strong indications for renal stenting, e.g. flash pulmonary oedema and uncontrollable hypertension. Few if any were entered into the trials and these rare indications remain non-evidence based.

Based on the data available there is no good evidence to support routine stenting for patients with atheromatous renal artery stenosis. The evidence will be presented and discussed.

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804.4

Renal stenting is dead: false

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The general idea that is currently accepted among Interventional Radiologists and clinicians is that the field of renal artery angioplasty/stenting in atheromatous stenosis is a somewhat lost battle against medical treatment. Most of us are in the mood that «medical treatment is the best we can offer to these patients and that there are no more indication for intervention».

If one refers to the history of renal artery angioplasty, it is easy to summarize as follows: an initial period of enthusiasm (1975-1995) in which all patients/lesions seemed as good indications, while there was an increased recognition of the need for systematic stenting of ostial stenosis.

Then 3 European-based randomized controlled studies that compared best medical treatment to angioplasty/stenting failed to show significant evidence that this intervention was successful in reducing blood pressure significantly.

A Cochrane review published in 2003 concluded «*Available data are insufficient to conclude that balloon angioplasty is superior to medical therapy in lowering blood pressure of patients with renal artery stenosis in whom blood pressure can be controlled with medical therapy. In patients with hypertension refractory to medical therapy, there is some weak evidence that balloon angioplasty lowers blood pressure more effectively than medical therapy. Balloon angioplasty appears to be safe and leads to fewer cardiovascular and renovascular complications. There is a need for randomised controlled trials comparing the effect of balloon angioplasty and medical therapy on the preservation of renal function in the long term*» (1-3).

The next step, more or less where we stand now was that of two additional randomized trials focused on a combined outcome of blood pressure and renal function. The Star trial and the Astral trial. The overall conclusions of these RCT were also negative (4,5). A recent meta-analysis re-stated again the overall deceiving results of renal stenting as compared to medical treatment.

This resulted in a dramatic reduction of the patient referred for stenting and motivates the present controversy.

In fact, we believe that the jury is still out and that living with the idea that stenting is not indicated anymore is not only inappropriate but is also dangerous for our patients. The referring partners that used to send us patients are often not motivated enough to go into the level of details of these trials and in most of the institution and therefore there is a need for a better education in this field.

First of all it appears that the two trials that are supposed to seal the case are both severely flawed and have both been repeatedly and severely challenged by several authors.

Star: Small groups, only 72% (46/64 patients) were effectively stented in the «stent group», unacceptably high adverse events rate related to the technique (low volume centers, high profile platforms up to 8 F sheath..) (4).

Astral: Most (65%) centers entered less than 1 patient/year, very long inclusion period (>7 years) (5). Randomization process based on uncertainty: a method supported by the authors of Astral on the basis of previous trial using this method, but a technique which is largely debatable (6-8). Because of the design of the trial, the only conclusion possible is «stenting in case of uncertainty is not indicated». In addition, the patients in which stenting was deemed indicated were not studied (their outcome is not reported in the study, this a serious flaw…). The authors themselves are in doubt on their results because they recently wrote: «however, there is without doubt a group of patients with renovascular disease who do benefit from intervention and it is essential that this subset be better defined» (6). Astral destroyed in many centers the previous patients

selection patterns because the clinicians read «stenting is not anymore indicated for renal function preservation» instead of reading «renal stenting in case of uncertainty is not efficient».

Today, in our academic center from which significant knowledge has been accumulated in the past 20 years on renal intervention (including leading the Emma trial and being centers participating in Star and Coral and French coordinating of the European centers of excellence in hypertension) we are still doing a fair number of renal stenting.

The indications that we accept for stenting are as follows:

1. Patients with poorly controlled HTN and a severe uni- or bilateral renal artery stenosis. These patients undergo renal artery stenting because the RCT have shown that the BP can be decreased by stenting of approximately 3 to 4 mm Hg (SBP) and 1-3 DBP (9). Our technique based on 5 F sheath and 0,014 low profile stents allows to treat these patients with a high success rate and much lower morbidity as compared to that reported in Star (2/64 patients died and in 2/64 others there was a technical failure to place the stent ...).
2. Patients with severe stenosis on a single functional kidney in which ACE are required either for the control of BP or for other indications (cardiac failure, renal failure ...).
3. Patients in which unilateral stenosis is not responsible in poor control of BP but in which 6-month follow-up demonstrates reduction in kidney length of more than 1 cm on echography.
4. Patients with recurrent flash pulmonary edema and uni- or bilateral renal artery stenosis, in case of absence of cardiac disease (valvular, ischemic or cardiomyopathy).

What will the future tell us?

Two new RCT focused on combined cardio-vascular outcome are in progress (slow patient inclusion rate for Radar and ongoing follow-up for Coral) (10). Results will not be available until 2 years. The combination of hard endpoints and a long follow-up period will maybe help in finding difference in the best medical treatment (BMT) group compared to the stent + BMT group.

Besides these ongoing trials, the whole issue of appropriate patient selection is still widely opened. Arterial stenoses are frequent in patients with hypertension so that is often difficult to determine whether the stenosis is the cause of hypertension or its consequence. All RCT previously published (including the ongoing ones) selected patients for inclusion according to the angiographic grading of the stenosis severity (with various cut-off between 50 and 70%) (Coral used also 4 F catheter gradient pressure measurements in patients with less severe stenosis but this technique is inappropriate). Unfortunately, we believe that this criterion is not the best. The severity is often grossly overestimated by angiography (11) and it yields a high inter observer variability (kappa < 0.40). It is hardly possible to distinguish between 50 and 60% stenosis or between 60 and 70% stenosis (12). On the other hand, previous work has also shown that there is poor correlation between the actual pressure drop distal to the stenosis and the angiographic severity of the stenosis (13).

The ongoing research on hemodynamic assessment of stenosis using .014 pressure wire to decide in which patient stenting is appropriate is certainly a future direction in which IR should be involved. Interventional Cardiologists have paved the way and are leading the research arena in this field (14). For example, in a prospective study of 53 patients undergoing renal stenting, transtenotic pressure gradient at baseline and during maximal hyperemia before stenting. At multivariate analysis, dopamine-induced mean gradient was the only independent predictor of variation of both the systolic and diastolic blood pressure. The optimal cut-off for identification of responders was a dopamine-induced mean gradient >= 20 mmHg.

Moreover in this study half of the patients referred because of subjective angiographic evaluation had a hyperhemic trans-lesional gradient below the threshold found to be predictive of improvement. Dopamine at the dose of 50 gg/kg intra-renal was the most powerful renal vasodilator (15). One can easily conclude that failure of blood pressure improvement in the previously published RCTs could be related to poor selection of patients (16). Stenting patients with a stenosis that has in reality no impact on hemodynamics result in no effect and confound the results.

Conclusion

1. Renal artery stenting is of common practice in dedicated centers and despite conservative approach, common indications are not to be overlooked (listed in this paper).
2. The results of ongoing trials will enhance our knowledge on this topic.
3. The use of .014 pressure wire to determine the pressure gradient after intra-renal injection of dopamine will likely help in selecting the patients in whom renal stenting could effectively result in lowering BP.
4. Renal artery stenting is not dead it may be well back in our daily practice provided that clinicians are well educated and the patient selection is done appropriately.

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Disclosure
I am consultant for Terumo and Cook.

804.5

A 60 year old fit patient with a 5.5 cm AAA should undergo EVAR

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No abstract available.

804.6

A 60 year old fit patient with a 5.5 cm AAA should undergo surgery

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There is a tendency to regard all things endovascular with rose tinted spectacles. Minimally invasive techniques using modern technology must be better than maximally invasive old fashioned open surgery. The wave of enthusiasm for endovascular aneurysm repair (EVAR) is now well past and longer-term follow-up of randomised trials provides some sobering evidence which requires critical appraisal.
This debate is deliberately chosen to obviate the advantages of EVAR with regard to perioperative mortality by stating that the patient is relatively young at 60 years old and fit. This patient would have a very low mortality from both open surgery and EVAR thereby removing the early advantage of the less invasive EVAR. This turns the spotlight on the durability of EVAR when compared with open surgical repair.
The eight-year results of both the EVAR and DREAM trials were published in consecutive articles in the New England Journal of Medicine in 2010 [1-3] . There was a perioperative advantage in terms of mortality for EVAR which measured 3% which was maintained at four years in terms of aneurysm-related mortality. This advantage was lost at eight years and even at four years there was no advantage for EVAR in terms of all cause mortality. The complication rate was higher in the EVAR group at all time intervals and more importantly the reintervention rate was also higher at all time intervals in the EVAR group. The EVAR trial expressed results per 100 person years. Overall in the 626 patients with endovascular repair there were 12.6 complications resulting in 5.1 reinterventions per 100 patient years with a hazard ratio of 4.39. In contrast of the 626 patients having open surgery there were only 2.5 complications resulting in 1.7 reinterventions per 100 patient years with a hazard ratio of 2.86.
There were a total of 756 patients with elective EVAR of whom 179 (24%) had serious graft complications at a mean 3.7-year follow up. 114 patients required reintervention – at a rate of 15% [4]. This was highest during the first 6 months with a late increase after 2 years. Longer-term follow-up is likely to find higher complications and reintervention rates. Factors predictive of poor outcome included large initial aneurysm size and large common iliac artery diameters.
One of the most disturbing findings was that whereas there were no aneurysm ruptures following open surgery there were 27 ruptured aneurysms after EVAR [5,6]. Eighteen of these patients died giving a mortality of 67%. Complications such as type I endoleaks, type II endoleaks with sac expansion, type III endoleaks or graft migration or kinking increased the risk of rupture. These poor results confirm those of the Pittsburgh group who found that rupture after EVAR was associated with poor outcome [7]. The late mortality associated with aneurysm rupture in the EVAR group is regarded as the "sting in the tail" of EVAR, and clearly should be avoided in patients with a long life expectancy.
The conclusions of the papers published in 2010 on the late results of the EVAR trials showed that EVAR was not associated with a survival advantage, either in terms of aneurysm related or all cause mortality. EVAR was associated with increased graft-related complications and reinterventions and was more costly. These results were confirmed by the DREAM trial.
The current economic climate brings into sharp focus both the cost of the endovascular procedures, the surveillance programmes required to detect problems during follow up and the secondary procedures required to correct the complications including aneurysm rupture. The low rate of post-operative graft-related complications confirms that no follow up is required after open surgical repair. The high rate of late aneurysm rupture means that no patient having endovascular repair can be discharged from surveillance.
In conclusion, a fit 60-year old man with a long life expectancy can expect a low risk open operation followed by certainty that the graft will prevent aneurysm rupture in the long term, and therefore requires no follow up. In contrast EVAR which has no survival advantage will be followed by a life of uncertainty as to when the aneurysm may rupture and requires a life-long surveillance programme which may not even predict failure [8].

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Foundation Course
Management of abdominopelvic fluid collections

901.1

Principles of drainage: anatomy, tools and techniques

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Learning Objectives:
1. To review the approach according to the location of the collection
2. To review tools available. To review the Seldinger and Trocar techniques
3. To review complications of the procedure and their management

Percutaneous drainage is a core skill for radiologists and should be readily available in all departments.

Drains are measured by their circumference in mm (French/Charrière) and the smallest pigtail drains (6Fr) are sufficient for uncomplicated ascites, pleural effusions and even purulent bile and urine. Abscesses and empyema can also be successfully managed through small drains if irrigated regularly; however, this is often not practical and larger drains may be required. The liberal use of local anaesthetic is essential, sedation is rarely required, but intravenous analgesia (e.g. paracetamol, fentanyl) should be considered. In case of sepsis, antibiotic cover should always be given.

The shortest and easiest access route is usually the safest.

Drains may be inserted over a guidewire (Seldinger technique) or by direct puncture with a trocar-mounted drain ("pig-on-a-stick"). Where this is not done under real-time guidance, trocars with a safety mechanism should be considered to prevent lung or bowel injury. Needle guides for US-guided puncture remove the guesswork about needle position. Unfortunately few operators are familiar with these and many too "macho" to use them.

Ultrasound guidance is sufficient in most cases. CT is invaluable for deep collections. For longer access routes or larger drain sizes, stiff guide wires, dilators and peel-away sheaths must be available and the operator needs to be familiar with these.

Abscesses should be aspirated as much as possible at the time of drain insertion and require active management.

Malignant ascites can re-accumulate quickly, sometimes requiring several drainages per month. Paracentesis can be performed safely as a daycase, but insertion of indwelling, tunneled catheters allows home drainage. This avoids repeated hospital admissions with significant cost savings and improved quality of life.

Drainage of loculated and purulent effusions can be easily improved by the instillation of 100-250.000i.U. of streptokinase for 4hours. This is cheap and safe.

Drain fixation and attachment of drainage bags is an art. Stoma bags attached to the skin over the drain are one of the safest ways to prevent accidental removal, but will lead to skin excoriation by urine or bile. Closed systems with an underwater trap are mandatory for pleural effusions.

Complications are rare; pain being the commonest. Injury to bowel/lung may be managed conservatively, but surgical support should be considered in all cases.

The lecture will illustrate basic drainage techniques, the use of needle-guides and safety-catheters, indwelling catheters for home drainage, streptokinase injection and chemical pleurodesis.

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Disclosure
I offer ad hoc staff training for UK Medical with reciprocal contributions to the departmental research and education budget.

901.2

Pancreatic abscesses and fluid collections

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Learning Objectives:
1. To review clinical symptoms and imaging of pancreatic abscesses and fluid collections
2. To describe different techniques of drainage
3. To review complications of the drainage and their management

No abstract available.

901.3

Deep pelvic collections: access and technique

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Learning Objectives:
1. To review clinical symptoms and imaging of deep pelvic abscesses
2. To review transabdominal, transgluteal, transrectal and transvaginal access to deep pelvic collections
3. To review catheter care and follow-up and management of possible complications of the drainage

Pelvic abscesses may present with a combination of systemic and local symptoms. Imaging with CT and US (often intracavitary US) usually clarifies their cause and extent. Once you know how to image abscesses and understand the basic techniques for their drainage you will be consulted about collections in many locations, including the deep pelvis. This presentation focuses on getting a satisfactory clinical result with the lowest possible risk of complications and medico-legal consequences in deep pelvic collections. Access to these may be challenging and not as simple as basic abscess drainage. Do not be daunted by this. The skill set required is generally the same as for simpler drainages, but the pre-procedural assessment may need to be more comprehensive and the access routes are different. Before doing the procedure, review the patient's imaging and talk to the referring clinicians, the patient and if necessary their family. Evaluate the insights, concerns and expectations of the patient and explain the benefits, alternatives and risks of the procedure. Correct any coagulation defects. Pay careful attention to the adequacy of sedation/analgesia and do not hesitate to seek general anaesthesia if you consider it warranted. Be sure any surgical options that may be needed if things go wrong are in place and have been explained to the patient. Then relax and do the procedure as planned. The methods that will be described typically work well and proper planning will negate predictable complications. Procedures will be considered by anatomic drainage route (1). The presentation will cover pelvic abscess drainage via narrow transabdominal windows, simple and difficult transvaginal drainage (2), transrectal and transgluteal (3, 4) drainage, as well as drainage of 'inaccessible' interloop abscesses (1) and management of inadvertent enteric transgression (5). The equipment and techniques used by the speaker in each case will be described. Complications will be considered. Principles of catheter care and follow-up will be addressed.

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procedures: aspiration, biopsy, and catheter drainage. Radiographics 2001; 21:657-672.
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901.4

Management of hepatic and renal cysts

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Learning Objectives:
1. The etiology, epidemiology and incidence of renal and hepatic cyst
2. The techniques of renal and hepatic cyst percutaneous treatment
3. The complications of the treatment and their management

Simple liver cysts are acquired and benign lesions without connection to the biliary tree consisting of cuboidal biliary epithelial cells. Although they are usually asymptomatic they should be treated whenever they are symptomatic. In patients with symptomatic simple liver cysts percutaneous aspiration is not a definitive therapy as it is associated with a high recurrence rate. Before Bean and Rodan reported their experience with alcohol sclerotherapy of symptomatic simple liver cysts, surgery was the only therapeutic option. Since then several papers of percutaneous treatment of simple hepatic cysts have been reported with successful results.

Hydatid cyst disease caused by Echinococcus granulosus is a parasitic disease that can emerge at any region of the body. However, liver is the most involved organ. Treatment options for liver hydatid cysts include chemotherapy, surgery, and percutaneous drainage. Complete recovery is observed only in less than half of the patients treated with anti-parasitic chemotherapy, in general. Although surgery is considered as the traditional treatment option in hydatid cysts of the liver, surgical treatment results are associated with high mortality, morbidity, and recurrence rates and longer hospital stay in the literature. Successful results of particularly the "PAIR technique" (Percutaneous Aspiration-Injection-Respiration) as well as "Catheterization technique with hypertonic saline and alcohol (we call it as "Standard catheterization technique")" and "Modified catheterization techniques such as MoCaT or PEVAC" published in the literature of the last two decades led to the acceptance of percutaneous treatment as an alternative to surgery for a successful treatment option of liver hydatid cysts.

Simple renal cysts can be found incidentally in most elderly patients. Treatment is not required for simple renal cysts as most of them are clinically silent. When they are associated with flank pain, hypertension, and obstruction of the collecting system, a treatment modality should be indicated. Although symptomatic renal cysts were managed by surgical techniques in the past, percutaneous treatment of symptomatic simple renal cysts with single or multiple-session sclerotherapy has already become the first-line treatment option as it is associated with high success rates.

The rates of major complications of the percutaneous treatment in patients with simple hepatic and renal cysts are very low. However, major complications of percutaneous treatment of liver hydatid cysts are around 10% which are treated by percutaneous techniques.

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Special Session
Abdominal aortic aneurysms

902.1

Fenestrated EVAR for AAA with short or absent necks: current status

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Learning Objectives:
1. Which aneurysms are suitable for fenestrated EVAR?
2. Basic technique of fenestrated EVAR
3. Outcomes of fenestrated EVAR

Introduction

Fenestrated stent-grafts are designed to treat patients who have unsuitable proximal necks for standard endovascular repair. These grafts are customized to the individual patients' anatomy. The graft used is a three-part composite system based on the Cook Zenith device. The first part is a tube fitted with the customized fenestrations. The second part is a bifurcated graft and the third part a contra-lateral limb. The technique involves four additional steps compared to a standard Zenith graft deployment. First a partial deployment (in terms of diameter) of the proximal tube graft (constrained by diameter reducing ties). This allows for repositioning of the graft during the second step, which is the catheterization of fenestrations and target vessels, usually the renal arteries, but sometimes also the superior mesenteric artery. The third step is a full deployment of the tube graft. The fourth and final step is sequential stenting of the fenestrations, to maintain full appositioning and therefore perfusion, a better seal at the level of the fenestrations, and perhaps a better fixation of the graft. A detailed comprehensive step-by-step technical approach has been published by Moore et al.[1]

Balancing the choice of treatment for AAA with short or absent necks

Fenestrated stent-grafting is an additional treatment option in the treatment of complex abdominal aortic aneurysms. Standard alternatives are still open repair, or no repair for patients with very important co-morbidity. Nowadays chimney techniques have also been proposed for such aneurysms. However, the broader public should understand that chimney techniques have mainly been used to rescue renal arteries after misplacement of a standard stent-graft, or in some acute situations. It would be a mistake to advice patients with complex abdominal aortic aneurysms to be treated with chimneys in the elective setting. There is simply not enough evidence (at this moment) to do this.

The final choice towards a fenestrated procedure is depending on patient characteristics (e.g., age and co-morbidity), and aneurysm characteristics (e.g., diameter and anatomical features). In 2011, to a certain extent, a patient has the right of choice if optional. Economic considerations also play a role considering the enormous problems of health care systems around the world.

The fenestrated technique is now entering its second decade and has matured.[2-4] Results have shown to be excellent and durable.[5-7] In addition, although technically more challenging again, the fenestrated technique has been used successfully to treat proximal type I endoleaks or extension of disease in patients having undergone previous standard endovascular and open surgery.[8-11]

Limitations of the fenestrated technique

It would be presumptuous not to recognize a number of limitations, both anatomical and non-anatomical. On the non-anatomical side it must be obvious that fenestrated techniques are characterized by a greater complexity therefore requiring extensive extra-mural, human, physical and economic resources. Furthermore, additional considerations in the choice between open and endovascular repair, such as threshold diameter for treatment, and co-morbidity of the patient, must be taken into account.

The anatomical limitations should include the manufacturing of the graft, the evaluation of technical challenges, and the experience of the "team". The anatomical limitations of the standard fenestrated technique become obvious if one keeps the necessary steps during the deployment process in mind: first, the graft needs to be repositioned to its final position to facilitate catheterization; second, the insertion of stents inside the renal arteries must be achieved correctly. Any anatomical feature rendering these two processes difficult to execute, makes the already complex technique even more tedious. Severe angulation of the proximal neck or the iliac arteries, narrow iliac arteries, previously inserted surgical grafts all can render repositioning of the graft during catheterization more difficult. Insertion of stents into the renal arteries and renal artery patency are at risk in case of small or diseased renal arteries, short renal arteries with early bifurcations, or a sharp take-off from the aorta. Other anatomical particularities can also increase the difficulties of the procedure: aortic branches in close proximity to each other render designing the graft more difficult and sometimes impossible; angulation of the proximal neck increases the difficulty to determine the correct level of the small fenestrations for the renal arteries; thrombus inside the proximal neck is not only a risk factor for endoleak but also for embolization during repositioning; a small neck diameter can render the catheterization process more difficult because there is not enough room to maneuver with the predesigned catheters.

Future considerations

The fenestrated technique is now mature and widely applied with great and consistent success. Renal function problems have been reported, however! They are caused by the risk of losing a renal artery not only due to technical failures but also due to repetitive contrast load around the procedure and during follow-up. We therefore clearly suggest following these patients with duplex ultrasound, standardized abdominal X-ray, measurement of systolic blood pressure and renal function, with CTA to be reserved in case of doubt.

Due to the manufacturing delay of these customized grafts, ruptured and acute aneurysms do not qualify for this technique. Up to now, at least! A standardized fenestrated graft is now under investigation within William Cook Europe, and other manufacturers are making first cautious steps towards standard fenestrated grafts. The new standardized fenestrated graft by Cook is a three-fenestration

graft for both renal arteries and the superior mesenteric artery, and a scallop for the celiac artery. Both fenestrations for the renal arteries are flexible in position and should accommodate the majority of complex aortic abdominal aneurysms. However, it is worth pointing out that an additional fenestration renders the technique more complex, requiring more extensive experience but also better angiography equipment. This author believes that all fenestrated and branched grafts should be done in operating theatres with fixed imaging as an ideal environment, but agrees that standard fenestrated grafts can be done with mobile imaging. Nevertheless, the cut-off point seems reached when the fenestrated technique becomes more complex and requires lateral fluoroscopy viewing for catheterization and stenting of the superior mesenteric artery.

Another important issue with standardized fenestrated grafts is the even more important patient selection in the acute situation. In other words, one will need a lot of experience to determine whether a patient is suitable for this type of graft and procedure in a stressful situation, with a great temptation to go for it in view of the poor alternative options. It is clear that caution is mandatory, and a prospective registry needed, to determine the safety and efficacy of these off-the-shelf fenestrated devices.

Conclusion

Many anatomical and non-anatomical factors have to be taken into account before a final decision can be made to treat a patient with a fenestrated graft. The technique has reached a high degree of maturity and published results are surprisingly consistent and durable. This authors' opinion is that the fenestrated technique is the first treatment option for most suitable complex abdominal aortic aneurysms.

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Disclosure

Consultant, speaker for 1/ W.L. Gore and Associates 2/ William Cook Europe 3/ Atrium

902.2

Percutaneous access for EVAR: devices, technique and outcomes

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Learning Objectives:

1. Which patients are suitable?
2. Which devices should we use? Describe the technique
3. Report of available literature, results and complications

Introduction:

Over the past two decade, endovascular aneurysm repair (EVAR) has revolutionized the treatment abdominal aortic aneurysms (AAA). Open surgical repair has steadily given way to EVAR and the mid- and long-term results of EVAR are encouraging (1,2,3). The early "home-made" devices as well as the first-generation of commercially available endograft systems in the early and mid-nineties were characterized by large diameters and significant rigidity, necessitating surgical exposure of the common femoral or the iliac arteries to facilitate introduction. This, in turn, made the procedure cumbersome (prolonged procedural times) due to the necessity of a surgical set-up including operating room personnel. Subsequent generations of stent graft systems became progressively more flexible and acquired smaller profiles. This development, coupled with the availability of percutaneous suture-mediated closure (PSMC) devices, opened up new avenues to the interventionist, leading to early reports on percutaneous endograft implantation appearing at the turn of the century. Almost all currently available endograft systems for treating AAA have French sizes below 24 F.

Closure devices:

Of the various devices currently available in the market, the two suture-mediated devices most commonly used for percutaneous closure of endograft access sites are the Prostar XL and the Proglide devices (Abbott Vascular). The Prostar XL has two sutures attached to four needles designed to deploy the sutures in a criss-cross fashion to facilitate closure of the arterial entry site. The Proglide device has only one suture deployed through two needles. For sheaths between 12 and 14 F, two Proglide devices may be used as an alternative to one Prostar XL; the two devices are sequentially advanced at an angle of 60° to 90° to each other in order create criss-cross sutures. For sheaths exceeding 16 F in size, generally the Prostar XL system is used. Although a single Prostar XL device has been successfully used for sheaths up to 24 F, most centres still tend to use two devices to optimize the chances of haemostasis.

Technique:

As far as possible, access should be obtained to the common femoral artery. Thereafter, a one-cm skin incision is made and the subcutaneous tract is bluntly dissected down to the level of the femoral artery to facilitate insertion of the devices. If two devices are used, they are inserted one after the other. The device has a side-hole for insertion and removal of the guide wire which makes the exchange of devices possible. The sutures are deployed prior to insertion of the stent graft system. After completion of the endograft implantation, the sutures are knotted and the knot allowed to slide down to the artery by applying traction on the appropriate suture thread; the knot is then pushed firmly against the outer arterial wall by means of a knot pusher and tightened by applying traction to the second suture thread. For ensuring complete haemostasis, further manual compression may be necessary for 3 to 5 minutes as the patients are generally anti-coagulated.

Outcomes:
With the currently available closure devices, PSMC is successful in about 85% of cases (4,5) with failures being attributable largely to lack of haemostasis or difficulty in device positioning. In a patient cohort with 445 patients, Etezadi and colleagues noticed a success rate of about 90% for devices smaller than 16 F and about 80% for larger devices. The complication rate after successful PSMC was significantly lower as compared to that after surgical exposure of the vessel. However, there was no difference in the complication rate between the two groups, if failed PSMC cases were taken into consideration. Seromas occurred significantly more often after surgical closures, whereas pseudoaneurysms more often after PSMC. PSMC procedural time was significantly shorter than that for surgical closure. Interestingly, obesity and vessel calcification did not significantly influence the outcome (4). In another series of 292 patients, Lee and colleagues report a technical success rate of 94% and a late complication rate as low as 1.9% (6). A success rate of 100% has been reported by Haas and colleagues in a small group of 12 patients as early as 1999 (7). In their study with 80 access sites, Jean-Baptiste and colleagues were able to demonstrate shorter hospital stays in patients undergoing PSMC as compared to those in the surgical arm (8).

Future prospects:
In future, the sizes of the endograft introducer systems are expected to get smaller which could partially contribute to increasing technical success rates of PSMC. A further contribution toward achieving this goal may come from increasing experience of the interventionist with the handling of percutaneous closure devices as well as from improvement in closure device design. Consequently, EVAR for AAA treatment could well become an established percutaneous procedure in most centres in the decade to come with the percutaneous approach leading to shorter hospital stays as compared to those after surgical exposure of the vessel.

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902.3

Embolization of type 2 endoleaks: techniques and outcomes

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Learning Objectives:
1. Indications for treatment
2. How to treat IMA endoleaks
3. How to treat lumbar endoleaks

In the context of endovascular repair of abdominal aortic aneurysms (EVAR), type 2 endoleaks are defined as an endoleak occurring into the aneurysm sac as a result of retrograde flow from side branches of the aorta. In practice, the main side branches responsible for type 2 endoleaks are the inferior mesenteric artery (IMA) and the lumbar arteries. Type 2 endoleaks may occasionally arise from retrograde flow in accessory renal arteries arising from the aneurysm sac, although these are much less common.

Early in the experience of EVAR, type 2 endoleaks were routinely treated by embolization, which in large part contributed to the high reintervention rate in the EVAR arm of the EVAR 1 trial. However, with the accumulation of increased data on follow-up after EVAR, it became evident that while type 1 and type 3 endoleaks are risk factors for aneurysm sac expansion and rupture, type 2 endoleaks per se did not seem to be a risk factor for late rupture. As a result of this, the standard management approach for type 2 endoleaks in the last decade has been observation by interval imaging, either by CT or by ultrasound, with treatment reserved for an increase in aneurysm sac diameter on serial imaging.

Intervention for increasing aneurysm sac diameter is not supported by good evidence and there are many interventional radiologists and vascular surgeons who would not intervene for a type 2 endoleak even if there is documented evidence of aneurysm sac expansion. However, the 10-year results of the EVAR 1 trial have revealed that late aneurysm rupture is a small but worrying cause of late mortality, which erodes the success of EVAR compared with open surgery. Late rupture occurred in a high proportion of cases where there was documented ongoing sac enlargement, and some of these patients had type 2 endoleaks, which gives support to their treatment when there is increasing aneurysm sac diameter.

Type 2 endoleaks may be treated by several techniques, which include transarterial embolization, embolization after direct puncture of the aneurysm sac and by a variety of surgical techniques including laparoscopic clipping of the offending aortic side branch (or branches). My favoured technique is transarterial embolization.

Embolization of the IMA involves the cannulation of the middle colic branch of the superior mesenteric artery with a reversed curve catheter (Sidewinder or Simmonds 1 or 2) and a hydrophilic guidewire. Once this sometimes challenging manoeuvre is achieved, a microcatheter and wire can be passed relatively easily distally into the left colic branch of the IMA, and then the IMA itself. The usual embolic agents are coils, although glue and Onyx are other popular embolic agents.

Embolization of the lumbar arteries is usually more challenging and involves the catheterization of the iliolumbar branch of the ipsilateral internal iliac artery, which is a branch of the posterior division of the internal iliac artery, although the exact site of origin may vary. The usual technique is to catheterise the internal iliac artery with a cobra or reversed curve catheter, followed by catheterization of the iliolumbar artery with a microcatheter. Further passage of the microcatheter to the offending lumbar artery may be straightforward, although it is often quite technically difficult, due to the presence of very small tortuous communicating arteries between the iliolumbar artery and the lumbar arteries. Once the microcatheter has been passed to the lumbar artery implicated as causative for the type 2 endoleak, the choice of embolics used is similar to those used for

IMA embolization.
The procedure is technically successful in the majority of patients, with higher technical success rates for embolization of the IMA compared with lumbar artery embolization. In our cohort of 13 patients, no patient had further increase in sac diameter perfusion post embolization. We have experienced no major or minor complications to date.
Disclosure
1. Consultant for William Cook, Europe.
2. Member of Medical Advisory board for Navilyst Medical

902.4

Current status of iliac branched grafts: patient selection and outcomes

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Learning Objectives:
1. Which patients are suitable?
2. What is the technique?
3. What are the outcomes?

Unilateral common iliac aneurysms are present in 43%, and bilateral common iliac aneurysms in 11% of patients with abdominal aortic aneurysms. In these cases EVAR requires distal extension of the aorto-iliac stent graft into the external iliac artery with coverage and embolisation of the internal iliac artery (IIA). Sacrifice of the IIA is associated with a wide range of complications from buttock claudication and erectile dysfunction to more serious pelvic, bowel or spinal cord ischaemia.
While a number of combined endovascular and surgical techniques have been described to preserve IIA patency iliac branched grafts (IBDs) allow a completely endovascular means of maintaining IIA flow in patients with aorto-iliac aneurysms.
Patient suitability:
Clinical criteria
Identifying which patients are at greatest risk from IIA occlusion is difficult. Active patients and those with bilateral iliac aneurysms are the groups most commonly considered for IBDs
Anatomical criteria
Only 50% of patients with aorto-iliac aneurysms are suitable for IBDs with a number of size and morphological restrictions/contraindications. Absolute contraindications include an aneurysmal or heavily stenotic IIA and a CIA lumen less than 18mm. Relative contraindications include a tight aortic bifurcation and marked iliac tortuosity. If the CIA length is shorter than 50mm the common iliac part of the IBD will protrude above the aortic bifurcation and the bridging stent cannot be placed using the crossover technique and access from the arm is required.
Devices:
There are 3 commercially available IBDs based on the Cook Zenith platform: the Zenith bifurcated iliac side branch (ZBIS), the helical side branch device (HSE) and a custom Zenith IBD with a flexible side branch.
All have an indwelling catheter through the side branch allowing a thru and tru wire to be established over the aortic bifurcation. Over this a long sheath is placed from above into the IIA through which a covered bridging stent is placed to complete the branch into the IIA.
Technique:
Initially the IBD is aligned 10mm above the IIA origin and the proximal graft opened. A 10 or 12 F sheath 45-55cm in length is advanced from the contra lateral side over the tru and tru wire into the side branch.
A cobra catheter is placed alongside the tru and tru wire and the IIA catheterised followed by placement of a stiff wire. The tru and tru wire is then removed and the sheath advanced into the IIA trunk. The bridging covered stent is positioned in the distal sheath but not deployed until the IBD graft is fully unsheathed and the delivery system removed. Once the IBD is fully completed the main bifurcated stent graft is then placed from the contra lateral side and linked to the IBD with a standard zenith limb.
A variety of modifications to the IBD technique are described including coaxial sheaths to reduce friction over the bifurcation. Either balloon or self expandable covered bridging stents can be used usually either Atrium V12 or Fluency stents. Diameters of 9-13.5 mm with lengths of 38-60mm depending on the IIA trunk dimensions.
Outcomes:
Over 3000 IBDs have been placed worldwide. Nine series have reported the use of IBD in 196 patients. Technical success was 85-100% with no aneurysm-related mortality. Branch occlusion occurred in 24/196 with buttock claudication occurring in 12/24 after IBD occlusion.
Conclusions:
IBDs can be performed with a high technical success rate and good medium term patency. However, IBDs add to the cost and complexity of the aorto-iliac EVAR and this has to be balanced against the variable sequelae of IIA occlusion. The groups of patients who will benefit most from IBDs remain to be fully identified.
Disclosure
I have been paid fees for proctoring,consulting and speaking by Cook and Lombard Medical

Special Session
Kidney cancer

903.1

RFA: patient selection, techniques and challenges

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Learning Objectives:
1. To present the current indications for ablation of renal cell carcinoma
2. To present the RF ablation techniques for renal cell carcinoma
3. To report on complications and strategies to avoid complications and enhance the results

Radiofrequency ablation (RFA) has evolved considerably in the last 15 years through expandable, cooled and multi-tined probes to deliver reliable treatments for small (<4cm) renal tumours. However, if image-guided ablation (IGA) is to become the standard of care for such disease the IR will have to be able to confirm to the multidisciplinary tumour group caring for these patients that they can deliver subtotal treatment rates of <5% and little or no late tumour recurrences.
If this standard is to be ensured the IR must deliver renal tumour ablation in an optimised setting ideally with both US and CT guidance and formal anaesthetic support. Published data [1, 2] suggest that if subtotal treatments are to be minimised using current RFA devices then the technique should be applied to sub-37mm tumours with due diligence in terms of probe placement accuracy and treatment coverage. Probe re-stationing has been advocated to ensure tumour coverage with adequate margins using current RF probe technology; however, absolute intra-procedural confirmation of treatment completion becomes more problematic after positioning. “Impedance roll-off”, temperature dosimetry and gas obscuration have proved to be problematic measures of treatment adequacy but with accuracy and adequacy, excellent oncological results can be obtained. Given current RF technology it seems appropriate to offer RFA to sub-40mm tumours. Some authors have advocated pre-embolisation [3] to enhance the ablation volumes achieved with

RFA. Largely anecdotal evidence suggests that this is the case but problems of treatment adequacy seem more likely to be overcome with the enhanced treatment dosimetry and coverage provided by cryoablation (CRA).
In terms of dosimetry and consistency of results the urologic community has argued in favour of CRA [4] but if careful and consistent technique is utilised RFA can obtain sound oncologic results in sub-35mm renal tumours.
Almost all renal tumours are accessible for image-guided tumour ablation regardless of anterior or posterior location [1,2]. Although more centrally located tumours are reported to have a higher rate of subtotal treatment these can usually be addressed by adequate treatment without adverse outcome. Critical attention should, however, be paid to structures such as the pelviureteric junction, tail of pancreas and the closely related adrenal gland which, if inadvertently injured, can give rise to intra-procedural hypertension. The basic operative premise is that the operator should take time carrying out adequate contrast-tinted (2%) hydrodissection, displacing adjacent critical structures such that a thorough and adequate tumour ablation can be carried out. This should aim to also treat the related subjacent renal cortex and ensure that the tumour-parenchyma interface is completely treated.
Imaging follow-up suggests that RFA is effective in oncological survival terms but there is a small incidence of late local recurrence of approximately 4% which warrants longer term imaging follow up.
The IR should routinely attend the Urological Tumour Board and be aware of the relative merits of image-guided renal tumour ablation versus open partial and laparoscopic partial nephrectomy. In particular, image-guided ablation has been shown to have minimal influence on post-treatment renal function and is usually well tolerated with a reported complication rate of approximately 4% (>Clavien Grade 2).

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903.2

Cryoablation: equipment, technique and challenges

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Learning Objectives:

1. To present the current indications for cryoablation of renal cell carcinoma
2. To present the equipments and cryoablation techniques in renal cell carcinoma
3. To report on complication and strategies to avoid complications and enhance the results

No abstract available.

903.3

Review of published data: which lesions should be treated?

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Learning Objectives:

1. To present a review of the RF ablation series on renal cell carcinoma
2. To present the pattern of image findings during follow-up after ablation of RCC
3. To report, based on current results, what the conditions for a successful treatment are

Introduction: Ablation by any of the previously discussed techniques is now firmly established in the armamentarium of renal tumour therapy. Pending randomised trials, the accumulating follow-up data of large cohort studies show that they can produce long lasting disease control, amounting to cure in a substantial majority of cases. These techniques are now viable alternatives to and beginning to challenge the role of partial nephrectomy.
Outcome: If the larger reported series of RFA of renal tumours are considered, than a pooled sample of >500 cases treated by percutaneous RFA followed for a median of 10-57 months can be evaluated. From these data a primary success rate of 79-97% can be predicted; which is further boosted to 90-100% after a second, third or more ablative sessions. Data on percutaneous renal tumour cryotherapy are less extensive, nevertheless a group of >250 cases can be analysed. The reported success rate is better than with RFA at 94-98%, but this is over a shorter follow-up period of 7-19.2 months.
What is clear is that both modalities are viable alternatives to surgery. But the surgical and percutaneous ablation series cannot be directly compared as there are differences in selection and tumour size. Undoubtedly selection bias will begin to narrow with the passage of time and increasing technical experience, but currently cases for percutaneous ablation need to be carefully selected.
Selection of Tumour: The ideal tumour is that which has a favourable shape, size and location. Round lesions are theoretically more suited for RFA whilst oval lesions may be better suited for cryoablation, as the latter often require multiple needles and the 'ice-ball' is ellipsoid in shape around the needle tip and shaft. Peripheral lesions, exophytic masses and lesions surrounding by perinephric fat are also good candidates, whilst central lesions and those richly perfused are not, although there are described ways of overcoming these limitations; e.g. by prior vascular occlusion. Similarly those near critical structures, such as the ureter and adjacent to the bowel or pancreas are also technically challenging. Again, techniques such as hydrodissection (with dextrose for RFA) or aero-dissection can be used to create a window of safety. But these are technical limitations; and issues used to assess for technical suitability for percutaneous ablation.
Regarding tumour biology, there are no tumour types that are intrinsically not suitable for ablative therapy. Even the most aggressive cell type (say Fuhrman grade 4) would be suitable for attempted cure by ablation, as long as it was technically feasible to ablate the tumour with a suitable penumbra of treatment.
Natural History of Small Renal Masses: However, there are other issues to do with the natural history of small renal masses that the interventionalist needs to be aware of. Emerging data show that asymptomatic small renal masses (some use <4cm as the cut off for 'small' and others define it as <3cm), have a distinct and separate epidemiology to large, symptomatic renal masses. Many small renal masses are of benign or non-aggressive aetiology, e.g. angiomyolipoma and the oncocytoma. Non-invasive diagnosis of these tumour types is not always reliable, and in some partial nephrectomy series up to 20% of small renal masses are of such benign cell types.
Accumulating data on the follow up and surveillance of these lesions

have shown that they can grow very slowly, and sometimes hardly at all; and the risk of metastasis during follow-up is very low. This raises the increasing question, of whether we should obtain cytological and cellular confirmation of all small renal masses before deciding on active treatment, whether surgical or ablative. Failing that whether we should maintain a period of surveillance to gauge the growth characteristics of a given small renal mass before deciding on treatment. It has been stated that <2 cm masses should be followed, and treatment selected once they exceed 3 cm in diameter. This is certainly a safe policy as the likelihood of occult metastasis at this size is negligible. These are emerging dilemmas with ablative policies, and will occupy many of our minds in the years to come.

Assessing Treatment Success: But a separate and perhaps more germane issue is how to judge treatment success. In the initial explorations of the ablative techniques, there were some alarming reports of apparently viable tumour tissue on immediate histological examination of successfully ablated renal tumours. These reports have now been refuted, by the appreciation that the pathology of ablated tissue very soon after treatment is difficult to interpret. Cell viability after ablation is not easy to gauge, and apparently healthy looking cells may in fact be undergoing indirect cell injury.

This inability to definitely measure treatment success is in many ways the largest hurdle that the ablative therapies face, when compared to the surgical route. Successful surgery is apparent as soon as the pathology report is available, but ablative therapies can only be assessed eventually by the less satisfactory and slower method of follow up imaging.

Follow-up Imaging: Regarding follow-up imaging there are no defined surveillance polices. But one often used is 3,6,12 and yearly after for the first 5 years. Follow-up can be by CT or MRI (the two modalities are probably equivalent, but the former is often the preferred option). What is undoubted is that, whichever modality is selected, both a pre- and post-contrast study (i.e. a proper renal mass protocol) is important as residual enhancement is the key indicator of viable tumour tissue and the need for re-treatment.

Difficulties with Assessing Enhancement: It is of course a pre-condition of all ablative treatments that an amount of surrounding normal tissue should be included as the penumbra of the treatment zone. This can vary between 5 and 10 mm around the tumour, but it is not uncommon to see a degree of altered enhancement as a rim around the treated area. This is especially so immediately post-ablation. Viable tumour can be difficult to exclude at the edge and this should be monitored further for growth. The absence of enhancement within the main body of the mass is the key consideration when assessing treatment response. Absent enhancement is taken as a surrogate for non-viable tissue. But this is where the importance of both a pre- and post-contrast study becomes clear. Ablated tissue, whether heated or frozen will usually be of a higher density (by up to 20HU) than normal renal parenchyma. This makes enhancement a difficult feature to gauge. On a subjective glance, successfully ablated tissue may be misinterpreted as enhancing because of its residual high density. To accurately assess true enhancement the pre- and post-contrast density should be measured within the mass, using carefully placed region of interest cursors, positioned over the solid areas, avoiding fat or calcium, and the incremental rise after contrast is measured.

Enhancement and Treatment Success: Although not yet well studied, it is accepted that the same criteria used for renal mass analysis can be applied for assessment of successful ablation. Thus, an incremental rise of >20HU after contrast denotes viable, enhancing tissue and should be assumed to be residual tumour, requiring repeat ablation. An increment <10HU after contrast is considered 'normal' and compatible with successful ablation. An intermediate rise 10-20HU is more problematic, and unfortunately often encountered. In this situation, a policy of watchful surveillance should be chosen and re-treatment recommended only if growth of this area is observed.

Enhancement is especially difficult to gauge along the intra-renal margin of the ablated zone, as altered edge enhancement may be due to 'damaged' normal renal parenchyma. It is the authors view that when faced with a large renal mass (say 4cm) or a mass of complex shape where the need for repeat ablation can be predicted (because of the size or the shape), than the intra-renal extent of the tumour should be preferentially targeted at the first ablation and good margin coverage ensured here, as this area will always prove difficult to evaluate of surveillance. Residual tumour is often revealed as an area nodular or crescent shaped enhancement.

Rim enhancement: Other changes that may be seen on follow-up are a 'bulls-eye' appearance as the ablated mass develops a rim of surrounding fat, with a more peripheral soft tissue rim. This may be seen in up to 75% of cases (more commonly with exophytic lesions). The rim may show linear enhancement, due to peripheral perfusion. This has been reported in up to 20% of masses after cryoablation, and often disappears after 6 months. Experimentally, it has been shown that rim enhancement denotes partial coagulative necrosis caused by lower temperatures at the edge of the ice-ball. Although one cannot yet be categorical, the author believes that rim enhancement after the first year should be taken as suspicious for residual disease. Post-ablation calcification has rarely been seen with angiomyolipoma. Increased perinephric stranding is often seen soon after ablation, representing an inflammatory response, but this gradually diminishes. If progressive infiltration is seen, especially if along the needle path, then active disease should be suspected.

Size as a measure of success: Decrease in size as a surrogate for success, can be a difficult to judge. Only a minority completely disappear, even after total ablation. More usually, there is sometimes an immediate slight increase in size, followed by a gradual diminution in dimensions (around 30% at the end of the first year). Decrease in size is said to be more common after cryoablation rather than RFA.

Biopsy as a measure of Success: All this discussion of the limitations of follow-up imaging raises the issue of post-treatment biopsy as a measure of treatment success. Not many centres have used these as the pathology is difficult and there is always the issue of sampling error. This will be further discussed.

To summarise, accumulating data show that ablation is a successful alternative to surgery for the treatment of small renal tumours. Most success is seen with exophytic masses, <3cm in size, peripherally located and away from critical structures. Treatment success can only be assessed on follow-up imaging. Of the various changes seen on follow-up imaging residual enhancement is the key indicator of success. The limitations of current surveillance policies are discussed above.

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Special Session
GI haemorrhage

904.1

Imaging of acute and chronic upper and lower GI bleeding: is CTA all we need?

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Learning Objectives:
1. To review CT techniques in GI bleeding visualization
2. To review (CT) anatomy of the upper and lower GI tract
3. To demonstrate typical findings, comment on their interpretation and their significance for further (embolic) management

No abstract available.

904.2

Which embolic agent - does the embolic differ for upper and lower GI tract embolization?

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Learning Objectives:
1. To review different embolization materials and their use
2. The use of embolic materials in upper GI bleeding
3. The use of embolic materials in lower GI bleeding

Anatomical considerations:
Upper GI tract (UGIT): as a speciality of this region there are different arteries, which supply almost the same parenchymal organ structures or territories of the GI tract. Therefore, it is mandatory to know the arteries and their possible collateral pathways (e.g. the pancreatic arcade) to understand the diagnostic work-up and the embolization strategy.
Lower GI tract (LGIT): due to the fact that the supplying arteries are end- arteries, there are almost no collateral pathways (exception: rectal perfusion) and the strategy of embolic agent selection has to be as different as the way of vessel catheterization.

Diagnostic and micro-catheters:
In most of the cases the catheterization of the main visceral arteries is done via a common femoral artery access. Therefore, different configurations are available: Simmons I & II, Cobra 1 -3, Sos Omni catheter, shepherd-hook catheter, IMA catheter. It depends on the experience of the interventionalist, which French size is used. If the embolization procedure is planned to be in a coaxial mode the bigger is better to have possibilities of control angiography and also stability of access. With exception of the origin of the gastroduodenal artery (GDA) and the splenic artery coaxial systems have the benefit of being less spasmogenic to the entered vessel and if occlusion of the transport catheter happens, exchange is much easier. The choice of the microcatheter size (especially of the inner diameter) depends on different parameters: 1. the delivered embolic agent (there is a range of 0.010 to 0.027 inch), 2. the distance of the bleeding point, 3. the anatomy of the patient.

Embolic agents:
There are clear indications due to the bleeding source and the anatomical situation. The most common embolic agent are, either for the upper and lower GI tract, coils.
Macro- & micro-coils: especially in the upper GI tract the principle of "front and back door occlusion" has to be considered, to avoid retrograde filling of the bleeding site from collaterals. Therefore, pushable or detachable coils are the embolic agent of the first choice,

depending on the bleeding site. The range is from 0.035 to 0.010 inch, the diameter varies from straight to compex shaped coils and different loop sizes. Some are combined with silk or dacron to be more thrombogenic. Length differs from 5 to 500 mm. There is also a big variety of detachment mechanisms. Detachable coils are excellent for occlusion of bleeding visceral aneurysms and/or pseudoaneurysms. One of the therapeutic goals is to prevent the parent artery and filling of the aneurysmal sac with detachable coils is almost an easy going procedure.
The goal for the lower GI tract is to occlude the hemorrhage feeding vessel as peripheral as possible. Special ways of delivery of the coils are necessary, e.g. the usage of coil-pushers or detachable coils.
Vascular plugs: there might be an indication for their use to occlude the "front door" in bigger sized arteries, which can be intubated with a diagnostic catheter, like the GDA. There is no indication for the lower GI tract, because proximal vessel occlusion has to be avoided.
Particles and microspheres: if the bleeding point is not reachable very selectively, a "shower" of a small amount of particles is, especially in the UGIT, possible and allowed, with a calculated risk of soft tissue necrosis. If the hemorrhagic point in the lower GI tract is not reachable, a very limited amount of particles or spheres can be injected. The size should be limited to bigger than 250 µm. For the LGIT the end arteries are the limiting factor of embolization.
Gelfoam: this might be an ideal embolic agent for hemorrhage embolization in the LGIT due to its potential of recanalization within a short period of time.
Glue: either in the UGIT and the LGIT there are very limited indications for liquid embolic agents. Mainly for bleeding av-Malformations or fistulas it may be recommendable to use glue. It also can be administered into pseudo-aneurysms, just to occlude the outer surface of the artery. A special indication is the retrograde embolization of variceal bleeding in the case of portal hypertension.
Onyx: there are some publications reporting embolization procedures of GI-bleeding with this liquid agent. Indications could be (pseudo-)aneurysms or other bleeding sites. The liquid can be administered like a "coil" to occlude the feeding vessel at a certain point. Theoretically the preinjected DMSO may work like an embolic agent too due to its spasmogenic side-effect. For the LGIT there is a risk of occlude a whole vascular territory due to its "lava-like" behaviour.
Ethanol: its usage should be limited to especially experienced interventionalist and has its indication in the treatment of bleeding AVMs or variceal bleeding.
Stentgrafts: for bleeding sites on main stem arteries it is mandatory to preserve the parent artery. To exclude the bleeding site like dissection or pseudoaneurysms it is possible to cover the pathology and prevent the artery from occlusion. Alternatively bare metal stent covering with trans-stental occlusion is an option.
Summary:
Due to the anatomical specialities in the upper and lower GI tract there are clear indications for the usage of special embolic agents. Depending on collateral pathways the selection of material differs between hemorrhage indication in the UGIT and LGIT. For emergency and life-threatening cases straight forward procedures are necessary, for chronic bleeding indications more sophisticated procedures are possible.

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For references, please refer to the author.

904.3

The role of provocative angiography and prophylactic embolization

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Learning Objectives:
1. To review the role of prophylactic (blind) embolization
2. The technique of provocative angiography and its indications
3. To review the complications of provocative angiography

Provocative angiography:
Gastrointestinal bleeding is intermittent; frequently stopping and restarting. It has been documented that in 40-80% of patients with gastrointestinal hemorrhage the GI bleeding will stop with bed rest and medical therapy. Therefore, the use of provocative agents to reactivate gastrointestinal hemorrhage that has already stopped is controversial. Some strongly feel that once bleeding has stopped, it is both dangerous and potentially life threatening to attempt to restart it. On the other hand, every experienced interventional radiologist has encountered patients who have had multiple negative endoscopies, angiograms and barium studies attempting to localize the lesion responsible for gastrointestinal bleeding. Negative angiograms are wasteful in terms of effort and expense. They are invasive, uncomfortable and have morbidity. Therefore, it is precisely in this group of patients that provocative angiography may be indicated. However, the decision to provoke GI bleeding should never be taken lightly or unilaterally. Both consultations with the patient's referring gastroenterologists and surgeons and ensuring that sufficient blood is readily available for transfusion is required before attempting to provoke rebleeding.
We first published our experience using provocative angiography in 1982. Some provocative agents such as vasodilators and fibrinolytic agents were used to reactivate bleeding that had stopped. Since GI bleeding is intermittent often starting and stopping spontaneously, other agents, anticoagulants, such as heparin were used to keep patients actively bleeding from the time the interventional team is first notified until the angiogram is performed. Using interventional measures to provoke or prolong GI bleeding increased the rate of active extravasation seen in patients with lower GI bleeding. Prior to using provocative measures only 32% of our patients undergoing angiography for lower GI bleeding had extravasation on the diagnostic angiogram. However, with the use of provocative angiography the percentage of positive cases increased to 69%
The danger of provocative angiography is the potential to reactivate GI bleeding that is massive and uncontrollable. This complication has not occurred in our almost 30 years of experience using this technique.

Prophylactic (empiric) embolization:
Prophylactic or empiric embolization is the practice of embolizing an artery that supplies the bleeding area in the absence of extravasation on the diagnostic angiogram. It is most often employed for gastric or duodenal bleeding. The artery to be embolized depends on localization by endoscopic findings or visualization of extravasation on CT angiography. Often the endoscopist will place a clip at the bleeding site. The interventional radiologist will then embolize the left gastric artery if there is gastric bleeding or the gastroduodenal artery if duodenal hemorrhage is present.
The problem with this approach is that gastric bleeding is caused not only by the left gastric artery but also by lesions supplied from the right gastric, short gastric, right gastroepiploic and left gastroepiploic arteries. Fortunately, in a study of 100 patients with gastric bleeding whose angiograms demonstrated extravasation, 85% of the bleeding lesions were supplied by the left gastric artery. Therefore, empiric embolization of the left gastric artery will have an

85% chance of controlling any potential future bleeding from that lesion.
Similarly, most duodenal hemorrhage occurs from lesions supplied by the gastroduodenal artery. However, the inferior pancreaticoduodenal artery and its branches may supply a significant percentage of patients with bleeding duodenal lesions.
Looking at empiric embolization rationally, it is the process of taking a patient who is not bleeding actively and whose diagnostic angiogram does not have extravasation and then embolizing an artery supplying the suspected location of the bleeding lesion. If there is no rebleeding, is the reason because the correct artery was embolized ("**success**") or is it because the patient stopped spontaneously and would not have bled again anyway ("**serendipity**")? Similarly, if the patient does rebleed is it because we embolized the wrong artery ("**bad luck**") or because we did a poor job embolizing the artery responsible for the bleeding ("**bad technique**"). We usually never know.

904.4

Should we be concerned about the risk of bowel infarction - what is the evidence?

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Learning Objectives:
1. Embolic materials and the risk of bowel infarction
2. In which areas is the risk of bowel infarction high?
3. The techniques preventing bowel infarction

Vascular anatomy of the bowel is the key of understanding and preventing of ischemic complications after transarterial embolization (TAE) in patients with lower gastrointestinal bleeding (LGIB). The mesenteric collateral network comprises 2-3 arcades including the marginal artery of the colon and gives rise to the terminal vasa recta supplying the wall of small and large bowel. The risk of infarctions following TAE is based on the sparse intramural arterial network of the colon behind the level of the vasa recta. If TAE includes proximal arcades or the marginal artery in a way that permanent occlusion of more than 4-5 vasa recta (1 vas rectum per cm bowel length) results, the risk of insufficient intramural collateralization is increasing.
Between the early 1970s and the 1980s embolotherapy had to be performed using standard 5 French catheters proximal to the level of the vasa recta and resulted in rates of bowel infarctions between 13% and 33% due to territorial ischemia [1-3]. The preference of treatments by intraarterial vasopressin infusion was the consequence despite several disadvantages of this therapy, like cardiovascular side effects and high recurrence rate [4].
In the 1990s availability of microcatheters and microcoils brought out renewed interest in embolization treatment of LGIB. Capability of microcatheters to reach vasa recta clearly decreased the frequency of major ischemic complications to 0-6% (mean value 2.0%, median 0% in reported series). Based on more than 300 cases published in case series consistent low risk of serious ischemic complications was shown, if superselective embolization succeeded [5-17]. If only strictly superselective TAE of vasa recta is performed, the risk of infarction to the colon is 0% [13]; however, atherosclerosis, vasospasm and vessel tortuosity may compromise superselective catheterization and embolization.
Low ischemic complication rates are reported [5-17] independent of the embolization material used (microcoils, PVA 150-1.000µm). Microcoils ranging in size from 2 to 3 mm in diameter and 20 to 30 mm in length are generally preferred. They are easy to see and accurately to deploy. Pushable coils are sufficient in most cases. If vascular anatomy strictly demands very precise release of coils to prevent occlusion of parent vessels, the use of detachable coils may be advantageous. If superselective positioning of microcatheter is impossible, the use of polyvenylalcohol (PVA) particles is recommended with particle size of >250 µm [18]. In case of bleeding angiodysplasias the use of PVA particles is preferred by some authors. Liquid embolic agents should usually not be used because of the risk of associated ischemic complications [19]. This risk arises if multiple vessels are occluded by liquid embolics including proximal and very distal branches. However, glue has also been used successfully without ischemic complications if superselective application is performed. In 14 patients with insufficient coagulation, superselective TAE was performed with N-butyl cyanoacrylate without clinical signs of bowel infarction [20].
The frequency of acute ischemic complications depends also on the method to look for these complications. Subclinical ischemic lesions may occur after TEA in patients with LGIB more frequently. If routine endoscopy was performed after TAE, the frequency of asymptomatic ischemic lesions to the colon was 22% in 2 of 9 patients [5].
Late ischemic complications such as bowel stricture and ulcerations may also occur; however, they are very rare and in most cases not clinically relevant [12, 21].
If a bleeding site is identified by catheter angiography, successful embolotherapy is based on three factors: decreased arterial perfusion pressure to the bleeding lesion, patient's ability to form blood clots and local vasospasm induced by wires and catheters. The latter two factors are also reasons for relapse of bleeding. How much is enough during embolotherapy in patients suffering from LIGB? Embolization treatment in these patients is always an individual decision in terms of embolization level, choice of embolic material and definition of treatment endpoint outweighing the risk of rebleeding against the risk of ischemic complications. If the patient's conditions are critical including unstable blood pressure, embolotherapy must be performed until the bleeding has clearly stopped during control angiography. If treatment is performed in a patient with chronic intermittent LGIB only very selective embolization can be recommended, because surgery can be performed safely in case of recurrency if the source of bleeding has been identified.

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Foundation Course
Management of benign biliary disease

1001.1

MRCP techniques in benign biliary disease

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Learning Objectives:
1. The basic techniques of MRCP
2. Interpretation of MRCP imaging
3. Comparison of MRCP, CT and ultrasound

Introduction

MRCP visualizes the biliary fluid, the duct walls and adjacent soft-tissue structures of the intrahepatic and extrahepatic biliary system. In contrast to ERCP, all biliary ducts and the gallbladder, which are in vivo filled with fluid, are demonstrated. MRCP uses heavily T2-w sequences with TE's longer than T2-relaxation times of soft tissue, which then do not contribute to the signal on images. This technique allows visualization of static fluid and may be considered as a fluid-weighted technique. T2-w MRI w/wo fat-suppression with moderate TE and Gd-enhanced T1-w GRE demonstrate duct wall and adjacent soft tissue structures [1] [2] [3].

Technical considerations and interpretation

A variety of MRCP techniques with different approaches depending on scanner hardware and software are available including 2D, 3D T2-w pulse sequences with breath holding or respiratory triggering. For a quick overview a simple breath-hold thick-slab T2-w sequence in radial orientation requires no further post-processing. Still commonly used is multi-section T2-w half-Fourier single-shot technique with thin sections and post-processing to generate maximum-intensity projections (MIP). Current 3D-techniques are typically based upon FSE/TSE sequences acquired with respiratory triggering using navigator techniques and thin near-isotropic voxels. Consideration of thin source images together with post-processed images is mandatory for clinical analysis [4].

While hepatobiliary contrast agents exhibit high signal intensity within the bile and, thus, directly visualize the duct lumen, Gd-enhanced T1-w MRI shows ducts with intraluminal low signal intensity and can be used as a "dark-fluid" technique. Gadolinium-enhanced FS T1-w MRI is ideal to image the ducts and adjacent soft tissues.

Functional information may be obtained by adding secretin, which stimulates pancreatic secretions allowing for better visualization of strictures and ductal anomalies [1].

Clinical application of MRCP

MRCP is a useful tool in diagnosing benign biliary disease [5] [6] [7] [8]. The list of clinical applications includes [1]:
- clinically relevant biliary anomalies prior to surgical procedures,
- acute and chronic cholecystitis,
- patients with suspected cholangitis (infectious or sclerosing cholangitis),
- calculous disease (e.g. prior to laparoscopic surgery),
- biliary obstruction, and
- cystic biliary diseases (choledochal cyst, choledochocele, or Caroli's syndrome)

Pitfalls:

Pitfalls in diagnosing calculous disease are biliary prostheses, clips, aerobilia, hematobilia, and incrustations. MRCP studies should be performed prior to placement of biliary endoprostheses, because aerobilia renders MRCP assessment of bile ducts difficult. Plastic prostheses are diamagnetic and provide no signal on MR images isointense to stones or sludge. Metal stents show susceptibility artifacts depending on their structure and composition [1] [9].

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1001.2

Techniques to access the non-dilated biliary tract

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Learning Objectives:
1. The role of US, CT and MR in no-dilated tract imaging
2. Technical tips and tricks for non-dilated tract puncture
3. To review current techniques and the tools available

Percutaneous transhepatic biliary drainage (PTBD) is an established technique for treating patients with biliary obstruction or leakage.
Due to the non-invasive imaging techniques that are available nowadays such as ultrasonography, CT and MRCP, there is virtually no role for percutaneous cholangiography without drainage.
PTBD in patients with non-dilated biliary ducts may be indicated in biliary obstruction after biliojejunostomy, following liver transplantation, in primary sclerosing cholangitis or primary biliary cirrhosis. In addition, drainage may be necessary in cases of iatrogenic bile duct injury and leakage.
Requirements to access the non-dilated biliary tract are anatomical knowledge of liver and bile ducts and adequate pre-procedural imaging, patient preparation, per-procedural imaging and presence of specific minimal invasive materials.
Anatomical variants of the biliary tree have been described by Scott Gazelle who noted that in 40% of patients there is no classic anatomy with a left and a right hepatic duct, but rather a trifurcation or drainage of either the right anterior or right posterior segmental duct into the left hepatic duct.
Various anatomical variants of the cystic duct have been described by Turner and co-workers.
Pre-procedural imaging is necessary to assess the cause and level of biliary obstruction or leakage and to rule out diffuse segmental obstruction in patients with liver metastases.
Patient preparation includes an IV drip, prophylactic antibiotics, analgesia such as fentanyl and a sedative such as midazolam.
PTBD, in general, and especially of non-dilated biliary ducts is preferentially performed with the combination of ultrasonographic and fluoroscopic guidance. In order to keep the procedure as minimal invasive as possible specific materials such as 22-Gauge Chiba needles, 0.018 inch guidewires, tapered 6F catheters, 0.035 inch hydrophilic and stiff guidewires, sheaths and hydrophilic drainage catheters should be available.
Additional techniques in order to facilitate drainage of non-dilated ducts may be the administration of contrast material through T-tubes, biloma drains, gallbladder drains or nasobiliary drainage catheters.
Relatively few manuscripts with small series of patients have been published of PTBD of non-dilated ducts. Conflicting results are reported regarding technical success and complication rates of PTBD of non-dilated ducts vs. dilated ducts. Most frequent complications are cholangitis, sepsis and bleeding.
In conclusion, knowledge of biliary anatomy, adequate imaging, optimal patient preparation and the presence of specific minimal invasive materials may facilitate to access non-dilated biliary ducts.

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1001.3

How to manage benign strictures and calculi

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Learning Objectives:
1. To review treatments for benign disease
2. To review techniques in benign biliary lesions treatment and calculi management
3. To review percutaneous and endoscopic approach

Intra- or extrahepatic biliary strictures and stones can be the result of various conditions. Biliary strictures can be the result of primary or secondary cholangitis and small stones tend to get formed above the strictures. Another common reason for extrahepatic stricture is intraoperative iatrogenic CBD injury, while multiple biliary duct confluence strictures can be the result of intraoperative thermal injury. Also, late stenosis of a bilio-digestive anastomosis can lead to similar problems.
ERCP is the primary interventional imaging method for the treatment of pathological problems of this area. However, when ERCP cannot approach the bile ducts, percutaneous transhepatic approach is indicative.
This can occur in the following situations :
a) in shortage of specialized medical staff or ERCP equipment,
b) when due to a previous operation the anatomy of the area has changed, thus making the catheterization of the biliary tree impossible,
c) when extensive benign or malignant stenosis of the gastrointestinal tract at any point prior to the ampulla of Vater or a duodenal diverticulum are present, and
d) when intrahepatic stones exist. These stones can either be multiple, impacted or located in isolated branches or behind stenoses.
Percutaneous treatment is initiated with the performance of PTC. Its technical success rate reaches up to 98% in patients with dilated, and up to 70% in patients with non-dilated biliary tree branches. PTC-Drainage of the dilated biliary tree is the second step. Transhepatic drainage can be performed through the right or the left liver lobe.
In patients with benign biliary strictures of the bile duct or the biliodigestive anastomosis, dilatation with high pressure balloons can be attempted prior to mechanical lithotripsy, followed by long-term internal drainage with large bore catheters 12-16 Fr.
Lithotripsy can be fluoroscopically performed with the use of special stone retrieval baskets or special retrieval balloons. It can also be performed with the use of percutaneous cholangioscopy assisted by intracorporal electrohydraulic lithotripsy. The lithotripsy success rate is as high as 92-100%, while multiple sessions within a period of three months may be necessary.

Conclusion and teaching points by the moderator:
Percutaneous transhepatic methods are useful in cases endoscopic or surgical treatment cannot help.
After initial drainage, application of percutaneous lithotripsy, aided mechanically or endoscopically, is an effective method.
In combination with a qualified surgical and endoscopic department, percutaneous methods constitute the necessary supplement for providing complete therapeutic services of benign biliary disease.

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1001.4

How to manage bile leaks and postsurgical complications

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Learning Objectives:
1. The etiology and incidence of biliary leaks
2. The techniques of bile leaks treatment
3. The possibility of combination of percutaneous and endoscopic approach

Bile leaks after laparoscopic cholecystectomy are normally easily treated but can be a cause of significant morbidity unless promptly diagnosed. Leaks most commonly occur from the Cystic Duct stump and less frequently from the tiny Ducts of Luschka penetrating the from the gallbladder bed into the superior surface of the organ. Bile leaks occur in about 1% of laparoscopic cholecystectomy patients but the incidence is higher after hepatic resection or transplantation. Persisting abdominal pain, fever or abnormal liver function tests should raise awareness of the possibility of a bile leak. Ultrasound examination will normally demonstrate free peritoneal fluid and allow the placement of a peritoneal drain for the relief of pain and confirmation of the diagnosis. Suction should not be applied to such a drain.
Although more complex intervention is occasionally recommended, ERCP with stent placement (not sphincterotomy) is the therapeutic method of choice and is virtually universally successful in closing the bile leak. The stent can be removed after six to eight weeks. Some have used nasobiliary drainage but this is intensely unpleasant for the patient and normally keeps them in hospital unnecessarily. Complications of stent placement for bile leak in this way are very low, pancreatitis in 1-3% being the most common. Any associated retained bile duct stone or biliary stricture needs treating in its own right. If endoscopic access is not possible then treatment is much more difficult as it relies upon trans-hepatic biliary drainage of a decompressed biliary system.
The rationale behind treatment, the management of tricky situations and follow up will all be discussed.

Special Session
Carotid lesions

1002.1

Update on recent trials for symptomatic and asymptomatic patients

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Learning Objectives:
1. To review the current literature
2. To learn about the guidelines of different important radiological, surgical and neurological societies
3. To learn how the study results and guidelines should be transferred to clinical praxis

Introduction: In the last decade several prospective randomized trials were performed in Europe and the United States which compared the outcome of carotid angioplasty and stenting (CAS) with carotid endarterectomy (CEA).

Results: A meta-analysis of the data of EV-3S, SPACE, ICSS, and CREST shows a tendency in favour of CEA concerning the ipsilateral stroke rate, but not mortality rate. The stroke rate depended on the age of the patients. CAS had better results for patients younger than 70 years (CREST) resp. 65 years (SPACE), whereas CEA had a lower stroke rate in elderly patients. The trials showed an equal mortality rate, but a significantly higher incidence of myocardial infarctions, of cranial nerve palsies – 1-2% of them permanent - and after-bleeding. A more thorough analysis reveals a number of shortcomings of the European trials. CAS interventionalists did not need credentialing with a sufficient number of procedures performed. Tutor-assisted procedures were accepted. We know from several sources, e.g. the German ProCAS registry, that experience with CAS is a highly significant outcome factor. Cerebral protection was not routinely used and platelet inhibition was often insufficient. Therefore, the European trials do not fulfil the criterion of "good medical practise".
The US trials like SAPPHIRE or CREST did not permit tutor-assisted CAS and had consequently better results. We also learnt from the studies that a better patient selection would influence the outcome. CEA had a much larger number of exclusion criteria than CAS. A better balanced evaluation of both methods requires more exclusion criteria for CAS like severe elongations and ulcerative atherosclerosis of the aortic arch.
The trial data were collected between 2000 and 2007, but none of them used proximal balloon protection which reduces the rate of strokes and of clinically silent diffusion impairments as revealed by MRI. New data from post-market trials have proven that the stroke and mortality rate of symptomatic patients can be kept below 5%

and of asymptomatic patient below 3%.

Conclusions: The quality of the European CAS vs. CEA trials is poor and of little help to evaluate the procedure. The benefit of symptomatic patients with CEA and now also CAS is well established. CAS can be recommended to asymptomatic patients when their life expectancy exceeds 3 years and the complication rate is lower than 3%. Ongoing studies like SPACE II and ICSS II will show within the next years if best medical treatment can compete with CAS and CEA in prevention of stroke.

1002.2

Plaque imaging characterization: how it relates to treatment modality selection

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Learning Objectives:

1. To learn about the different possibilities of plaque imaging
2. To learn about the clinical significance of plaque imaging
3. To learn when and how plaque imaging should be done and how it could influence the selection of treatment modality

Traditionally, the indication for carotid interventions was based on the degree of luminal stenosis, as it has been shown that symptomatic patients with >50% stenosis and asymptomatic patients with >80% stenosis profit the most from interventions. However, numbers needed to treat to prevent one ischemic event range from 4 to 7 procedures for symptomatic and 14 to 17 procedures for asymptomatic patients (1-3). These numbers were calculated in large cohort studies in the 90-ies based on average peri-procedural event rates between 3 and 7% with lower event rates reported for asymptomatic patients (1-3). While peri-procedural event rates have not changed dramatically during recent years, best medical treatment has improved substantially and recent studies (4) have suggested that event rates in medically treated patients are currently much lower than they used to be.

Given the large number of patients needed to treat to prevent an event, a low but substantial risk of peri-procedural events and an improvement of conservative treatment we should aim to find better criteria to identify those patients that profit most from carotid interventions. But how should we identify those patients? Recent studies have clearly demonstrated that the degree of luminal stenosis is insufficient to predict a plaque's vulnerability, e.g. 60% of all myocardial infarctions occur in vessels with ≤50% stenosis (5;6). Similarly, a prospective study published in 2011 in the New England Journal of Medicine (7) which used intravascular ultrasound has shown that most non-culprit coronary lesions responsible for follow-up events were angiographically mild at baseline (mean diameter stenosis=32%).

Recently, the concept of the "vulnerable" plaque has emerged. "Vulnerable" plaques are atherosclerotic plaques that have a high likelihood to cause thrombotic complications, such as myocardial infarction or stroke. Plaques that tend to progress rapidly are also considered to be vulnerable. In order to define vulnerable plaques a classification for clinical as well as pathological evaluation of vulnerable plaques was recently put forward, which proposed 5 major and 5 minor criteria, such as (8;9). "Vulnerable" plaques are atherosclerotic plaques that have a high likelihood to cause thrombotic complications, such as plaques with a thin cap and a large lipid-necrotic core, active inflammation, a fissured plaque, stenosis greater than 90%, endothelial denudation with or without superficial platelet aggregation and fibrin deposition, endothelial dysfunction, calcified nodules, intraplaque hemorrhage, glistening yellow plaques (seen at angioscopy), and outward remodeling.

In order to identify patients "at risk" and in order to distinguish between patients that profit the most from carotid interventions and patients that profit most from conservative therapy imaging methods are needed that are able to identify most - if not all - of the features of the vulnerable plaque. Although several imaging modalities, such as intravascular ultrasound (10) or computed tomography (CT) (11), have been in use to assess atherosclerotic plaques, this lecture will show that magnetic resonance (MR) provides the unique potential to identify most of the key features of the vulnerable carotid plaque (12). MR is non-invasive, does not involve ionizing radiation, enables the visualization of the vessel lumen and wall (13) and can be repeated serially to track progression or regression (14). Furthermore, the excellent soft tissue contrast provided by MR enables the evaluation of compositional and morphological features of atherosclerotic plaques with good correlation to histopathology (12). Recent studies have shown that MRI is able to differentiate symptomatic from asymptomatic plaques (15) and that certain MRI features, such as intraplaque hemorrhage or a thin/ruptured fibrous cap are associated with an increased risk of cerebrovascular events (16). Furthermore, data will be presented which will show the influence of preoperative plaque morphology as assessed by in vivo MRI on the peri-procedural risk and MRI-based literature that demonstrates that non-stenosing obstructive plaques can cause thrombembolic events in the carotid arteries (17). The potential of other non-invasive imaging techniques, such as CT, PET/CT and ultrasound will also be discussed.

In summary, this lecture will focus on the potential of non-invasive imaging techniques to characterize carotid atherosclerotic plaques and will discuss the potential of the different techniques to help to select the best treatment modality for each individual patient.

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1002.3

Restenosis: when and how to treat

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Learning Objectives:
1. To learn about the incidence of restenosis after surgery and CAS
2. To learn when a restenosis should be treated
3. To learn how restenosis should be treated

No abstract available.

Special Session
Lung cancer

1003.1

Clinical and imaging indications: how to select the patient

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Learning Objectives:
1. To discuss indications and contraindications of interventional treatment
2. To analyse results of clinical trials
3. To understand the role of interventional therapies in the management of lung cancer

The evolving field of pulmonary interventional oncology can be considered as a small integrative part in the complex area of oncology. The development of image-guided percutaneous techniques for local tumor ablation has been one of the major advances in the treatment of solid tumors. In patients who are deemed not to be candidates for surgery, various treatment strategies are available, including observation, conventional fractionated radiotherapy, stereotactic body radiotherapy and RF ablation. While it is generally accepted that observation and conventional radiotherapies offer survival rates that are inferior to the other therapeutic strategies, respectively - 5-year survival rates in the range of 6–14% and 10–27% – there is no standardized, clearly established therapy to offer patients in this situation (1,2,3,4). According to the American College of Chest Physician (ACCP) either stereotactic radiation therapy or percutaneous thermal ablation should be offered to patients who are medically inoperable (5). For selected patients, these technologies offer an optimal treatment option given their availability in the outpatient setting and low associated morbidity and mortality. In the category "thermal ablation" all energy sources that destroy a tumor with thermal energy are included, either by heat (hyperthermal ablation) which include radiofrequency (RF), laser and microwave (MW) or by cold (cryoablation or hypothermal ablation). The main objectives of pulmonary tumor ablation therapy (and other malignancies) are: 1) to eradicate all viable malignant cells in the target volume, with a safety margin to ensure complete eradication, 2) minimizing the damage to certain targeted volume will provide a good functioning reserve of the rest of the lung. This is particularly important for patient with limited pulmonary functions due to extensive underlying emphysema and fibrosis (6,7). The potential advantages of local tumor ablation therapy over surgical resection might include: 1) selective damage, 2) minimal treatment morbidity and mortality, 3) less breathing impairment in patients with borderline lung function through sparing healthy lung tissue, 4) repeatability, 5) fairly low costs, 6) excellent imaging during the procedure and for follow-up and last but not least, 7) the gain in quality of life with less pain, much shorter hospitalization times with the interventions performed on an outpatient base or with overnight stays and thus a quicker re-access to social life (8,9). Lung ablation can be a reasonable therapy even for selected patients with more advanced cancer. Such patients would include those with stage IIIb disease (based on a second nodule within the same tumor lobe) or stage IV disease based on a satellite nodule within another lobe. In addition, patients with advanced stage disease who may be treated with RF ablation include those who have responded to definitive radiation and chemotherapy but have a persistent solitary peripheral focus of cancer, and those who present with a recurrent isolated cancer after previous lung resection (10). Percutaneous thermal ablation is generally indicated for nonsurgical patients with metastatic cancer limited pulmonary metastatic burden. Approximately 30% of patients with colorectal cancer have pulmonary metastases, and in about 2–4%, these metastases are isolated (11). The number of lesions should not be considered an absolute contraindication to RF ablation if successful treatment of all metastatic deposits can be accomplished. Nevertheless, most centres preferentially treat patients with five or fewer lesions (12). The target tumor should not exceed 3–3.5 cm in longest axis to achieve best rates of complete ablation with most of the currently available devices 6. Radiofrequency ablation is considered contraindicated in the presence of tumors located <1cm main bronchi and when tumors are associated with atelectasis or obstructive pneumonitis (12,6). Thermal injury of hilar structures must be avoided because of the risk of a severe hemopthysis (13). In experienced hands, thermal ablation of tumors located in the vicinity of major vessels, like the aorta, and the heart has been shown to be feasible. In these cases, however, the risk of incomplete treatment of the neoplastic tissue close to the vessel may increase because of the heat loss by convection (14). In contrast to existing thermo-ablative technologies, however, microwave treatment offers several key theoretical advantages in this and in similar situations. These include efficacy on lesions with a cystic component and/or in proximity to vascular structures >3 mm in diameter with a reduction in the heat-sink effect, a larger volume of cellular necrosis, reduction in procedure times, greater temperatures delivered to the target lesion, the possibility of using multiple antennae simultaneously and less intraprocedural pain (15,16,17). In addition, MWA does not require placement of grounding pads (15). Patients with untreatable or unmanageable coagulopathy or with performance status >2 are not candidates for thermal ablation of lung tumors. The treatment is possible but at a higher risk of complication and should be performed by an experienced operator in patients that have undergone previous

pneumonectomy or when lesions are adjacent to major vessels or to the heart (18,14). Patient records, complete history, physical examination, and prior imaging studies should be evaluated to determine the indication and the feasibility of RF ablation. Biopsy should be performed before RF ablation in patients suspected to have a NSCLC, to confirm the diagnosis of cancer; however, in some high-risk patients, it is better that the patient undergo the risk of the biopsy and RF ablation in one setting (19). In case of lung metastases, histopathologic or cytologic confirmation should be obtained whenever there is atypical presentation or very late presentation after the primary tumor (20,21). Pretreatment imaging must carefully define the location of each lesion with respect to surrounding structures. Lesions located near or adjacent to pleura can be treated with RF ablation, although their treatment may be associated with pleural effusion caused by pleurisy brought on by the heat conducted. However, pleural effusion is usually small in amount, asymptomatic, and thus clinically insignificant (22). Treatment of subpleural lesions may be also more painful, and an adequate pain relief strategy must be foreseen (22,23). Pretreatment imaging is also aimed in evaluating the planned trajectory and the conditions of pulmonary parenchyma. In fact, it has been shown that the length of needle trajectory through aerated lung and the presence of severe emphysema represent important factors for the development of peri and post-procedural pneumothorax (22,24). Therefore, the electrode trajectory should be chosen to avoid fissures, to minimize the amount of aerate lung that needs to be traversed, avoid larger vessels and bullae (12). Preprocedural laboratory tests should include carcinoembryonic antigen (CEA) in patient with colorectal lung metastases and a careful patient's coagulation status. This includes measurement of the complete blood count, including platelet count, prothrombin time (PT)/international normalized ratio (INR). In some institutions the activated partial thromboplastin time, and/or cutaneous bleeding time are requested. An important issue surrounds management of antiplatelet (i.e., aspirin, ticlodipine, clopidogrel, IIb/IIIa receptor antagonists, nonsteroidal anti-inflammatory drugs) and/or anticoagulant drugs (i.e., warfarin) before and after the time of RF ablation. Antiplatelet medications should be discontinued several to 10 days before RF ablation. Antiplatelet therapy may be restarted 48–72 h after RF ablation. Even anticoagulant medications should be discontinued prior to RF ablation. Warfarin should generally be discontinued at least 5 days prior to RF ablation. Heparin and related products should be discontinued 12–24 h prior to RF ablation. Warfarin may be restarted the day following RF ablation. Clinical and imaging findings associated with a multidisciplinary team evaluation are the most important features to obtain high clinical efficacy and to avoid complications.

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1003.2

RFA in primary and metastatic lung cancer: technical tips and tricks

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Learning Objectives:
1. To describe techniques and devices used in lung ablation
2. To describe the imaging findings related to lung ablation
3. Tips and tricks in challenging cases

In the treatment of primary and metastatic lung tumor by radiofrequency ablation (RFA) a wide variety of different RFA systems are used, most commonly: RITA (Angiodynamics, Queensbury, NY), LeVeen (Boston Scientific, Boston, MA) and Cool-tip (Covidien, Boulder, CO). The latter two based on tissue impedance monitoring, whereas the first based on intratumoral temperature monitoring. Also, the electrode geometry differs with RITA and LeVeen using multitined expandable and Cool-tip straight internally cooled electrodes. The use of these different systems depends on treating physician, availability and tumor localization or configuration. Comparative studies regarding clinical efficacy are still lacking.

In most cases lung RFA is performed in curative intention which makes a preinterventional imaging work-up mandatory to exclude distant metastases, possibly changing the therapeutic concept. Thoraco-abdominal computer tomography (CT) or positron emission tomography (PET)-CT are useful modalities for this intention. The same imaging modality can be used to assess the target tumor for size, location and neighboring organs, which will influence the type of anesthesia, patient positioning, access route, additional maneuvers for safe access or ablation and configuration as well as size of the electrode. At this moment CT is the most accurate imaging modality for perinterventional imaging of lung RFA. Fluoro-CT results in very fast and accurate needle placement, at the risk of higher patient an operator dose compared to conventional CT-guided puncture. The possibility for multiplanar reconstruction facilitates an almost immediate assessment of the needle position in relation to the tumor or surrounding critical structures. Ground glass opacity surrounding the ablated tumor is an immediate indicator for treatment success after ablation. After 24-48 hours the ablation zone is clear visible and thereafter shrinkage of this lesion can be expected. Different postablational imaging patterns have been described with fibrosis as the leading pattern after 12 months in tumors <2cm, whereas tumors >2cm appear as nodules in the vast majority. The challenge for the treating physician remains to identify areas of incomplete treatment. MRI either contrast enhanced or diffusion weighted, PET-CT or growth of the ablated zone seem to be the most reliable imaging methods or features for detection of incomplete ablation. Due to the possibility of late recurrence extended follow-up imaging after treatment is required.

Even though a direct puncture followed by ablation of the lung tumor is feasible in most of the cases, different techniques for successful ablation of pulmonary tumors in critical location must be kept in mind. Artificial pneumothorax is a possibility to prevent thermal injury during RFA for tumors in contact with the heart, phrenic nerve or diaphragm. In selected cases artificial pneumomediastinum can be created for the same reason. Guiding needles can be used to speed up the procedure or to perform a biopsy at the same time as RFA through the same path. Anchoring of a tumor with a needle prior to puncture with the RFA electrode can be another technique to perform a safe ablation of a mobile pulmonary nodule. More sophisticated techniques like navigation devices could help in the future to create sufficiently overlapping ablations including the necessary safety margin for larger or irregular shaped lung tumors.

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1003.3

Update on results of RFA treatment

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Learning Objectives:
1. To define indications for RFA of primary and secondary lung cancer
2. To present results of RFA for primary lung cancer
3. To present results of RFA for lung metastases

Local success of RFA depends on tumour size and location. As the sole treatment modality RFA has been successfully applied to <3-3.5cm tumours, either primary or secondary. Larger tumours are usually ablated in conjunction with another therapeutic modality such as radiotherapy. Location next to >3-mm diameter blood vessels or bronchi can, but not necessarily, result in incomplete ablation. Local recurrence is higher in primary lung cancer than metastatic disease and so a larger ablative margin is recommended.

COLORECTAL METASTASES

Colorectal metastases form the largest single cohort of patients. Results from metastasectomy suggest a survival advantage. Number, distribution and speed of development of lung metastases are considered when deciding whether a patient is operable.

Surgical preference is given to fit patients with fewer than 3 metachronous metastases and no extra-pulmonic disease. Ablation is currently considered in inoperable patients. Our analysis of 133 patients who were not operable candidates but who had small volume colorectal lung metastases showed a 3-year survival of 52%. Significant factors were lesion size and the presence and type of extra-pulmonic disease. Median survival in patients with <3 cm tumours was 46 months vs. 28 months for larger tumours (p=0.03). Median survival in those without extra-pulmonic disease was 42 months, for those with synchronous, but ablatable, liver metastases 29 months and for those with other types of extra-pulmonic disease 16 months (p = 0.0065).

Results from other centres are not dissimilar. Median, 1-year, 2-year and 3- year survival of 33 months, 85%, 64% and 46% has been reported in one cohort of 55 patients with inoperable colorectal metastases (1). In the Rhode Island series 57 patients treated for local tumour control who had a median tumour size of 2.5 cm achieved a 3-yr survival of 57% (2). Chua et al reported on 100 non-surgical patients who achieved a median survival of 36 months and 5-year survival of 30% (3).

SARCOMA

There is good evidence that repeated sequential metastasectomy is beneficial. The reported 3-yr survival is between 30 and 54%, and the 5-yr survival is 15-40%, median survival of 12 -18 months. Nakamura et al reported on 20 patients with a mean of 7 metastases, mean size 1.4 cm. 1- and 3-yr survival were 58% and 29% overall, median 12.9 months but for the subgroup who had complete ablation of all visible disease the 1- and 3-year survival was 89% and 59% (4).

Our results of RF or MW ablation of 87 sarcoma metastases in 36 patients also reflect the therapeutic intent of ablation. Ablation can be used in inoperable patients with small volume lung only disease but also in operable patients for whom surgery would be inappropriate, too invasive at that particular time-point, or would interrupt other therapy. All of our patients treated with curative intent are alive at a median of 20 months, median survival for the non-curative group was still important, although not as good, at 23 months.

PRIMARY LUNG CANCER

Primary lung cancer patients are much more challenging. They often carry significant medical co-morbidity which makes ablation harder. Limited respiratory reserve and repeated infective exacerbations of underlying chronic obstructive pulmonic disease turn ablation from a very benign intervention into a more significant intervention. Recurrence rates are generally higher and margins may be harder to achieve in irregular, infiltrative, invasive tumours. A larger margin is generally recommended. In support of this one analysis of 91 patients with non-small cell lung cancer treated with ablation showed that recurrence was equally likely to be local or distant and therefore improved results could be anticipated with more aggressive local ablation (5).

Ablation has delivered reasonable survival data in early stage lung cancer. Hiraki reported on 20 non surgical patients with stage 1 non-small cell and showed that the cancer-specific survival at 2 years was 93% and at 3 years 83% (6). Pennathur reported on 100 patients with significant medical co-morbidities treated with ablation who achieved a 2-year survival of 49% (7).

The role of ablation relative to conventional treatment modalities is being established but more work is required. A retrospective comparison of sublobar resection, RFA and cryotherapy showed similar 3-year cancer-specific survival in all three groups (8). Kim et al compared matched patients with stage I lung cancer who underwent RFA (n=8) and surgery (n=14) and found no difference in overall survival (9).

Ablation can be used in isolation or in conjunction with radiotherapy. It is expected that the combination will be more effective than either treatment alone. One-, 2- and 3-year survival figures in 41 patients with inoperable Stage I/II lung cancer treated with RF and radiotherapy were 87%, 70% and 57% with a mean survival for tumours <3 cm of 44 months (10).

CONCLUSION

Ablation is a very effective tool for the local control of small volume lung tumours. This will be a major ablation application in a range of different clinical settings.

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Disclosure

Research for CoVidien, Galil, Microsulis

1003.4

Image guided radiation therapy versus interventional radiology

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Learning Objectives:

1. To describe technical aspects of image guided radiation in lung cancer
2. To describe indications and results of image guided radiation in lung cancer
3. To understand the role of image guided radiation with respect to other therapies in lung cancer

No abstract available.

Special Session
Innovators in IR

1004.1

The Guenther Tulip filter

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Learning Objectives:
1. To explain the motivation to develop a new medical device
2. To explain the role of accident and fortune in developing a new filter
3. To understand the various steps from an idea to a product

Very often a clinical problem and the search for a solution lead to new techniques and products. Most important factors in developments are innovative ideas, basic and applied research and availability of suitable technologies. Sometimes translation of a new idea into a new technique or product will end in a cul-de-sac. "Trial and error" is probably more often seen rather than "trial and success". A good example is the Porstmann's "caged balloon" in the search for an angioplasty balloon tolerating higher pressures.

Theoretically, there are several potential ways to go, e.g. from an idea to a particular clinical application or from a clinical problem to a solution or from an already existing solution to a modification, improvement or extension. The right technical partner for the realization of a new device is of the utmost importance on the way to success.

It is a long way from an innovative idea to a device that can be used clinically. Medical products have to be approved by the authorities in a lengthy process to assure the safety and effectiveness of a device. FDA approval in the United States of America is a prerequisite for clinical application, whereas in Europe there are EU directives regulating approval. Products are classified into low, medium and high-risk devices. The latter include, e.g. stents and caval filters. Certified medical devices will obtain a CE mark.

Examples of successful stories in Interventional Radiology include, e.g. the development of balloon catheters, stents, thrombectomy devices, embolization materials and also caval filters. Caval filters have been around since the development of the Mobin-Uddin and the Greenfield filters in the late 1960s. Because of the large calibre of the introducer systems used at that time, we developed together with COOK Medical a basket filter for percutaneous introduction using a small calibre (8.5F ID) introducer sheath in 1983.

Despite successful experimental testing, clinical use revealed asymptomatic fatigue fractures of the filter struts in the long-run. This prompted us to develop a new filter, the Günther Tulip filter, which was designed for percutaneous introduction, but also percutaneous retrieval (1992). This was the first optional filter. For safety considerations, retrieval was limited initially to 10-14 days postimplantation. Later on, it turned out that filter retrieval was possible even after longer periods of time. The Tulip filter has become a successful and established protective device against pulmonary embolism world-wide. In view of the long-term sequelae of filters in general (postthrombotic syndrome), however, filter retrieval even after longer dwell-times is a desirable feature.

For that purpose, we finally modified this filter by opening the loops of the Tulip leafs in order to facilitate extraction even after ingrowth of the anchoring legs into the caval wall (Celect filter/COOK). This story exemplifies the stepwise progress in filter development from a large to a small calibre device and from a permanent to a retrievable and finally optional caval filter. The key to success was to identify the clinical and technical problems and to find a safe and effective solution in close cooperation with a competent industrial partner having access to the necessary technology and the market.

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Disclosure
Patent holder together with Cook Medical

1004.2

The early days of embolization

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Learning Objectives:
1. To describe the pioneers of embolization
2. To describe how embolization started
3. To review early embolic agents
4. To review early embolization procedures

No abstract available.

1004.3

The Bolia technique

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Learning Objectives:
1. To explain the motivation to establish a new medical technique
2. To explain the role of accident and fortune in developing a new revascularization technique
3. To understand the various steps from an idea to a new technique

In January 1987, a 65-year-old male patient presented with intermittent claudication of 150 meters in the left leg, which he had for over 1 year. No pedal pulses were detected and the ABPI was 0.5. A diagnostic angiogram revealed a 12-cm occlusion of the popliteal artery. During attempted crossing of the lesion, with a Teflon coated 1.5 mm J wire, a dissection occurred accidentally. There was also a small perforation in the mid popliteal artery. As the 'J' wire was pushed further, it formed a 'U' loop, which re-entered the lumen distally without any difficulty. The occlusion was dilated with a 7 French 5 mm x 4 cm balloon. Whilst cosmetically it was a poor result, showing extensive dissection and perforation, haemodynamically it appeared to be an excellent result, shown by very fast flow.

The ABPI next day was 0.95, and subsequently the patient was asymptomatic in that leg. A follow-up angiogram three months later (done when the patient came to have his other leg treated) showed an excellent cosmetic and clinical result.

The success of this result and subsequent 'accidental' crossings of total occlusions through dissections reinforced a view that acceptable results could be achieved through the dissection route,

subsequently called subintimal angioplasty.
The success in the femoropopliteal segment was extended to other areas such as tibial, profunda, brachial, subclavian, iliac and even superior mesenteric arteries.
The standard Teflon coated 'J' wire in 1990 was superseded by hydrophilic curved and subsequently the 1.5 mm 'J' wires for crossing femoropopliteal and tibial occlusions. The introduction of a 'Bolia minicath' has transformed the treatment of flush SFA occlusions.
The standard retrograde approach for iliac occlusive disease, especially the common Iliac artery invariably results into a dissection and subsequent difficulties to achieve re-entry into the proximal segment (aorta). This has prompted the development of the outback catheter (Cordis J&J), now commonly used in common iliac occlusive disease.
The technique has had major impact on the treatment of occlusive disease, particularly in challenging situations like flush superficial artery occlusions, long tibial occlusions, bifurcation occlusion of common femoral artery and trifurcation occlusions extending into all the run off vessels. Without subintimal angioplasty, these situations would be very difficult to treat endovascularly. The technique has had the most impact on patients with critical limb ischaemia, achieving limb salvage rates of near 90% and in many of these cases, surgery would not be applicable. For intermittent claudication, promising results have been demonstrated, but still probably do not match the results of bypass surgery, especially when a vein is used. Best results for subintimal angioplasty are obtained when patients are entered into a surveillance programme, so that stenosis can be treated before it becomes an occlusion, thus improving secondary patency.
The technique is also used for crossing total occlusions before implanting a bare metal stent (BMS), drug eluting stent (DES), or a covered stent, otherwise called endolining. It has also been suggested that a drug eluting balloon (DEB) may have favourable outcomes.

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1004.4

The development of MR guided interventional radiology

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Learning Objectives:

1. To learn about the difficulties involved in MR guided IR, and how they have been overcome to date
2. To learn about specific procedures performed today, in which MR guided IR is particularly useful
3. To learn about current work in progress and future developments regarding MR guided interventions

This talk will describe the earliest manifestations of MR-guided interventional work alongside with the machine technological changes that have been utilised to try and unable work in this field to occur. The differences between the different types of open magnets will be described and how work was adapted to utilise these different magnet configurations. Surgical MR-guided procedures ablation procedures using MR compatible ablation materials will be described. The necessary modifications required to convert conventional equipment to MR compatible equipment will be outlined. The problems of the hostile environment of the magnet will be described and how they have been overcome to lesser or greater expense in various applications and how the future of MR-guided intervention is developing. Current developments using MR-guided focused ultrasound are in many ways the successors to the initial MR-guided interventional procedures and they will allow therapeutic energy to be applied in such a targeted manner that no invasion will be required at all. The areas of application of MR-guided focused ultrasound currently under investigation across the world will be outlined and the variety of projects that have been developed will be described. Nature of modifications and procedure alterations that need to be developed to allow successful projects to be undertaken using MR focused ultrasound guidance will be briefly outlined. Projects involving fibroid ablation, liver ablation, prostate ablation, facet joint ablation, breast cancer ablation, brain tumour ablation and opening up of the blood brain barrier and functional neurosurgery done noninvasively will be mentioned to illustrate these points.
The overall scope of MR intervention is very wide and only limited areas can be effectively mentioned in such a brief description. The current state of the machine technology with wider bore shorter magnets that allow some degree of access whilst maintaining high image quality will be discussed. In previous more open magnet manifestations which allowed greater access to patients during MR scanning quality was always compromised because the tradeoffs made to allow the open environment usually meant that field strength and gradient strength were significantly reduced resulting in relatively poor quality very fast near real-time MR images. The current crop of wider bore 1.5 Tesla scanners hold out the opportunity of carrying out high-quality imaging with some degree of patient access to allow these procedures to be done.
The future for MR intervention therefore lies between higher quality wider bore scanners allowing some instrumentation to patients in a less closed environment than a conventional MR scanner and the

development of MR-guided focused ultrasound.
The potential therefore for the descendants of the initial MR-guided technological developments is intervention so minimal that there is no breach through the skin but rather all procedures are carried out as closed image-guided procedures requiring the minimum of hospitalisation and maximising the rapidity of patients return to normal activities and work often within one-day post-procedure therefore allowing maximum cost benefit for such a procedure despite the utilisation of machinery that has a higher initial capital cost.

Disclosure

I act as a consultant to Insighetec who make hte focussed ultrasound equipment that my unit uses.

Hot Topic Symposium
Is CCSVI a real entity? Should we treat MS patients with CCSVI by venoplasty?

1201.1

The Neurologist's view: basics and clinical signs of MS

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Multiple Sclerosis (MS) is believed to be an autoimmune disease of the central nervous system (CNS) caused by antibody-mediated damage of the central myelin sheaths (demyelination) of axons in the brain and spinal cord (encephalomyelitis disseminata). It affects mostly young adults, females more than males. Symptoms are due to localized inflammatory lesions in the cerebral and spinal white matter that occur at disseminated locations and times. Diagnosis is based on the clinical course, signs and symptoms, MR-imaging, and typical CSF findings.
Most patients experience episodic deteriorations or discrete attacks (relapsing-remitting course), although symptoms can also develop in a slowly progressive manner (primary or secondary progressive course). Symptoms and signs depend on the location of the cerebral lesions and may include visual loss, weakness, motor control, sensory disturbance, or cognitive functions. The degree of disability is usually measured by the Expanded Disability Status Scale (EDSS).
Strong evidence suggests that both T- and B-lymphocytes contribute to the inflammatory process resulting in later axonal loss and atrophy of the brain. The inflammatory and autoimmune pathogenesis is further supported by the effectiveness of anti-inflammatory and immune-modulatory compounds used in the treatment of the disease. Although there is no cure, very effective disease modifying drugs are available; such as interferons, gatiramer acetate, mitoxantrone, natalizumab, and a number of recently approved oral drugs. Furthermore, monoclonal humanized antibodies that deplete specific subgroups of lymphoctes such as alemtuzumab (antibody against CD52 lymphocytes) or daclizumab (interleukin receptor CD25) seem to have very strong effects on the disease activity and the disability. However, genetic (polygenetic) predisposition and environmental factors (anteceding infection) might influence the occurrence of the disease.

1201.2

Venous congestion in CCSVI: research data

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Multiple sclerosis (MS) is an autoimmune central nervous system disease with polyfactorial etiopathogenesis and is characterized by demyelination centered around cerebral veins. Recent studies have suggested this topographic pattern may be caused by venous congestion, a condition termed 'chronic cerebro-spinal venous insufficiency' ('CCSVI'). Five parameters of venous drainage anomaly ("CCSVI criteria") were postulated by transcranial and extracranial color-coded duplexsonography (ECCS) and a perfect overlap of impaired extracranial cerebral venous outflow with an MS diagnosis was reported. These findings caused exorbitant interest among scientists and clinicians, in patient support groups, and the non-medical media. However, further studies applying various techniques such as sonography, magnetic resonance angiography and selective venography failed to reproduce or to support the CCSVI hypothesis. Nevertheless, endovascular treatments are increasingly being performed outside clinical trials, misleading MS patients to believe that these procedures are harmless while a proof of this and of a clinical benefit is lacking.
The presentation summarizes the data published so far regarding the "CCSVI" hypothesis and presents a critical analysis of the original "CCSVI" criteria under special consideration of the cerebrocervical venous anatomy and hemodynamic. Furthermore, the findings from our own studies, which argue against a causal relationship between venous congestion and MS, will be discussed in detail:
1. An observational ultrasonographic study in 56 patients and 20 controls showed no significant differences regarding the prevalence of "CCSVI" parameters nor further hemodynamic parameters such as the venous blood flow velocity and blood volume (BVF).
2. A second trial compared ECCS with MR-Venography (MRV) in 40 patients. Three groups were analysed based on regional internal jugular vein lumen reduction found by MRV: ≤50% (n = 12), 51-80% (n = 19) and >80% (n = 9). ECCS, however, showed IJV-narrowing in one patient and a significant reduction of BVF was observed only in the latter group.

1201.3

CCSVI is real and we should treat MS patients by venoplasty

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No abstract available.

1201.4

There is no evidence for CCSVI or its treatment in MS patients

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Regarding the discussion on CCSVI I hereby want to refer to the IDEAL document published in the lancet in 2009.(1) This document, which is paraphrased below deals with how, in a scientific way, new technologies and interventions should be introduced. None of the criteria in Ideal document is applicable to the current introduction and promotion of treatment of an anatomical variation, by some called CCSVI, to improve patients with MS.
Invasive therapies are complex interventions, the assessment of which is challenged by factors that depend on operator, team, and setting, such as learning curves, quality variations, and perception of equipoise. In the ideal paper recommendations are made for the assessment new interventions based on a five-stage description of the development process. They also encourage a widespread use of prospective databases and registries. Reports of new techniques should be registered as a professional duty, anonymously if necessary when outcomes are adverse. Case series studies should be replaced by Prospective (and no case series) development studies should be done for early technical modifications and by prospective

research databases for later pre-trial evaluation. Protocols for these studies should be registered publicly. Statistical process control techniques can be useful in both early and late assessment. Randomised trials should be used whenever possible to investigate efficacy, but adequate pre-trial data are essential to allow power calculations, clarify the definition and indications of the intervention, and develop quality measures. Alternative prospective designs, such as interrupted time series studies, should be used when randomised trials are not feasible. Established procedures should be monitored with prospective databases to analyse outcome variations and to identify late and rare events. Achievement of improved design, conduct, and reporting of new intervention research will need concerted action by editors, funders of health care and research, regulatory bodies, and professional societies.

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Honorary Lecture
Andreas Gruentzig Lecture

1202.1

Evidence based interventional radiology - not how but if and when

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"Not how but if and when" was my original title for this lecture but it was suggested by the CIRSE office that a clearer title might be more useful. Therefore I have added "evidence-based interventional radiology", easily understood by all but perhaps practised by a minority? Harsh words perhaps but now is the time for interventional radiologists to reflect on their practice and indeed the practice of the entire specialty.

"Not how but if and when" means what it says. As a heavily technique-based specialty we now need to move on to a higher level of understanding and practice. "Should I be doing this procedure (e.g. venoplasty on this patient with multiple sclerosis)? And if so when? Should I be doing vertebroplasty, carotid stenting, EVAR and renal stenting on my patient?" These are easily understood questions, but are much more challenging to answer.

Clearly we need to know how to perform procedures safely within agreed standards. With constant technological advances in IR it's easy to see how the "how to do it" mentality has become a major focus or even obsession for all of us. Traditionally seen as a non-bed-holding specialty, many expect us to simply carry out the requested procedure without any further consultation. In a busy work environment it is often easier and quicker to "do it" rather than "question it", rather like an ultrasound request. One important difference, however, is that an unnecessary ultrasound scan is unlikely to do any harm, whereas an inappropriate IR procedure carries the risk of morbidity and occasional mortality. Surgeons learnt this many years ago: good surgeons know how to operate, the very best surgeons know when not to. We interventional radiologists also need to wake up to this.

So how do we decide whether a procedure is appropriate for a patient? In the past this was done by anecdote or, in other words, based on our individual experience; "the last iliac angioplasty did well so I`m going to do it again." Far better though to make that decision based on the accumulated experience of many interventional radiologists who have seen tens-of-thousands of patients, rather than just one. These are the roots of evidence-based medicine.

Interventional radiology is very fertile ground for evidence-based medicine. This has already been recognised by other specialities and research-funding bodies. In the U.K., for example, vascular surgeons and neurologists have been driving research in EVAR and carotid stenting respectively. IR is obviously involved in this research but all too often in a facilitatory rather than leadership role. We should not despair, although there is still much to be done. Knowledge gaps in IR can make you gasp; for example where is the evidence that embolisation stops haemorrhage and saves lives? We all think it stops bleeding, but is it more effective than surgery? Is prophylactic embolisation for high risk pregnancy effective? Is emergency EVAR superior to open surgery for ruptured aneurysms? Is aspirin as good as a carotid stent? Do drug eluting stents reduce amputation rates in diabetics? I could go on.

There will be those who say they know an IR procedure works and seek no further reassurance, that trials can`t be done, or are unethical. Open your eyes: some of these difficult trials are already underway and others are in an embryonic form. We should not shy away from evidence-based IR but embrace it; we need to be comfortable with uncertainty and equipoise and share it with our patients. After all, you can only persuade a patient to participate in a clinical trial if you are comfortable that you personally do not know the answer to the question being asked.

The world has moved on since the halcyon days when interventional radiology "rode on the crest of a wave". Healthcare costs have rocketed and together with an aging population countries and governments struggle to contain costs. We need to prove that what we do is effective, safe, superior and more cost-effective than the alternative therapy. Regulatory control of medicine in only going to become increasingly robust.

Fortunately there are increasing numbers of clinical trials progressing in IR, within the vascular, non-vascular and oncological fields. We have a very promising future provided we "empty our minds" and help generate the questions and answers of the future. It's fundamental to our very survival.

Foundation Course
Management of vertebral fractures

1601.1

Clinical and imaging inclusion criteria

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Learning Objectives:

1. To present necessary imaging features and clinical correlation to disease
2. To show clinical tests and their relation to imaging
3. To portray patient management prior to vertebroplasty

It is a fact that 80% of the European population will experience at some point in their life an incidence of back pain. Part of the back pain incidence is attributed to vertebral fractures.

As minimal interventional procedures are gaining momentum in musculoskeletal interventional pain procedures, clinical evaluation of patients with back pain becomes a necessity, prior to treatment.

The interventional radiologist involved in pain management, specifically with vertebral augmentation and peripheral osteoplasty, should not only be able to interpret imaging findings but also be able to correlate those to clinical findings and establish a comprehensive patient treatment.

In this course we will try to analyze the imaging characteristics relative to vertebral fractures and integrate them to the clinical tests that will increase the level of certitude for a successful treatment.

Part of the course will be to develop algorithms that will include the whole armamentarium of interventional pain procedures and their relation to each other in order to establish faster pain control and

possible healing of osteoporotic and metastatic lesion.
We will analyse indications for bone biopsy, cement augmentation, radiofrequency ablation, focus ultrasound and their respective roles to medical treatment and radiotherapy.
The aim of our course is to help the interventional radiologist to comprehend and to develop a "one stop" pain clinic that will include diagnostic procedures, clinical correlation and a final comprehensive therapeutic treatment.

1601.2

Vertebral augmentation

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Learning Objectives:
1. To present the pertinent anatomy for vertebroplasty
2. To describe different techniques of vertebral augmentation
3. To review material for vertebral augmentation

Different percutaneous procedures to treat vertebral compression fractures have been reported. All aim at restoring vertebral body height (augmentation) and stabilization of the fracture. Vertebral compression fractures in osteoporotic patients are still treated with simple and cost-effective vertebroplasty.
Traumatic fractures (A1) in non-osteoporotic patients are the best indications of augmentation techniques (Kyphoplasty and stenting) with use PMMA of phosphocalcic cement. Viscous cements are particularly useful in hypervascular fractures and/or with high risk of leakage. Eventually, tumoral fractures can be treated with vertebroplasty associated to cavitation or ablation in specific cases. All systems and techniques have advantages and drawbacks. We emphasize on the specific indications of each technique and system and propose some tips and tricks to avoid complications.

1601.3

What can go wrong?

T. Sabharwal;
Department of Radiology, Guy's and St. Thomas' Hospital, London, United Kingdom.

Learning Objectives:
1. To review the present literature on complications
2. To show all possible complications and strategies to avoid them
3. To display cases and patient management post vertebroplasty

No abstract available.

1601.4

Clinical results and future developments

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Learning Objectives:
1. To review data from studies about vertebral augmentation
2. To discuss new technical approaches
3. To present future trends related to vertebral augmentation

Year 2000 estimated 9.0 million osteoporotic fractures of which 1.4 million were clinical vertebral fractures [1]. Spine is a common site of cancer metastatic spreading, with 50%-80% of patients presenting with spinal lesions during their disease [2]. These fractures cause pain, disability, diminished quality of life, decreased survival [3], an increased risk of future vertebral fractures in osteoporosis [4] and poor clinical conditions in malignancy. Vertebrae can heal with non-surgical management that includes analgesia, radio-chemotherapy, physiotherapy and brace support but pain can resolve slowly and persist [5; 6]. In these patients vertebral augmentation achieved by vertebroplasty and kyphoplasty have gained world-wide application as an effective treatment for back-pain due to vertebral collapses refractory to conservative treatment [7-11]. Both procedures can achieve a significant and durable pain relief with improvement in daily life performance and can increase survival also as recently published [12]. Vertos II study randomized vertebroplasty against conservative care in 202 patients: vertebroplasty resulted in greater pain relief than did conservative treatment; difference in mean VAS score between baseline and follow-up was -5.2 (1 month) and -5.7 (1 year) after vertebroplasty, whereas -2.7 and -3.7 after conservative treatment. Difference between groups in reduction of mean VAS score from baseline was 2.6 (1 month-$p<0.0001$) and 2.0 (1 year-$p<0.0001$) [13]. These favorable clinical outcomes were supposed to be inducted by placebo effect by two studies published in NEJM [14; 15]. This is different from what others published trials described [11; 16] if correct indications are respected. Another issue against vertebral augmentation is the increased risk of a new vertebral fracture [17-20]. In our personal experience of 3105 patients (2041 osteoporotic), pain relief was achieved in 2987 patients (96,2%): average VAS of 7,9±1,6 significantly dropped to 1,2±1,7 ($p<0.0001$); a new symptomatic osteoporotic vertebral collapse occurred in 262 (12,8%) osteoporotic patients. Among 2223 patients that wore the external brace, 2043 did not longer use it after. These results convinced us that NEJM "placebo effect" is probably due different patients' selection criteria.
Future developments include vertebral stenting [21] and biological bone cement [22; 23]; they are aimed to improve vertebral height restoration achieved by kyphoplasty and to optimize cement integration within the cancellous bone stimulating bone formation and ingrowth allowing, in the future, a prophylactic vertebral augmentation in osteoporotic patients with an high-risk of vertebral collapse and enlarging indications to young patients with trauma.

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Disclosure
Consultant of Medtronic

Special Session
Long SFA occlusions

1602.1

How good are drug eluting balloons?

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Learning Objectives:
1. To learn about the different types of drug eluting balloons
2. To learn about the results of current trials
3. To learn if and when drug eluting balloons should be used in clinical routine

How good are drug eluting balloons?

In order to answer this question both the efficacy and the possible limitations of drug eluting balloons have to be considered. The current basis for this is the data of the Thunder- and FemPac trials done with the Paccocath-Cotavance Catheter (Medrad) and the Levant One Trial with the Lutonix catheter. In addition there are some anecdotal information from drug eluting balloons available which have CE marc and which are used in the daily practise in Europe - mainly the Medtronic Invatec catheters for both the SFA and BTK indication. The current trials have shown that drug eluting balloons in lesions with a mean length of around 8 cm can significantly reduce the restenosis rates compared to non-drug-eluting balloons. Different coatings have shown to be safe and effective – even it has to stated that is most likely that despite the same drug (paclitaxel) and the same amount on the balloon surface the efficacy of the balloons differ. At the end the total amount of drug delivered to the arterial wall drives the long-term clinical outcome. This amount is dependent on the way the drug is adsorbed to the balloon.

On possible limitation of drug eluting balloons could be that the effect in prevention of restenosis is limited to a certain time, only resulting in a catch up of restenosis in longer follow-up. At least this is not true for the Paccocath-Cotavance catheter where data are available until two-year follow-up.

It has to be stated that the current data with DEBs are limited to more easy lesions which are not too long and which show not too much calcification. At least in our daily practise we could show that severe calcifications of the vessel wall are limitations for drug eluting balloons. This might overcome by atherectomy prior to the use of DEBs, nevertheless data are currently lacking. In addition, it is currently unclear of DEB together with self-expanding nitinol stents work. It might be that the chronic outward force of these stents might not be sufficiently addressed by the short time application of drugs.

In summary, the DEB technology is just in the early phase. It is most likely the early enthusiasm about this technology will be overcome by the notice that there are also some limitations of this technology. These limitations might be overcome by additional technologies like atherectomy in order to prepare the vessel wall for better drug uptake. In general, the DEB technology has also to be evaluated compared to other new technologies like the drug eluting stents. In the future we will learn much more about the indication of the different technologies based on the lesions characteristics.

In addition, it is not likely that all lesions will require the same amount of drug. In more complicated lesions or lesions with a higher likelihood of restenosis like in-stent restenosis or lesions in diabetic patients only a higher dose might be effective. On the other hand, higher dose might be followed be side-effects like aneurysms. Nevertheless, there are currently no clinical data that doubling the dose results in effects like this. In the Thunder trial the overlapping zone of DEBs was analysed – no undesired effects were noted.

Disclosure
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1602.2

How good are drug eluting stents?

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Learning Objectives:
1. To learn about the different types of drug eluting stents
2. To learn about the results of current trials
3. To learn if and when drug eluting stents should be used in clinical routine

The use of drug-eluting stents for the management of long segment peripheral arterial occlusive disease involving the superficial femoral artery (SFA) has been a topic of great interest over the last decade. In an effort to address the limitations of percutaneous balloon angioplasty (PTA), bare metal stent placement and a number of other endovascular devices (atherectomy, laser, cryoplasty, etc.), enthusiastic attempts to translate the benefits of drug-eluting stent technology applied with success in the coronary circulation to peripheral arteries have met with mixed results. Clearly, the well-documented frequencies of re-stenosis following PTA (12-month patency rates of 35% to 45%) and bare metal stenting (12-month patency rates of 60% to 70%) compromise the long-term patency and clinical benefits of these procedures. The success of both of these established endovascular therapies are closely related to the length of the diseased segment treated. In other words, failure is directly proportional to lesion length. The initiation of drug and device combination therapy with the development of self-expanding drug-eluting stents for the SFA is an approach designed to provide a physical/mechanical scaffolding to support the artery against the effects of recoil, dissection flaps, etc., that are likely to occur when treating a long (>10 cm) lesion, while delivering a pharmacological agent directed at preventing smooth muscle cell proliferation, intimal hyperplasia and resultant re-stenosis in response to the intervention. In this regard, to date three trials of drug-eluting stents in the SFA are worthy of discussion.

The first study performed in this area is the SIROCCO trial, a double-blind, randomized, prospective feasibility trial in the SFA. 36 patients were enrolled and randomized. The mean lesion length was 8.5 cm and 57% of the SFA lesions were occlusions. The primary effectiveness end-point was in-stent percent mean diameter stenosis determined by quantitative angiography follow-up at six months. The stent used was the SMART stent and the drug was sirolimus (dose: 140ug/cm). A permanent polymer in two formulations (slow and fast release kinetics) was employed to bind the drug to the stent. At 6 months, the mean % diameter stenosis was 22.6% in the sirolimus-eluting stent group and 30.9% in the bare stent group. The in-stent mean lumen diameter was significantly larger in the drug-eluting stent group (4.95 mm versus 4.31 mm, P=0.047) and the binary in-stent re-stenosis was 0% in the sirolimus-eluting stent group and 17.6% in the uncoated stent group. At 18 months follow-up, the re-stenosis rates were no different between the two groups; however, all of the restenosis observed in the sirolimus-eluting stent group occurred in the devices that included a fast-release polymer formulation. Patients who had devices with a slow-release kinetic formulation had no re-stenosis. Subsequently, a second phase of the trial was initiated (SIROCCO II) that used only the slow-release polymer formulation. At 24 months, pooled data from the SIROCCO I (slow-release formulation only) and II phases in 93 patients (47 received the sirolimus-eluting stent and 46 the bare SMART stent) showed no difference in the re-stenosis rates. The average lesion length was 8.3 cm. The re-stenosis rate in the sirolimus group was 22.9% versus 21.1% in the bare stent group (P>0.05). The target lesion re-vascularization rates (TLR) was 6% (sirolimus-eluting stent group) and 13% (bare stent group).

The second trial that merits attention is the STRIDES single arm study that investigated the Dynalink-E drug-eluting stent, a combination of a self-expanding nitinol stent, Dynalink, coated with a permanent polymer impregnated with everolimus. Everolimus is similar in structure and action to many of the drugs in the limus family, like sirolimus. The EVAL polymer used in the formulation was designed to provide 80% elution of the drug by three months, a prolonged timeframe for release that is slower than that studied in SIROCCO. 106 patients were enrolled. 91% of the lesions were de novo and 9% re-stenotic (no in-stent restenosis). The mean lesion length was 9.0 cm and 45% of the lesions were occlusions. The promary patency at 6 months was 94.1%; however, this fell markedly to 68.5% at 12 months. The corresponding rates for TLR at 6 and 12 months were 95.2% and 70.0%. When compared to the patency rate for an identical bare stent platform studied in the ABSOLUTE trial (51 patients with a comparable mean lesion length of 13.2 cm) there was no major difference at one year, with a 63% patency in the bare stent group.

The third and final drug-eluting stent platform evaluated in SFA lesions is the Zilver PTX, combination of a self-expanding nitinol stent, Zilver, and the drug paclitaxel, applied as a coating to the stent without use of a polymer or binder. The dose of paclitaxel is 3 ug/mm. Two clinical studies of this drug-eluting stent have been performed: a single arm study of 787 patients in Europe, Canada and Korea, and a randomized trial of 474 patients in the United States, Japan and Germany. In total over 1000 patients and 2000 stents were evaluated. The randomized study had a unique trial design which employed a primary randomization of patients to PTA or Zilver PTX. The mean lesion length in these patients was 6.6 cm and 27% of the SFA lesions were occlusions. In those patients who experienced an on-table failure of PTA based on pre-specified criteria, a secondary randomization occurred. In these patients with PTA failure, they went on to receive either a Zilver PTX stent or an identical bare Zilver stent. In this trial, 50% of the initial PTA procedure were sub-optimal and thus, in this group of failed PTA patients, 59 patients had bare Zilver stent implantation and 61 had Zilver PTX stent placement after secondary randomization. At 12 and 24 months the patency rates for the Zilver PTX group versus the group that experienced a successful PTA were significantly different at both time intervals (P<0.01, P=0.029). The Zilver PTX group patency was 83.1% and 74.8% versus 64.5% and 57.8% in the successful PTA group. Perhaps, more interesting are the results of the secondary randomization groups for those patients who experienced an immediate PTA failure. At 12 and 24 months the patency rates for secondary Zilver PTX were 89.9% and 81.2% and for secondary bare Zilver were 73.0% and 62.7%. At both time intervals, the difference between the two groups was statistically significant (P<0.01 at both points). The difference in 24-month re-stenosis represents a 50% reduction in the re-stenosis rate with Zilver PTX versus bare Zilver. It is important to note that the mean lesion length in the randomized trial was relatively short and although the maximum lesion length permitted for enrollment was dictated by the regulatory bodies overseeing the study, the results beg for investigation of longer, more real world lesions.

The Zilver PTX Single Arm study did enroll essentially all-comers with SFA disease, including 20% with in-stent re-stenosis. The mean lesion length in this group was just over 10.0 cm. It turns out that the results are quite complementary with the randomized trial data. Overall, the TLR rates for patients with Zilver PTX stents at 12 and 24 months are 91.1% and 84.3% in the single arm study experience and 91.1% and 86.5% in the randomized trial. When a subgroup of patients with long lesions form the Zilver PTX Single arm study is evaluated, it is possible to assess the potential benefit of paclitaxel-eluting stents in extensive SFA disease. Out of the total number of lesions treated (n=900), 133 had a de novo lesion with a length greater than 15 cm. The mean lesion length in this subgroup was 22.6 cm. 83% of these lesions were total occlusions. The patency rates for these long lesions at 12 and 24 months were 94.3% and 77.0%, respectively.

The future for drug-eluting stents for the management of long SFA lesions is unknown. The results to date have been mixed with no sustained difference from bare metal stent patency rates with permanent polymer-based, limus drug coatings (SIROCCO and STRIDES) and a significant reduction in restensis over bare metal stents with a paclitaxel coating and no polymer (Zilver PTX). Other factors to consider during future evaluations of drug-eluting stent programs in th SFA include: stent fracture rates (20% in SIROCCO, 0.9% Zilver PTX-randomized trial, 1.5% Zilver PTX-sArm study, etc.), the effect of the polymer formulation used in the device (permanent polymer, bio-degradable polymer, no polymer), the patterns of restenosis observed (initial experience indicates that drug-eluting stents share

a focal lesion as the most common morphologic pattern of re-stenosis as opposed to the diffuse pattern of disease frequently encountered after bare metal stent placement), and the opportunities for new endovascular technologies (drug-loaded balloons, bioresorbable stents, etc.) to more effectively manage the failure modes of drug-eluting stents when re-stenosis does occur. The challenge over the next few years will be to more precisely define which subsets of patients, if any, can expect to experience a sustained clinical benefit from this technology and a clearly demonstrated incremental value over existing standard therapies for the management of SFA disease

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Disclosure

Member, Scientific Advisory Board: Abbott Vascular;
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1602.3

How good are stent grafts?

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Learning Objectives:

1. To learn about the currently available devices and their special features
2. To learn about the results of current trials
3. To learn about the comparison with bypass surgery

Peripheral arterial disease (PAD) is a worldwide problem and the estimated prevalence increases dramatically with age. In the general US population a PAD prevalence of 14.5% were found in those aged 70 years or older (1). Symptoms of PAD were reported either as intermittent claudication in the legs in 10-35% or as rest pain or tissue loss in 1-3% (2). The superficial femoral artery (SFA), and particularly long occlusions in the SFA, is one of the most controversial areas of revascularization. Comparing randomized stent studies (ABSOLUTE, RESILIENT) an association between lesion length and restenosis rates might be assumed (3,4). To overcome the tissue infiltration and intimal hyperplasia that can lead to in-stent restenosis, covered stents were developed for the treatment of infrainguinal lesions. Since 2000 several studies evaluated the ePTFE covered Hemobahn/Viabahn stent-grafts for mainly long SFA stenosis and occlusions.

In a multicenter nonrandomized trial, Lammer et al. reported on 80 SFA lesions treated with the Hemobahn stent-graft. The mean stented length was 13.1 cm (range, 5-40 cm). Deployment of endoprosthesis was technically successful in all patients. An early thrombosis, within 30 days, occurred in 4 (3.8%) patients. The cumulative primary and secondary patency rates at the 1-year follow-up were 78.7% and 93.4%, respectively (5).

Fischer et al treated 60 limbs with a technical success of 98%. The mean length covered by stent-graft was 15.9 cm. In all, additional inflow/outflow treatments were performed in 16 (27%) of 59 patients. The total re-occlusion rate was 47% up to 5 years with an early thrombosis rate of 10% up to 30 days. The primary and secondary patency rates were 67%/81% after the first year, 57%/80% after 3 years, and 45%/69% after 5 years. In this study, a subgroup analysis of patients with re-occlusions showed multiple factors of "non-ideal" indications in 11 cases. After exclusion of patients with heavy calcifications, complete SFA occlusion, poor runoff and inadequate antiplatelet therapy, the patency rates were improved.

In the study by Alimi et al. (7), according to preoperative symptoms, three groups of treated patients were distinguished. The first group included patients with intermittent claudication (50 limbs, mean lesion length 116 mm), the second group patients with critical limb ischemia (32 limbs, mean lesion length 124 mm), and the third group patients with acute limb ischemia (20 limbs, mean lesion length 108 mm). Technical success was achieved in 100% of patients. However, number of procedures performed on the outflow was significantly higher in patients with critical and acute limb ischemia. A statistical significant difference of primary and secondary patency rates regarding preoperative symptoms or the quality of runoff vessels was not found. Primary and secondary patency rates at 3 years were significantly different between treatment of TASC C and D lesions. Authors concluded that severity of lesions, rather than preoperative symptoms and status of runoff vessels, should be the main consideration for the use of Hemobahn/Viabahn endoprosthesis.

Four-year follow-up of a randomized prospective comparison of percutaneous stent-graft versus prosthetic femoral-popliteal bypass in the treatment of SFA occlusive disease has recently been reported (8). Mean total lesion length of the treated SFA segment in the stent-graft group was 25.6 cm. In the stent-graft group, primary and secondary patency rates at 12 and 48 months were 72% and 83% and 59 and 74%, respectively. In the surgical group primary patency rates at 12 and 48 months were 76% and 58%, and the secondary patency rates were 86% and 71%. Authors concluded that treatment of SFA occlusive disease with stent-grafts may offer an alternative for revascularization when prosthetic bypass is being considered.

Enrollment for the randomized, prospective multicenter study VIASTAR was completed recently. In this study, the Viabahn endoprosthesis with bioactive surface is compared to bare Nitinol stents in the treatment of TASC B to D lesions.

There are a few technical considerations for implantation of Viabahn endoprostheses which should be taken into account. Avoidance of edge deployment in diseased vessel segments, substantially (>10%) oversizing, short overlapping of stent-grafts, post-dilation beyond the grafted zone and implantation in heavily calcified vessel segments. Furthermore, to avoid early thrombosis, in- and outflow lesions should be treated.

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1602.4

Is there a role for atherectomy or cryoplasty?

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Learning Objectives:

1. To learn about the different currently available devices
2. To learn about the results of current trials
3. To learn about the possible indications for these techniques in clinical routine

Treatment of the patient with symptomatic femoro-popliteal (FP) atherosclerotic disease is continuously evolving. Peripheral arterial chronic disease (PAD) of the lower extremities remains one of the often unrecognized manifestations of systemic arteriosclerosis symptomatically affecting between 3% and 7% of the population and up to one in five patients older than 75 years of age. Standard tools for endovascular treatment of FP steno-occlusions remain balloons and bare metallic stents. Because of numerous unmet needs, especially the challenge of long chronic occlusions, many new devices appear on the market and often operators are not always able to understand the real benefit.

In the recent years, debulking techniques and excimer laser have been proposed as alternative techniques to achieve recanalization.

The operator should keep in mind that sub-intimal angioplasty is a major tool that all interventional radiology (IR) should master. It has opened new frontiers in terms of lesion length, well beyond the TASC 2 recommendations, especially in the setting of critical limb ischemia (CLI).

We will analyse and give the technical features of the most common debulking devices; the laser systems and the cryoplasty devices available.

Roughly, there are 2 categories of recanalization/debulking device: those that need a guidewire cross the lesion and devices that do not require a guidewire to cross the lesion.

Devices designed to facilitate recanalization:

These devices (laser and Crosser) are designed to cross the occlusion intraluminally.

Laser excimer laser (Spectranetics) may facilitate to treat complete occlusions or long stenoses, it can recanalyze a vessel without the support of a previously passed guidewire and is designed to remain into the true lumen. It is a Xe-Cl laser with a wavelength of 308 nm and a catheter output fluence of 30-80 mJ/mm^2. The duration of the laser pulse is 135ns.

The laser gives 3 combined effects on atheramous/fibrous lesion: photochemical, photothermal and photomechanical. The combination of those 3 effects can permit to achieve intraluminal recanalization

Different devices are available: over the wire (optical fiber of 0.9–2.5 mm) and rapid exchange (optical fibers of 0.9–2.0 mm) with a introducer shaft of 4 F to 8 F**.**

In long SFA occlusions a 90.5% immediate success rate by primarily utilizing the step-by-step procedure has been reported as well as a 1-year assisted primary and secondary patency rates of 65.1% and 75.9%, respectively. Complications such as perforation and distal embolization have been reported. Very calcified lesions can lead to cases of perforation.

Crosser (Flow Cardia)

The crosser device consists of a re-usable electronic Generator, high-frequency Transducer and single-use CROSSER CTO Recanalization Catheter. The generator and transducer produce high frequency mechanical vibrations (20 kHz) which are propagated through a Nitinol core wire to the metal tip of the CROSSER Catheter. The nitinol core wire transmits the vibrational energy to the metal tip of the catheter. The high frequency mechanical vibration facilitates guidewire passage of the CTO and allows for subsequent angioplasty.

Variable results are reported with immediate success of intraluminal recanalization comprised between 41 and 75% of cases (ref).

Devices that require preliminary recanalisation with a guide wire.

These devices are all designed with the aim to debulk the plaque using different approaches. Therefore, they can all be qualified as atherectomy devices.

Silver Hawk Plaque Excision System (EV 3) is a device used to remove plaque that blocks arteries and interrupts blood flow instead of compressing it against the vessel wall like angioplasty or stenting. It consists of a flexible, smooth-coated shaft with a cutting unit on the distal end, containing a rotating blade in a conical, tapered housing (6 cm in length) with a lateral window. The proximal end of the catheter, which has a locking mechanism, connects to a disposable, battery-operated electric motor. For the SFA treatment it requires a 7/8 Fr. introducer sheath. The key problem is that it needs that a guidewire cross intraluminaly the lesion, in long SFA occlusions it can be difficult but in short and no calcified occlusions is feasible, other application could be in long tandem stenosis/occlusions.

The company also manufactures the TurboHawk, it is useful to perform atherectomy on calcified vessels, it requires 7/8 Fr introducer sheath.

Briefly, the guidewire is passed through the lesion, the device is pressed against the plaque by a specific bending mechanisms with a handle, the rotator is activated and the blade is passed several times retrograde. After a few passes, the device is removed and the plaque that has been captured into the specific reservoir is extracted. Usually, the intervention takes several minutes to be successful but can effectively remove relatively large amount of lesion.

It can be a valuable tool for eccentric stenosis at the level of the common femoral or popliteal artery.

The fullest data resource on use of the SilverHawk device is the observational non-randomized.

Treating peripherals with Silver-Hawk: Outcomes Collection (TALON) Registry, involving investigators from 19 different centers. 601 consecutive patients with 1258 symptomatic lower extremity atherosclerotic lesions treated by plaque excision with the SilverHawk catheter. Mean lesion lengths above and below the knee, respectively, were 62.5+/-68.5 mm. placement following plaque excision occurred in only 6.3% of lesions. The 6- and 12-month rates of survival free of TLR were 90% and 80%, respectively.

Diamondback 360° Orbital Atherectomy System employs an eccentrically mounted, diamond-coated crown that rotates at high speed to sand away plaque as it slowly advances through narrowed or occluded arterial sections. The faster the crown rotates, the wider the orbit, which creates a larger lumen.

Few studies are available regarding the Diamondback 360° and patency data for this device are still undefined, it is compatible with calcified lesions and the mean debris diameter created has a 1.9 µm size. There are no data in literature regarding the patency rate, it seems that this device has a higher embolization rate compared with angioplasty or angioplasty + stent alone.

Pathway PV Atherectomy System when rotating the excised material is aspirated via ports in the fluted tip into the catheter lumen and transported to a collection bag located on the device console.

One study on the Pathway PV Atherectomy System is in the literature, 172 patients were treated, the device success was 99%, the 1-year restenosis rate was 38.2% based on duplex imaging. It appears to be safe and effective even in the presence of challenging lesion conditions.

Auth Rotablator is one of the first rotation excision devices. It can perform atherectomy when it is not possible to cross a lesion with a balloon or to inflate a balloon especially in calcified concentric heavy calcifications.

The Rotablator is a high speed (150.000 – 180.000 rpm) air driven, end drilling, irrigated system. The optimal burrs size for SFA is 3 mm and requires a 9 Fr. introducer sheath.

The system is compatible with a 0.009" guidewire that needs to

cross the lesion.
The Auth Rotablator device has an immediate success rates of 72% to 94%. Patencies reported at 1 and 2 years are dismal, ranging from 31% to 61% and from 12% to 18%, respectively.
Significant complications are associated with the device, including thrombosis, arterial spasm, hemoglobinuria, hematoma, and embolization. Late restenosis and reocclusion are also significant limiting factors of the Auth Rotablator. This device currently has limited applications for treatment of peripheral arterial occlusive disease.
As a complement of these tools, cryoplasty is proposed to increase patency rate and reduce post-angioplasty dissection.
Cryoplasty: The cryoplasty device is based on traditional balloon angioplasty technology but has been modified to incorporate nitrous oxide as the inflation medium instead of the standard mixture of saline solution and contrast medium.
To achieve the target temperature of –10°C at the interface of the inflated balloon and the vessel wall. Cellular necrosis (and consequent inflammation) does not occur until temperatures reach the range of -20°C. It requires 6 Fr introducer sheath.
Many studies have been carried and we can asses that the cryoplasty showed good immediate success rates (74%) with lower stent placement rates compared with angioplasty alone (non-randomized studies).
The long-term lesion patency rate at 6 months was 59.4%, with rates of 55.9, 52.6, and 49.1% at 1, 2, and 3 years, respectively.
Conclusion: All these devices are proposed as alternative techniques for recanalization in order to achieve a higher patency rate, lower dissection rate, avoid the stent in-stent technique and cross heavy calcification zones while remaining in the true lumen. Therefore, they can have a role in selected patients and in selected anatomies. The extensive use of these devices is not recommended for long SFA occlusions but can be useful for complex anatomies, stent occlusions and heavy calcifications.

Special Session
New frontiers in oncologic IR

1603.1

HIFU for prostate cancer

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Learning Objectives:
1. To review the indications for HIFU in prostate disease
2. To describe the technique, limitations and complications of HIFU
3. To present the results of focused US in prostate disease as compared to other techniques

Purpose: To evaluate the safety of focal therapy using magnetic resonance imaging guided focused ultrasound surgery (MRgFUS) with a special transrectal MRgFUS transducer and real time MR thermometry for treatment of the patients with low-risk, early-stage organ-confined prostate cancer, who may currently be on watchful waiting or active surveillance.
Material and Methods: An IRB-approved industrial sponsored prospective single arm trial. The inclusion criteria: 50- to 75-year old patients with low-risk, early-stage organ-confined prostate cancer (cT1c and cT2a, N0, M0), diagnosed with TRUS-guided transperineal mapping biopsy (TPBx), no more than two lesions each less than 10mm; Gleason score=6, PSA < 10 ng/dl and no contraindications to MR, positive TRUS-guided transperineal biopsy (TPBx) cores, detected in a maximum of four (4) sectors, (2 for each cancerous focus) out of 16 sectors (or out of 12 sectors in prostates with volume < 20 cc). Patient should also be eligible for spinal/epidural anesthesia, and general anesthesia (in case of complication, requiring intervention), willing and able to give consent and attend all study visits as defined in the protocol. Prostate gland volume should be no greater than 70 cc, volumetrically measured. In case of MRI-visible tumor, tumor should be in capsular contact of less than 5mm, on axial images and no definite evidence of extracapsular extension or seminal invasion by MRI. CT pelvis was performed to identify intra-prostatic calcifications adjacent to the rectal wall and multiparametric MR imaging for identification of tumour foci and radiological staging. Exclusion criteria includes: ASA > 2, contraindications to MRI, severely abnormal coagulation (INR>1.5),unstable cardiac status including severe hypertension (diastolic BP > 100), severe cerebrovascular disease, ADT, PCa chemotherapy, cryotherapy, photodynamic therapy or prostatectomy, radiation therapy to the pelvis for prostate cancer or any other malignancy, medications that can affect PSA for the last 3 months prior to MRgFUS treatment, individuals who are not able or willing to tolerate the prolonged stationary supine position during treatment (approx. 3 hrs), Any rectal pathology, anomaly or previous treatment, which can change acoustic properties of rectal wall or prevent safe probe insertion (e.g., fistula, stenosis, fibrosis), any spinal pathology which can prevent safe administration of epidural/spinal anesthesia, identified calcification of 2 mm or more in largest diameter neighboring the rectal wall (in a distance of less than 5 mm) and interfering with the acoustic beam path, lower limb musculo-skeletal fixed deformities, prostate with multiple cystic lesions, evidence for seminal vesicle/lymph node involvement of cancer, bladder cancer, patient that had TURP procedure before, urethral stricture/bladder neck contracture, patient with baseline symptoms of incontinence defined as urine leak in any of the following circumstances: before the patient can get to the toilet; when coughing or sneezing; while being asleep; while being physically active/exercising; after finishing urinating and being dressed; leaking for no obvious reason; active UTI; prostatitis NIH categories I, II and III; implant near (<1 cm) the prostate, interest in future fertility and current participation in another clinical investigation of a medical device or a drug or has participated in such a study within 30 days prior to study enrolment. Under regional or general anaesthesia, MR localization of target based on mapping biopsy findings and MR identified tumour focus (if present) followed by MRgFUS ablation with real time thermometry The critical areas of the rectum, bladder neck and the urethral sphincter and neurovascular bundles were excluded from beam path when possible without compromising efficacy of treatment. A final contrast-enhanced MR was performed to outline the non-perfused treated area immediately after completion of treatment. After treatment, indwelling urinary catheter was kept and antibiotics prescribed as prophylaxis.
Results: From July 2010 to Feb 2011, 7 eligible patients underwent this procedure, with more planned. The mean age was 63.8 years (range 58 to 69 years). All patients were stage 1C clinically. Four patients had one tumour focus and 3 patients had two tumour foci. All tumour foci detected were of Gleason score 3+3. Pre-procedure multi-parametric MRI with DCE-MRI and DW-MRI showed tumour focus in only one patient that correlated to the mapping biopsy The rest of the positive biopsy lesions were not confidently identifiable on multi-parametric MR. The pre-procedure PSA values ranged from 2.2 to 8.5. 6 patients underwent the procedure under regional anaesthesia and one patient under general anaesthesia. The median pre-procedure preparation time in the MRI room was 105 minutes (range 60 to 200 min). The median treatment/sonication time was 125 min (range 60-155 min). Number of macrosonications delivered range from 8 to 16. The post-treatment contrast-enhanced MRI demonstrated the desired non-perfused areas corresponding to the treatment plan and treated non-perfused volume (NPV) ranged from 9.7 to 12.5cc. Five patients had transurethral urinary catheter and two patients had suprapubic urinary catheters inserted prior to procedure. All patients experienced only minimal discomfort after treatment and voided normally after an overnight

stay with an indwelling catheter. No complications were observed. The one-month follow-up MRI showed the no significant change in NPV within the prostate in 6 patients, with slight decrease in non-perfused volume in one patient. 6/7 patients showed a decrease in serum PSA values one month after treatment. One patient had a transient increase in serum PSA one month after treatment but showed decrease below baseline three months after treatment. Per protocol patients are expected to undergo repeat MR imaging and repeat biopsy at 6 and 24 months. The 6-month biopsy of the first patient returned negative.

Conclusions: So far the safety of the treatment is demonstrated with 7 patients experiencing minimal morbidity. Initial efficacy demonstrated by the non-perfusion on contrast-enhanced MRI that persist at one month after treatment and will be further confirmed by repeat mapping biopsy, serum PSA and multiparametric MRI 6 and 24 months after treatment. The device appears to deliver safe and accurate focal therapy to the prostate with minimal side effects. The longer term outcome of these low risk patients will depend on the biology of the disease. They will be under close surveillance with repeat biopsies. The failure of focal therapy should be defined as escalation of treatment to radical surgery or radiation. The goals of focal therapy is to preserve quality of life while ablating the focal index tumour.

1603.2

Ablation of breast cancer

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Learning Objectives:

1. To define the rationale for ablation of breast tumours
2. To describe indications, patient selection and techniques of ablation
3. To present results of preclinical, phase I and phase II studies

Breast cancer is a global epidemic. There were 1.38 million new cases of breast cancer worldwide in 2008. In the European Union (EU 27) there were 332,000 new breast cancers in 2008. In Asia, the rate of breast cancer is increasing dramatically and will likely reach that of Western nations in the next 10 to 20 years.

Great strides have been made recently in the field of breast cancer detection. The widespread implementation of digital mammography and high resolution breast ultrasound and MRI has made finding smaller and earlier stage breast cancers more likely than ever before. New and future imaging modalities such as breast tomosynthesis, automated whole breast ultrasound, positron emission mammography and breast specific gamma imaging add to our diagnostic capabilities. On March 14, 2011 at the European Congress of Radiology in Vienna promising new data were presented on multimodal ultrasound tomography of the breast and its ability to find and differentiate benign from malignant breast lesions in sizes as low as 3mm.

Given the fact that we can now find such small cancers with greater frequency and accuracy it is the responsibility of the surgical and interventional medical communities to develop techniques to accurately biopsy and treat these tumors using percutaneous image-guided techniques. 20 years ago, the standard of care upon finding a suspicious breast lesion was needle localization and surgical excisional biopsy. Today, the standard is first consider minimally invasive percutaneous image-guided biopsy using ultrasound, stereotactic or MRI guidance. 20 years ago, if breast cancer was diagnosed, the standard of care was to offer the patient a radical mastectomy regardless of the cancer size. Over the years this has changed from mastectomy to partial mastectomy to today's lumpectomies with partial breast irradiation. These techniques were developed in an attempt to improve cosmetic outcomes and to reduce patient morbidity.

Today, a new opportunity exists. The promise of treating breast cancer without surgery is real. Percutaneous image-guided ablation procedures have now been employed to safely and effectively treat cancer. These procedures are now widely accepted treatment options worldwide for cancers of the lung, liver, kidney, prostate and bone. It is a logical progression to apply the techniques of percutaneous image-guided cancer ablation to treat breast cancer. To date, more than 35 studies have been published or presented worldwide on the topic of breast cancer ablation. The majority of these are feasibility studies, and what were titled as phase I and phase II trials.

One of the first studies published in 2003 by Wu F et al from China used high-intensity focused ultrasound to treat a total of 48 women with T 1-2 breast cancer followed by mastectomy. This showed that the tumors could be treated and the technique was safe and feasible in ablating the breast cancers. In 2005, Noguchi M et al from Japan reported treating 10 patients with a mean tumor size of 1.1cm with radiofrequency ablation followed by surgical excision. Histological evaluation of the specimens yielded no viable tumor cells in the areas treated with ablation. Susini T. et al from Italy reported a pilot study in 2007 in which they treated 3 patients deemed elderly and inoperable with ultrasound-guided radiofrequency ablation and no surgical resection. The tumor sizes were from 10 to 13mm. 18-month follow up showed no tumor recurrence. In 2008, a phase II trial was reported by Medina-Franco H. et al from Mexico. They treated 25 patients with ultrasound-guided radiofrequency ablation. Fourteen tumors were less than 2cm and eleven tumors between 2 and 3.8cm. Following surgical excision it was found that 13 of the 14 smaller tumors were effectively ablated yet only 6 of the 11 tumors greater than 2cm were effectively treated. The authors suggest that RFA is promising in treating small breast carcinomas. Finally in 2009, Littrup PJ et al from the United States published results of their work with cryoablation in JVIR. They treated 22 breast cancer foci in 11 patients who refused surgical excision. 6 patients were treated with ultrasound guidance and 5 with combined ultrasound and computed tomography. Breast tumor size ranged from 5mm to 5.8cm. Biopsies were performed at the margins following ablation and yielded no viable tumor. No local recurrences have been reported in his cohort after 18 months of follow up.

In addition to the decreased morbidity and improved cosmesis derived from minimally invasive percutaneous breast cancer ablation, there may be an added benefit. Lu P et al from China published data in 2009 describing an increased number of activated tumor-infiltrating lymphocytes in women who had their cancers ablated with high intensity focused ultrasound prior to surgery versus a control group who was not ablated. This limited research in 23 patients suggests the possibility that ablation may trigger the body's immune response against the antigen created during ablation therapy. Thus, in theory, the body may be able to produce anti-tumor antibody following ablation which may prove protective against future recurrence or metastasis.

It is clear from the research being performed that there is a worldwide interest in the possibility of using percutaneous image-guided ablation in the treatment of breast cancer. It has also been documented that small tumors, lesions up to 2cm in diameter, can be effectively ablated using imaging guidance and percutaneous cryoablation or radiofrequency ablation. It is therefore a logical conclusion that percutaneous image-guided ablation of small breast cancers can and should be used to treat patients as an alternative to surgical resection. What is also clear is that what is now needed are worldwide multi-center trials on larger cohorts of patients to validate the adequacy of ablation of small cancers as a primary treatment option. There must also be, as part of these studies, an adequate way to document effective tumor ablation without surgical resection whether it be through post-ablation biopsy at the margins or follow up breast MRI or something else. Finally, this research should be carried out by physicians who are well qualified in performing image-guided interventions and accurate placement of

needles and probes using imaging guidance, otherwise the data may be negatively skewed due to operator error. With their vast experience in ablation therapy and their advanced skills and training in performing precise image-guided biopsies and interventions, interventional radiologists are uniquely qualified to perform breast interventions including breast cancer ablation. Interventional radiologists should embrace the opportunity to participate in the research and development of these new techniques to treat primary breast cancer.

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1603.3

Head and neck malignancies

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Learning Objectives:

1. To report on the rationale for local management of head and neck tumours
2. To describe the indications, patient selection and techniques for local treatment
3. To present results of local management of head and neck tumours

The head and neck region is a complex anatomical region with many important anatomical structures which can be affected by malignancy. Most of the lesions can be diagnosed by clinical examination in combination with imaging, including CT, MRI and angiography. Biopsies are mainly done in clinical practice by the ENT or the maxillo-facial surgeons. The first treatment choice for head and neck malignancy is surgery, often followed by radiation therapy or combined radiochemotherapy. If surgery is not possible due to extensive tumor infiltration or general contraindications for surgery the treatment of first choice is radiation therapy or chemotherapy or a combination of both. So far there is no indication for image-guided therapy modalities in the primary treatment of head and neck cancer. Some studies however are indicating that initial intraarterial induction chemotherapy can help to improve the outcome of surgery.

However, there are some situations where interventional radiology plays an important rule. This presentation will focus on image-guided biopsies and image-guided ablation of tumors in the head and neck region.

First, image-guided biopsy can help in the approval or exclusion of a recurrent tumor.

Different approaches as the subzygomatic approach, the retromandibular or retromaxillar approach and a variety of different direct approaches are available to puncture head and neck lesion. Most of the interventions are done under CT-guidance. However, there are also some interventions, which can be performed under MR-guidance or ultrasound guidance.

Later on, especially, if the palliative treatment options for recurrent head and neck cancer are limited by the proximity of vital vascular and neural structures and the aggressive nature of these tumors. Depending on the localization of the recurrent tumor, a minimally invasive treatment modality such as radiofrequency ablation or MR-guided laser-induced thermotherapy offers a number of potential treatment benefits.

First, imaging provides unparalleled topographic accuracy due to its excellent soft-tissue contrast and high spatial resolution. Secondly, the temperature sensitivity of specially designed MR-sequences can be used to monitor the temperature elevation in the tumor and surrounding normal tissues, thus increasing safety. On-line MR imaging during LITT therefore allows early detection of local complications and treatment effects such as bleeding, hemorrhage, or necrosis. Thirdly, recovery times, lengths of hospital stay, and the risk of infection and other complications can be reduced when compared with conventional palliative surgery. A further, indirect advantage is the psychological effect due to avoidance of cosmetic deformities that can result from major reconstructive surgery.

Technically every available treatment device could be used for head and neck tumor ablation. Single tip needles have some advantages compared to umbrella type needles. I personally prefer bipolar radiofrequency devices. Most interventions can be done under local anesthesia with some mild sedation. CT-guided puncture is used to place the ablation probes.

However, the indications for tumor ablation in the head and neck are limited. The main indication is not to cure the patient or prolong the survival, but to reduce the clinical symptoms like pain and

dysphagia. Only well circumscribed lesions can be treated and in most cases only a partial tumor ablation is possible.

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1603.4

New non-thermal ablation techniques

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Learning Objectives:

1. To describe the mechanism of action of electroporation and other non-thermal techniques
2. To present technical details of intervention and its potential clinical applications
3. To present the results of pre-clinical, animal and clinical studies

New, non-chemical non-thermal image-guided ablation techniques are currently undergoing clinical investigation. These include irreversible electroporation (IRE) and light-activated drug therapy. These techniques promise to overcome some of the limitations of chemical and thermal-based techniques. Electroporation is a technique that increases cell membrane permeability by changing the transmembrane potential and subsequently disrupting the lipid bilayer integrity to allow transportation of molecules across the cell membrane via nano-size pores. This process – when used in a reversible fashion – has been used in research for drug or macromolecule delivery into cells. IRE is a method to induce irreversible disruption of cell membrane integrity resulting in cell death without the need for additional pharmacological injury. The IRE system (NanoKnife; AngioDynamics, Queensbury, NY) consists of two major components: a generator and needle-like electrical probes. The generator can deliver up to 3,000 V of energy in a maximum of 100 pulses which have a maximum pulse length of 100 µsec. The electrode probe is 19 G in diameter and has an active tip that can be exposed up to 4 cm. Two or more monopolar probes or a single bipolar probe must be used at a time. The number of monopolar probes that are used during an IRE procedure is dependent on the size and shape of the desired zone of tissue ablation. The treatment parameter for voltage is dependent on the distance between probes within the targeted tissue. IRE is administered under general anesthesia with administration of atracurium, cis-atracurium, pancuronium or an equivalent neuromuscular blocking agent to prevent undesirable muscle contraction. IRE creates a sharp boundary between the treated and untreated area in vivo. This would suggest that IRE has the ability to sharply delineate the treatment area from the non-treated, and that treatment planning can be precisely performed according to mathematical predictions. In addition, IRE can effectively create tissue death in micro- to millisecond ranges of treatment time compared to thermal ablation techniques, which require at least 20 minutes to hours. Moreover, because IRE is a non-thermal technique, there appears to be complete ablation to the margin of blood vessels without compromising the functionality of the blood vessels. Therefore, issues associated with perfusion-mediated tissue cooling or heating (a significant challenge with thermal methods) are not relevant. Preclinical investigation focused on HCC has shown promising results. In a recent study, HCC tumors were grown in 30 Sprague-Dawley rats that were divided into treatment and control groups. For treatment group, IRE electrodes were inserted and eight 100 µsec, 2,500-V pulses were applied to ablate the targeted tumor tissues. Pathology correlation studies documented progression from poorly differentiated viable HCC tissues before treatment to extensive tumor necrosis and full regression in 9 of 10 treated rats 7 to 15 days after treatment. These findings suggest that IRE can be an effective strategy for targeted ablation of HCC, and have prompted its clinical evaluation. Light-activated drug therapy uses light-emitting diodes to activate talaporfin sodium (Aptocine; Light Sciences Oncology, Bellevue, WA), a small drug molecule which is synthesized from a chlorophyll derivative. Talaporfin sodium has the capacity to concentrate in tumors when administered intravenously. It is then activated by a thin light emitting activator which is percutaneously inserted intratumorally under imaging guidance. The drug is capable of absorbing long wavelength light resulting in singlet oxygen that causes apoptotic cell death through oxidation and permanent tumor blood vessel closure. The device contains a tiny array of light-emitting diodes at the end of a very narrow (1.2-mm wide) flexible coated micro-wire. The array is inserted into the target tumor using a biopsy-like procedure requiring only a mild sedation. The device emits red light at a discrete frequency and intensity, for a fixed time period. Experimental studies suggest that singlet oxygen causes the destruction of all cells within the kill zone. The size of the kill zone is determined by the fluence level of activating light and the time of illumination. Research has shown that a maximum effective kill zone of 2.5 by 4.5 cm is achieved with a single catheter, although multiple catheters can be used in a single treatment to increase the kill zone. All vasculature within the kill zone is also quickly and permanently occluded by an accumulation of platelet fragments, fibrin deposition and vascular debris. Potential advantages of light-activated drug therapy with talaporfin sodium include the accurate prediction of the size of the kill zone by illumination time and fluence, the independency of treatment effect from tumor histotype and tumor location (proximity to large blood vessels or the gastrointestinal tract, for instance, neither affects the production of the primary kill zone nor is it associated with any complications) and the ability to treat large or multiple tumors in a single session requiring only mild sedation. Treatment with talaporfin sodium is generally well tolerated, although cutaneous photosensitivity requires attention and adequate protection. Of interest, findings from animal studies suggest that the production of large apoptotic masses in tumors with light-activated drug therapy yields tumor-specific clones of CD8+ T-cells which infiltrate distant, untreated tumors.

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Special Session
Introduction to acute stroke management: decision making process based on imaging/clinical findings and getting started

1604.1

Acute stroke imaging

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Learning Objectives:
1. To learn the principles of parenchymal imaging in acute ischemic stroke
2. To learn the principles of vascular imaging in acute ischemic stroke
3. To understand decision making processes based on imaging with understanding the physiologic and clinical significance of the mismatch concept
4. To learn about future concepts in acute stroke imaging with flat panel technology

Stroke is a leading cause of morbidity and mortality in the developed world. The goals of acute stroke imaging are to establish a diagnosis as early as possible to obtain accurate information about intracranial vasculature and brain perfusion to select the appropriate therapy. Comprehensive evaluation may be performed with a combination of CT or MRI. Unenhanced CT helps to rule out hemorrhage and may identify early signs of ischemic stroke, respectively. In addition, CT angiography and CT perfusion imaging may depict major vessel occlusion and perfusion disturbances indicating tissue at risk. Diffusion-weighted MR imaging is more sensitive in the detection of hyperacute ischemia. MR angiography reveals the status of extra- and intracranial vessels, and a mismatch between findings on diffusion and perfusion MR images may be pragmatically used to predict the presence of a penumbra. Regarding our own experience, "multimodal MR imaging" provides substantially greater information about brain ischemic pathophysiology and overall a more sensitive diagnosis for acute stroke, especially in patients with an uncertain time window of symptom onset and vertebrobasilar ischemia. Thus, combining various imaging techniques may help to differentiate patients who may profit from intravenous or interventional therapy in an even extended time window from those who do not. Thus we think that MRI should replace CT as the primary neuroimaging technique, at least in patients suspicious for vertebrobasilar ischemia or presenting in an extended time window. Acute stroke imaging protocols vary among institutions, depending on the availability of imaging time, software, and expertise. In our institution, we use a simple protocol that we believe is applicable at most institutions. We use a multimodal CT protocol when acute stroke patients present within 4.5 hours (ECASS III time window); patients presenting beyond this time window are examined with a multimodal MRI protocol.

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1604.2

Indications for intervention: neurologist's view

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Learning Objectives:
1. To learn the clinical and imaging based decision making algorithms for thrombolysis in stroke patients
2. To understand how to select systemic vs. intra-arterial treatment
3. To learn different clinical settings which may effect decision making process

Systemic thrombolysis by intravenous recombinant tissue plasminogen activator (rtPA) is currently the only approved treatment for acute ischemic stroke. Intravenous rtPA at a dose of 0.9 mg/kg (10% given as a bolus, remainder given over 1 hour, maximum dose 90 mg) administered within 3 hours of symptom onset significantly improves functional outcome at 3 months when compared to placebo [1-3]. Meta-analysis of randomized trials of intravenous rtPA (NINDS, ECASS-I, ECASS-II, ATLANTIS) shows an absolute increase of ~12% in number of patients achieving a modified Rankin Scale between 0 and 2 with intravenous rtPA treatment compared to placebo [1-3]. However, only less than 5% of patients with ischemic stroke can be treated with intravenous rtPA in the real world setting either due to the narrow therapeutic time window or contraindications for treatment [4]. Furthermore, the effectiveness of intravenous thrombolysis is poor in patients with proximal arterial occlusions; intravenous rtPA establishes recanalization in less than 25% of patients with internal carotid artery or middle cerebral artery occlusion [5].

Although, the number of patients receiving systemic thrombolysis might increase in the near future by extension of time window for treatment to 4.5 hours after symptom onset, based on the results of the recently published ECASS-3 trial [6], there still will be a significant amount of patients with acute ischemic stroke who will not receive intravenous rtPA or will not benefit from this treatment. Intra-arterial thrombolysis is considered as an attractive therapeutic option in such patients. The only prospective randomized trial that tested the efficacy and safety of intra-arterial thrombolysis was the PROACT-II trial, which compared intra-arterial prourokinase plus heparin with heparin alone in ischemic stroke patients secondary to middle cerebral artery occlusion admitted within 6 hours of symptom onset [7]. 40% of the patients in the prourokinase arm had a modified Rankin scale of 0-2 at 3 months, while 25% of the patients in the heparin only arm had favorable outcome. Despite these results, the treatment was not approved by the FDA and intra-arterial prourokinase did not become a standard of care in middle cerebral artery

occlusions presenting within 6 hours of symptom onset. Until now, no placebo-controlled trial has evaluated the use of intra-arterial rtPA in the setting of acute ischemic stroke. Similarly, no placebo-controlled trial has been performed with mechanical clot retrieval devices. However, the MERCI clot retriever and the Penumbra system have been approved by the FDA as thrombectomy tools for clot removal from cerebral blood vessels, based on prospective, nonrandomized multicenter trials showing the efficacy and safety of these devices in patients with large vessel occlusions presenting within 8 hours of symptom onset [8,9]. Bridging of intravenous thrombolysis and intra-arterial treatment is also a therapeutic alternative in patients unresponsive to intravenous rtPA. A pilot study has shown the feasibility and safety of intra-arterial treatment after intravenous rtPA [10]. The ongoing multi-center randomized IMS-III trial is now testing the efficacy of this approach versus intravenous rtPA alone.

Intravenous rtPA is the standard of care for all eligible ischemic stroke patients presenting within 3 hours of symptom onset. The selection of patients that should be treated by systemic thrombolysis is clearly outlined in the current acute ischemic stroke management guidelines [11]. On the other hand, the selection of patients for intra-arterial thrombolysis is a challenging process. A number of clinical or imaging criteria are currently used to guide clinicians to identify patients that could benefit from intra-arterial thrombolysis, albeit no level I evidence is present for the efficacy of this treatment in such patients.

a) Patients with acute ischemic stroke presenting within 3 hours of symptom onset, but who have contraindications for systemic thrombolysis might be considered for intra-arterial thrombolysis. In patients with recent history of surgery, gastrointestinal or genitourinary hemorrhage, myocardial infarction or coagulopathy systemic side effects can be minimized by intra-arterial thrombolysis, during which a low dose of fibrinolytic agent is used or no fibrinolytic is used at all.

b) The site of arterial occlusion is a key-factor in the decision algorithm for intra-arterial thrombolysis. This therapeutic option is considered for patients with proximal arterial occlusions and high clot burden, like internal carotid artery, middle cerebral artery stem and basilar artery occlusions. The vascular status should be evaluated by a non-invasive method like computerized tomography angiography, magnetic resonance angiography or transcranial Doppler ultrasonography in all patients with acute ischemic stroke for the possibility of an intra-arterial intervention. As there is currently no randomized trial comparing the efficacy and safety of intravenous thrombolysis vs. intra-arterial thrombolysis, it is unknown whether patients with proximal arterial occlusions should be directly taken to the angiography suite even if admitted within 3 hours of symptom onset. However, bridging of intra-venous and intra-arterial thrombolysis can always be considered as an option in such patients.

c) Aside from arterial status, the presence of salvageable brain tissue is critical to attain maximum benefit from intra-arterial thrombolysis. The presence of clinical-diffusion mismatch, diffusion-perfusion mismatch or CBV-MTT mismatch can be used to identify patients with significant amount of ischemic penumbra that might be salvaged by recanalization and reperfusion [12,13]. In addition, the amount of brain tissue that has already undergone irreversible damage might be a critical factor in deciding to proceed on with intra-arterial thrombolysis [14].

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1604.3

How to start an acute stroke practice in the angiography suite

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Learning Objectives:

1. As an interventionist who wants to start a stroke practice, to learn what one needs to establish in an angiography lab in terms of equipments and logistics for an efficient stroke team
2. As an interventionist who wants to start a stroke practice, to learn basics of endovascular treatment
3. To learn what kind of endovascular tools we have to keep handy to get started

Management of acute stroke, known as a leading cause of death and adult disability all over the world, still remains as a challenge despite rapidly developing technical innovations in materials used for intracranial endovascular re-vascularization procedures. Thromboembolic occlusion of major cerebral arteries is commonly associated with significant neurologic deficit and poor outcome. As acute stroke treatment could be defined as a "race against time", an on-call team including emergency room physicians, neurologists and interventional radiologists should be available for 24 hours to evaluate the patient and select the accurate management. Stroke management protocols could possibly differ among centers but intravenous thrombolysis with rtTPA for the treatment of ischemic stroke in selected patients within 3 hours after stroke onset is gained wide acceptance. This period is considered as critical time for the interventional team to be at the angio suit at night times. Intra-arterial intervention may then be considered either as primary intervention or as rescue intervention after systemic thrombolysis. First step of intracranial endovascular treatment of acute stroke is obtaining access to the related arterial territory. Majority of these patients carry the potential risk of supraaortic atherosclerosis and anatomic adversity due to severe tortuosity of the affected vessels. Therefore, access achievement begins with long vascular sheath placement up to common carotid or subclavian arteries to obtain advanced support for further catheter manipulations. After that, an atraumatic guiding catheter with appropriate inner diameter (at least 6 F) is advanced to ICA or vertebral arteries. Subsequently used materials and methods for intra-arterial interventions have different alternatives such as intra-arterial application of thrombolytic agents, mechanical clot extraction and aspiration, or angioplasty and stent application. Recanalization rate, showing well correlation with clinical outcome, depends on the location of the occlusion within the cerebral artery. The intra-arterial approach offers the advantage of higher concentration of thrombolytic agents over intravenous administration which results in higher recanalization rates for major cerebral artery occlusions. However, increased risk of symptomatic intracranial hemorrhage and the delay for initiation of intra-arterial mechanical thrombectomy approach counterbalance these advantages. Recently, new endovascular devices used for mechanical clot extraction and aspiration is gaining increased popularity among neurointerventionals. Early experience with MERCI clot retraction device revealed similar efficacy and safety rate compared with PROACT-II study which evaluated prourokinase for recanalization of acute occluded cerebral arteries. In the multi-center, prospective Multi-MERCI trial 55% percent of recanalization with device itself alone was reported. Recanalization rate was increased to 68% with combination of mechanical and intra-arterial thrombolytic therapy. The Penumbra is another mechanical throbectomy system designed specifically for removal of clot by an aspiration system. Multi-center international trial has achieved promising results with relatively good outcomes with 100% recanalization in 20 patients. Another recent single-center study revealed complete revascularization rate of 53% and a ≥4 point improvement of NIHSS score in 56% of patients. Limited data are available about the use of angioplasty and stenting in the emergency treatment of intracranial lesions in patients with an acute ischemic stroke. However, stenting is being increasingly used to treat patients with acute stroke especially when routine intervention methods fail. Most recently, Solitaire stent with its retrievability is reported to be safe and effective; and therefore being increasingly used as a thrombectomy device. Technical innovations promise better results in endovascular management of acute stroke.

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Disclosure

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Foundation Course Renal interventions

1701.1

CT and MR urography: what do they add to ultrasound?

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Learning Objectives:

1. The techniques of MR and CT urography
2. To compare CT and MR urography with ultrasound
3. How to use MR or CT to help to percutaneous access

Both CT and MR urography (CTU, MRU) feature unenhanced and contrast-enhanced examination techniques for imaging of the entire urinary tract. Contrast-enhanced excretory CTU and T1-weighted MRU are primarily used to obtain detailed urograms of the nondilated collecting system with preserved excretory function. On the other hand, the use of intravenous contrast material is not necessary in order to identify and access markedly dilated pelvicalices, both in CT and MRI. Moreover, unenhanced T2-weighted static-fluid MRU is the only imaging technique that provides typical urographic views of dilated urinary tracts, even if the renal function is severely impaired. CT offers high-spatial resolution and precise delineation of any puncture material, whereas MRI impresses with its inherent soft tissue contrast and missing radiation exposure. Since many years, ultrasound (US) is considered the imaging method of choice for real-time guidance of percutaneous nephrostomy (PCN). The use of ultrasound for gaining access to the pelvicalices may occasionally be confronted with problems in obese patients, or anatomic anomalies (eg. parapelvic cysts), or in nondilated urinary tracts. In case of failed US-guided PCN, CTU and MRU are potential alternative modalities for directing a puncture needle to the pelvicaliceal system. Indeed, it has been confirmed with several studies that PCN is accomplished under CTU-guidance with excellent precision and safety. For minimizing radiation exposure, CTU can be performed using low-dose protocols (80kVp). In addition, CT-guided nephrostomy has also been suggested for the protection of the collecting system during renal radiofrequency ablation. Unlike CT, MRU-guided PCN is not a clinically proven method although initial experimental studies demonstrated a good feasibility. Until now, only little clinical experience exists with MRU-guided PCN in a total of 34 patients worldwide, as reported in the literature. The minor acceptance of MRU-guided PCN may be explained by the limited availability of in-bore capacities, a problematic size of the puncture needle artefact relative to the dimensions of a calyx, and by inadequate visibility of nephrostomy tubes on MR images. Nevertheless, ongoing developments of dedicated MR compatible PCN equipment and increasing availability of open MR scanners will attract our attention to MRU as a guiding tool for PCN. Even if the clinical setting will not allow widespread use of CTU and MRU for the guidance of PCN, both imaging techniques will definitely add valuable information to US for the planning of complex renal punctures and for the detection of post-interventional complications such as hemorrhage, leakage, abscess, etc.

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1701.2

Techniques for access to the non-dilated system

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Learning Objectives:

1. Imaging of the kidney with non-dilated collecting system
2. The technique of the non-dilated collecting system access
3. Complications of the nephrostomy in non-dilated kidney and their management

The main indication for percutaneous nephrostomy (PCN) is relief of ureteric obstruction. These kidneys present with calyceal dilatation and renal access is straightforward, under combined sonographic-fluoroscopic guidance. Pure CT or ultrasound-guided PCN is also feasible. The safest route is via a prone, postero-lateral approach targeted precisely onto a posterior facing lower pole calyx. This minimises the risk of pelvic or arterial injury, as the path to the kidney is through renal substance and the relatively avascular territory

between the anterior and posterior renal circulation. Large series have documented the success of this procedure. Guidelines from the American College of Radiology quote a success rate of 98%.
But sometimes PCN is required for non-dilated kidneys, e.g. non-dilated kidneys with leaking ureters, to divert the urinary stream. This is more challenging as there is no large, visible calyx on ultrasound; and if the calyces are opacified using intravenous contrast, the posterior calyces are not well seen in the prone position. Furthermore, the smaller calyx makes wire/catheter manipulation difficult. Hence, the ACR guidelines quote a technical success rate of 80% with non-dilated kidneys.
Initial careful ultrasound examination is necessary to confirm absent calyceal dilatation. Any further imaging is not routinely necessary. Regarding technique, the especial hurdles to overcome are that the favoured posterior facing calyx is small and not well seen. Therefore, preferential visualisation and distension of this calyx has to be created. In the authors opinion this is most easily done by double contrast pyelography. A 22 G needle is inserted into the renal pelvis (under US or fluoroscopic guidance) and room air or carbon dioxide carefully instilled. Being buoyant, the gas gravitates into and distends the posterior calyces. This will persist for many minutes and there is sufficient time to target a second sheathed needle onto the chosen calyx. A hydrophilic wire is necessary to manoeuvre out of the small calyx. Forming a pigtail in a small renal pelvis can also present a difficulty.
Of other techniques, CT-guided PCN may be feasible, after intravenous contrast. But the calyx, though visible, will not be distended and entry is sometimes into the infundibulum with this technique. Nevertheless it can achieve renal drainage. MRI guidance is being explored.
There are only a few data on the success rate and complications of non-dilated PCN. In the authors experience a success rate of 96% can be achieved.

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1701.3

How to manage the renal transplant obstruction and leak

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Learning Objectives:
1. Etiology and imaging of the renal transplant obstruction and leak
2. Renal transplant collecting system access
3. Percutaneous treatment of renal transplant leak and obstruction

Obstruction of the ureter

Urinary tract obstruction is diagnosed in 2-10% of kidney recipients. The diagnosis is based on SCr increase and confirmed by dilatation of the graft collecting system. The most common cause of obstruction is ureteral stricture, localized almost exclusively in the distal ureter caused by ureteral ischemia as a result of devascularization during graft harvesting. Other causes of obstruction include blood clots, compression of the ureter, anastomosis edema, technical error during ureter implantation, fibrosis in the pelvic area or kidney stone.
Antegrade pyelography confirms the diagnosis. Percutaneous treatment involves nephrostomy, balloon dilatation, insertion of external-internal or internal drainage using plastic catheters and/or metallic stent placement.
A therapy of stricture is dilatation using a 7-8 mm balloon catheter. To prevent restenosis, external-internal nephrostomy (or an internal double pigtail catheter) is inserted after the dilatation. Several studies have reported a 70-80% long-term success rate in removing the obstruction. An option in cases where balloon dilatation fails is metallic stent placement; however, the long-term outcome of this procedure is unpredictable.
Urolithiasis is a rare cause of urinary tract obstruction in the renal transplant. Kidney stones can be removed using percutaneous techniques with shock-wave lithotripsy used occasionally.

Urinary leak

As kidney graft recipients receive immunosuppression, urinary leak is a potentially life-threatening complication. Leaks are most often diagnosed at weeks 1 to 2 post-transplant and reported to develop in 1–5% of all graft recipients. Urinary leak may be due to ischemic ureteral necrosis or erroneous surgical technique. It occurs most often in the distal ureter. Rarely, leaks may develop in the proximal ureter, renal pelvis, or calyces, usually secondary to ischemic necrosis due to occlusion of the accessory renal artery during harvesting and/or transplantation. Another rare cause is a complication of renal biopsy.
Leak is diagnosed by ultrasound detecting perirenal fluid followed by percutaneous aspiration and fluid analysis. The first-line treatment is urinary catheter insertion followed by nephrostomy. The nephrostomy may be technically challenging as the collecting system is usually not dilated. Whilst external-internal drainage for 2–3 months is commonly successful in the treatment of urinary leaks some patients develop stricture at the site of healed leak requiring further treatment.
If indicated, surgical therapy is usually preceded by nephrostomy. Nephrostomy restores renal function, allowing to perform surgery as a scheduled one**.** The leaks indicated for surgery include particularly early diagnosed leaks, large leaks, and those not responding to percutaneous therapy.

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1701.4

Leaks, fistulas and postoperative complications

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Learning Objectives:
1. Etiology, symptoms and imaging of postoperative complications
2. Percutaneous treatment of postoperative complications
3. Follow-up of postoperative complications treatment, catheter care

Complications are inevitable when performing any form of surgical or interventional procedure on the kidney. Surgical techniques are continually advancing with less invasive surgery leading to lower mortality rates. However, laparoscopic surgery is still prone to complications. Patients may well have non-specific symptoms and imaging is key in making an accurate diagnosis to allow interventional treatment. Laparoscopic surgical techniques may well provide some unexpected imaging findings which need to be recognised. These will be discussed and examples shown. Complications of laparoscopic and open surgery will be shown including haemorrhage, abscess formation and fistulas. Complications of renal transplantation will also be shown. Management will be discussed with imaging and video examples of technique and equipment used. Of course as interventional radiologists we also encounter our own complications and it is vital that we are able to recognise and treat these appropriately. I will discuss complications of nephrostomy, PCNL and stent insertion. These complications will be illustrated with examples from my own extensive list of complications. Examples will again include images and video to illustrate how these cases were managed. I will also show a technique for removing 'forgotten ureteric stents obviating the need for percutaneous access. Once we have managed a complication it is important to continue to see the patient in order to observe their progress and look for anything further that may need to be done. An important observation is that of a drainage catheter or nephrostomy. These are frequently mismanaged by ward staff who are not familiar with them. Visits to the ward may avoid the 'We found it in the bed doctor!' scenario.

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Special Session
BTK recanalization

1702.1

Imaging of the BTK circulation: state of the art

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Learning Objectives:
1. To learn about the different imaging modalities
2. To learn about their strength and the limitations
3. To learn when to select which imaging modality

Introduction

The decision to treat and choice of intervention in peripheral arterial disease is governed by the severity of the patient's symptoms and extent of athero-occlusive disease.

Patients with claudication often have proximal, single vessel disease, while patients with critical ischemia will have multi-segment and infra-popliteal disease (1). Imaging of the smaller infra-popliteal vessels can be challenging, but vital for planning patient treatment. The imaging modality should be chosen so as to maximise the quality and relevance of the information obtained, minimise the risks and inconvenience to the patient, although invasive angiography is still considered by many to be the gold standard in the management of patients with peripheral vascular disease, particularly with critical ischemia. There have also been huge advances in non-invasive imaging, particularly Duplex, MRA and CTA .

Digital subtraction angiography (DSA) enables imaging of the entire peripheral vascular tree including the aorta with high spatial and contrast resolution. It remains however, an invasive procedure requiring ionizing radiation and potentially nephrogenic contrast medium all which carry a small but appreciable risk (2,3). In addition,

it sometimes fails to demonstrate eccentric stenoses, especially if not routinely performed in two planes. The diagnostic accuracy is also adversely affected by vascular calcification and aneurysmal disease can also sometimes be missed. Contrast angiography is now on the whole reserved for patients who are being considered for endovascular therapy or for problem solving where other non-invasive modalities have failed.

Duplex

Several non-invasive imaging modalities now exist. Duplex is widely available, cheap and free from side effects and is particularly attractive for non-invasive imaging in peripheral vascular occlusive disease (4-6). The speed of imaging can be increased up using standard and power Doppler. Although time consuming and technically demanding, duplex has a high sensitivity and specificity for the detection of significant disease, i.e. stenoses >50% using a combination of peak systolic velocity (PSV) at the site of stensoses, the ratio of the PSV at the stenoses and the immediate normal velocity, end diastolic velocity and more subjective criteria such as number of phases in the Doppler waveform and degree of spectral broadening. The most important parameter to grade stenoses is the PSV ratio . Using these criteria reported median sensitivity and specificity are 88% (80-98%) and 96% (89-99%), respectively (4-6) for the detection of >50% stenoses in peripheral arterial disease. Several authors now also advocate using duplex as the only imaging modality prior to endovascular or surgical treatment (4-6).

However, in their extensive review of imaging in PVD, Collins et al (4) concluded that overall duplex was probably the least accurate of all the imaging modalities. In addition, the assertion that duplex is relatively inexpensive has also been recently challenged by the Netherlands-based diagnostic imaging of peripheral arterial disease (DIPAD) trial, which suggest an overall higher cost for duplex, probably explained by the need for additional imaging in 43% of their patients (8). However, these factors other than calcification are less of an issue in the infragenicular vessels. The proximity of the vessels to the transducer probe to the tibial vessels make them ideal for duplex. Eiberg concluded that duplex was the best imaging technique of the distal crural arteries (technical success 97% v 92% for DSA) (7). However, most units have duplex imaging and this is the mainstay of imaging in PVD allowing treatment planning in the majority of patients. It is the imaging of choice in patients with renal failure where there are significant risks of contrast-induced nephropathy or nephrogenic systemic fibrosis.

Magnetic resonance angiography (MRA)

MRA has advanced rapidly over the last decade and is now a invaluable technique in the assessment of arteries of the pelvis and lower limbs. This technique is non-invasive and requires no ionizing radiation. Contrast-enhanced MRA with its greater sensitivity and specificity has now replaced 2D time of flight and phase contrast MRA. Using better K space acquisition, improved techniques such as parallel imaging, stronger, faster gradients in combination with newer MR contrast agents, multiple 3D MRA data sets covering multiple vascular beds can be obtained in rapid succession (9-11). Where there has been direct comparison MRA is at least as accurate if not better than either duplex or CTA (11-14). In addition, compared to DSA not only does MRA demonstrate more run off vessels but also potentially demonstrate eccentric stenoses, retrograde filling of vessels distal to an occlusion by collaterals giving a more accurate assessment of length of occlusions. Overall contrast-enhanced MRA has the highest diagnostic accuracy of all the non-invasive imaging techniques with reported median sensitivity of 95% (92-99.5%) and specificity 97% (64-99%) for stenoses of >50% (4). Also in their recent review, Collins et al concluded that contrast-enhanced MRA was more specific than CTA, more sensitive than duplex and was generally preferred by patients over contrast angiography (4).

The drawbacks with MRA are that it has a tendency to overestimate the degree of stenoses and cannot detect arterial calcification potentially a disadvantage when revascularization options are being considered. In the presence of some stents the metal alloys result in signal dropout which precludes imaging of the instent segment, although flow can be reliably assessed proximal or distal to the stent. A significant minority of patients do not tolerate MRI due to claustrophobia (10%) or there may be contraindications to its use, i.e intracranial clips, implantable defibrillators and pacemakers and risk of NSF. Also in some centres there is still limited access to MR.

Computed tomography angiography (CTA)

CTA is a three-dimensional technique that provides information about the imaged vessels and adjacent structures. It requires only venous vascular access and is an outpatient examination with minimal risk.

Although it is possible to assess the aorto-iliac arteries with single slice CT. Using a single-detector spiral CT cannot provide imaging of the entire lower extremity. In an early feasibility study in 1995, Lawrence et al. reported imaging a portion of the lower extremity from the groin to the proximal calf in six patients with single detector spiral CT angiography. The patients were studied with 5 mm slices. The studies were performed over an area of interest of 60 cm and took more than two minutes to acquire. Another study by Raptouplos showed the aorto-iliac arteries could be successfully imaged using two sequential helical scans (15). A later study performed by Beregi et al (16) imaged the popliteal arteries in patients suspected of having popliteal artery disease. This study demonstrated increased sensitivity and specificity in the detection of patients with popliteal artery aneurysms, as well as improved characterization of arterial compression by adventitial cysts and entrapment syndromes. However, these could not image the whole of the arterial tree and had limited ability to reconstruct images.

MDCT has shorter scanning durations, thinner sections of entire anatomic territories, and greater longitudinal coverage. Rubin et al. used MDCT angiography on 24 patients with symptomatic lower extremity occlusive disease. The study used 2.5 mm slices to acquire images extending from the abdominal aorta to the feet. The average study time was a little over one minute and covered 1.2 meters. This study demonstrated a 100% concordance between CT and conventional angiography at direct comparison (17). Since several other studies have now shown good concordance with angiography. A recent review of all CTA studies has shown a median sensitivity of 91% (89-98%) and median specificity of 91% (83-97%) (14).

As with MRA, CTA can potentially demonstrate eccentric stenoses (18), and also more accurately determine the length of long occlusions. The excellent demonstration of adjacent structures and of coexistent aneurysms is a further advantage of CTA. Although operator dependency has been cited as a problem with curved multiplanar reconstructions (19). This was partly because earlier studies used predominantly maximum intensity projections which are of limited use in CTA because the vascular lumen is frequently obscured by mural calcification so that differentiation between tight stenoses and occlusion can be difficult and is cited as a major cause for decrease in the clinical utility of CTA in PVD (20). Post-processing with adequate windowing and the use of curved multiplanar reconstructions generally enables confident discrimination between vascular calcification and intravascular contrast medium. In large arteries such as the aorta and iliac's using the Mastercut technique or the semitransparent volume-rendering technique (21) can also be used to overcome problems with calcifications, but this is not always feasible for the smaller more distal vessels (22). Dual energy CT offers a potential solution to rapidly remove calcium from the images, but is not yet widely available. Another disadvantage of CTA is that very short stenoses may be missed, as its resolution in the z-axis is considerably inferior to conventional angiography (15). It still requires potentially nephrogenic contrast medium and a relatively high radiation dose to patients although compared to standard digital subtraction angiography the radiation dose is 3.9 times lower (23). But despite these limitations, diagnostic performance below the knee remains good (sensitivity 85-99%, specificity 79-97%) and can be an

invaluable tool for problem solving where other imaging techniques have failed.

Conclusion

Patient selection has evolved from using a combination of clinical assessment, including ABPI's followed by angiography, to include duplex assessment, MRA and or CTA prior to invasive angiography.

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1702.2

Conceptual approach to recanalization of crural arteries

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Learning Objectives:

1. To learn about the angiosomal concept of the perfusion of the lower leg
2. To learn about angioanatomical variations of the crural arteries
3. To learn about the clinical implications of the angiosomal concept

Territorial revascularization of the malperfused area is one fundamental concept in the treatment of patients with chronic critical limb ischemia. Ideally all three large crural arteries should be recanalized with a continuous peripheral run-off to the foot. However, this is often technically not possible. In these cases it should be the goal to recanalize those vessels which are major contributors to the angiosmes in which the soft tissue lesion is located.

The foot and ankle can be devided into 6 angiosomes. Each angiosome is supplied by one of the main arteries of the lower limb. The angiosome concept has been introduced by plastic surgeons (1); however, this concept can also be applied to revascularisation procedures in patients with critical limb ischemia.

The posterior tibial artery with its branches supplies 3 angiosomes including the medial segment for the lower leg, and 2 segments of the planta pedis, which are perfused via the medial and lateral branch of the plantar artery. The medial plantar branch has an important interconnection to the anterior tibial artery.

The anterior tibial artery supplies the anterior part of both ankles and its continuation, the dorsal pedal artery supplies the dorsum of the foot.

The peroneal artery supplies the lateral portions of both ankles and the rear foot.

There are multiple interconnection between the angiosomes which may provide collateral perfusion if needed (2).

Although extensive studies are not available in the literature, it has been shown in small series that direct revascularization of an artery which supplies the angiosome where a soft tissue defect is present yields better results compared to indirect revascularization, where an artery is recanalized which is not the main contributor to the angionsome where the lesion is located (3).

In any case it is very important that the operator who performs the recanalization procedure has a clear understanding of the vascular anatomy of the lower leg and the foot and knows exactly in which

angiosome the wound is located. By knowing that, the recanalization procedure can be targeted to the most important vascular territories.

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1702.3

Treatment of pedal occlusive disease

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Learning Objectives:

1. To learn about treatment indications
2. To learn about specific technical aspects of antegrade recanalization
3. To learn about the results

Since the introduction of endovascular therapy to the treatment of critical limb ischemia (CLI), interventions in below the ankle arteries were basically limited to the treatment of anastomosis-related problems after pedal bypass. PTA has been used as a repair technique for restenosis in pedal anastomosis after distal pedal bypass surgery.

Until now pedal occlusive disease still remains as one of the least treated territory regarding endovascular techniques.

However, with the introduction of new techniques and low profile devices endovascular techniques have also gained access to pedal interventions, and represent and probably underestimated field with amazing solutions.

Discussing modern concepts of endovascular treatment below the knee , de novo lesions in pedal arteries should be considered in a global therapy concept in patients with critical limb ischemia (CLI), Rutherford category 4–6, on the basis of non-healing gangrene and/or ulcerations of the foot associated with a critically low level of oxygen tension (TcPO2).

Starting with the pre-evaluation and patient selection, in patients with long occlusions of below-the-knee (BTK) vessels, foot vessels should critically be examined and imaged coincidentally, as the patency of plantar arch vessels provides essential blood flow to both the forefoot and the calcaneal region. Treatment of below the knee vessels becomes only effective when the outflow conditions are optimized

Regarding technical concepts for such indications Manzi et al described the pedal-plantar loop technique, which consists of the recanalization of both pedal and plantar arteries and their anatomical anastomoses. This technique was designed for patients with extensive trophic alteration of the foot requiring the maximum improvement in blood flow support.

Further it might also be used in cases in which it is necessary to use a retrograde approach coming from the plantar arch to treat the anterior or posterior tibial artery as the target vessel when antegrade crossing becomes impossible.

Antegrade femoral puncture is essential for performing BTK and pedal procedures. Devices are used on a 4 or 5F basis. Baseline angiograms should be performed including the pedal arteries in a clear overview, and magnification techniques.

Lesions are generally approached with a system consisting of hydrophilic .014-inch guidewires, supported by low-profile balloon catheter, specifically designed for BTK interventions, in various lengths.

Local injection through the balloon catheter can also be used to confirm the correct intraluminal position before inflation. Inflation times are recommended between 60 and 180 seconds, with a pressure rate between 7 and 10 atm. The balloon size for foot vessels and plantar arch is usually 2 to 3 mm. In cases where PTA alone is insufficient, dedicated stents may be used to solve local problems.

The pedal-plantar loop technique might be used for the antegrade recanalization of the anterior tibial artery and the dorsalis pedis followed by retrograde recanalization of the plantar artery and then of the distal posterior tibial artery or for antegrade recanalization of the posterior tibial artery and the plantar artery followed by retrograde recanalization of the dorsalis pedis and then of the distal anterior tibial artery.

Other techniques, which include pedal revascularization, are subintimal angioplasty, and transpedal access techniques. Subintimal arterial flossing with antegrade-retrograde intervention (SAFARI) might be used when there is a failure to reenter the distal true lumen or when there is only a limited segment of the patent distal target artery available for reentry. In such a case retrograde access can be obtained in the distal target artery, such as the dorsalis pedis, and a retrograde, potentially subintimal, channel can be created. A guide wire can then connect the retrograde and antegrade channels simultaneously and create a „flossing" guide wire. This tract can be further treated by appropriate endovascular techniques.

In conclusion, pedal arteries should be considered in a global concept, when dealing with the treatment of BTK arterial occlusive disease. Techniques and device selection for coincident treatment of pedal arteries should be considered in the setup of endovascular options. Main goals remain the improvement or optimization of vascular outflow, improvement of the level of oxygen tension, and consequently the wound healing process of the foot, particularly when angiographic and clinical results of above-the-ankle PTA remains insufficient.

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1702.4

Retrograde tibial artery recanalization

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Learning Objectives:

1. To learn about the indications for a retrograde approach
2. To learn about the technique
3. To learn about the results and specific problems and complications

Technical success of recanalization in crural arteries depends on the type of lesion and the catheter material used. In stenotic lesions recanalization is successful in 84-98%, however, in occlusions only in 21-76% [2,3,5]. In studies using 5F systems [1,6-10] recanalization succeeded in 75-92% (mean value 86%) and in studies using 4F systems with optional bail-out stenting [11-14] the recanalization rate was 89-96% (mean value 94%).

If appropriate catheter materials and techniques are used angioplasty of crural arteries is technically successful in 89-96%. However, the main negative predictor of failed recanalization is the length of lesion in case of occlusions. If endoluminal recanalization techniques (like drilling technique and step-by-step technique using different types of wires and support catheters) have failed, the technique of intended dissection may be successful. However, this technique is less effective in crural arteries compared to femoropopliteal arteries [18]. Creating a re-entry more distally than necessary is an important drawback of this technique in BTK arteries. Dedicated re-entry devices of appropriate size are not available for crural arteries.

If antegrade crossing of occlusions in BTK arteries using the standard transfemoral approach has failed, assistant retrograde passage of the lesion via transcrural or transpedal approach may facilitate successful recanalization. Selection of appropriate puncture sites in tibial arteries for retrograde approach has to consider the lesion location, arterial diameter, skin pathologies and – if applicable optional landing zones for bypass grafting. Native arterial wall calcification, temporary artery opacification by contrast injection via the femoral sheath and road map technique are useful for puncture guidance. Considering the anatomical topography of tibial arteries rotation of the calf to the outer direction is necessary. For puncture of the anterior tibial artery 10 degrees rotation and for puncture of the posterior tibial artery 45 degrees rotation are useful to obviate injuries of accompanying nerves during the needle is advanced in anterior-posterior direction. For puncture, 21 Gauge needles are used with length between 7 and 10 cm. A 0.018" guide wire is then gently advanced under fluoroscopic control into the arterial lumen. If the lesion cannot be crossed by the wire a 4F balloon catheter can be used for support and dilatation if necessary. After the retrograde wire has traversed the lesion often the passage of the antegrade wire is successful. If not undersized dilatation from both side will facilitate crossing with the antegrade wire. If that is also not successful snaring of the retrograde wire via the femoral sheath is another possibility. These options are used to allow continuation of angioplasty via the transfemoral access. If a transfemoral guide wire is placed across the lesion next step of the procedure is closure of the crural puncture site by endoluminal balloon occlusion over 3 to 5 minutes. If the puncture site is not closed angiographically after that time additional external compression by a pressure cuff should be used. Afterwards angioplasty of the target lesion is finished. Steps of transcrural procedure are demonstrated.

Transpedal access via dorsal pedal artery is performed following the same steps of the procedure. This artery is easy to puncture under fluoroscopic guidance and during temporary contrast opacification after the foot had been turned and fixed in an appropriate position for anterior-posterior needle passage. Shorter needles can be used. Closure of the puncture site is performed by simple manual compression. Steps of transpedal procedure are demonstrated.

Adjuvant retrograde access for recanalization of occlusions of BTK arteries is used in our department since more than 10 years. However, the frequency of this technique has become lower after introduction of dedicated 4F catheter systems and improved guide wires for angioplasty of crural arteries. From 1996 to 2000 about 10% of angioplasties of chronic total occlusions in BTK arteries in patients with CLI were performed with additional retrograde access and in 2010 this rate was 24/470 (5%).

Potential complications are local bleeding and compartment syndrome, injury to accompanying nerves and AV fistulas. In our series, the complication rate was 3% including bleedings and one patient suffering from temporary nerve palsy.

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Special Session
Oncologic IR under the microscope

1703.1

Tissue changes after tumour ablation: is there a clinical value?

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Learning Objectives:
1. To discuss the cellular mechanism of action of thermal ablation
2. To discuss how to evaluate cell death and viability after ablation
3. To demonstrate the correlation of histologic findings with oncologic outcomes after tumor ablation

Introduction/background
Ablation of tumors has become an accepted alternative treatment for selected non-surgical patients with liver malignancies. Several publications reported promising outcomes and overall survival comparable to surgery. Despite the safety and efficiency of the modality, the lack of tissue examinations and margins' evaluations remain an important limitation of the technique when compared to resection. This limitation may explain the relative high rate of local tumor progression (LTP) reported after percutaneous radiofrequency ablation (RFA). Prior series have examined the tissue of ablated tumors in animals as well as in humans. Some of these examinations demonstrated that thermal injury – tumor necrosis - results in early tissue changes; however, the histological appearance of thermal injury consistent with necrosis may not be evident until 24 or even 72 hours after treatment. Other studies demonstrated coagulation necrosis on a significant number of specimens evaluated immediately after ablation. Special viability stains have also been applied and demonstrated lack of viability in ablated cells that maintain their morphology. Areas of tumor have been seen on other studies when examining tissue extracted on multitined RF electrodes after treatment of liver tumors.

Purpose
This presentation will discuss the value of tissue examinations after ablation and how these can be of clinical and prognostic value.

Results/clinical outcomes
In prior studies we collected tissue from multitined electrodes and showed that necrosis was seen in up to 40% of specimens immediate after ablation, whereas in 60% of those specimens cellular characteristics or tumor could be identified. A recent report demonstrated the presence of residual viable tumor on multitined electrodes that do not offer the option of track ablation after treatment. A separate investigation applied proliferation and apoptotic immunohistochemical evaluation and proved that the presence of proliferation marker ki67 in tumor cells was associated with high rates of LTP. Specifically for tumors measuring under 5 cm in larger diameter the presence of Ki-67 positive cells extracted on the electrode after RFA of liver tumors was associated with a hazard ratio of 6 and for tumors under 3 cm with a hazard ratio of 10 ($P<0.001$) for LTP.
A recent 5-year follow-up established that ki67 tumor cells found on the RF electrode is an independent biomarker of LTP and overall survival after ablation of liver malignancies. Similar methodology was used is a separate study evaluating tissue on the RF electrode after ablation of lung tumors and demonstrated that ki67 positive tumor cells is also an independent biomarker associated with high risk for LTP after ablation of lung tumors.

Conclusion/discussion
Tissue examinations from ablated tumors can be used as prognostic biomarkers of outcomes and identify patients at risk for LTP and short survival after treatment. Different types of evaluations of tissue necrosis and viability will be described. Results of tissue examinations and their application in the clinical practice will be presented. Their prognostic value will be demonstrated. The development and improvement of these tissue examinations can be used to identify patients at risk that may benefit from additional treatment prior to the radiographic evidence of recurrent disease.

Future directions
The identification of specific tumor biomarkers that may hold prognostic value will be discussed. Tissue essays that may allow and direct tumor ablation in real time will be addressed.

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1703.2

Tissue changes after tumour embolization: does chemotherapy truly add to the cytotoxic effects?

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Learning Objectives:
1. To discuss the mechanism of action of bland embolization and TACE in liver tumours
2. To discuss if hypoxia/anoxia are related to tumour death or tumour triggering
3. To analyze how understanding these interactions may lead in the future to better tumour control

The rationale for regional chemotherapy is to maximize drug concentrations and tumor drug uptake in the target organ and minimize systemic toxicity. For regional drug delivery to successfully impact relevant outcomes, several important principles regarding tumor biology, drug pharmacology and delivery systems must be fulfilled. Liver cancer, either primary or secondary from colorectal cancer, complies with these principles, as liver cancer has a regional pattern of dissemination (with the liver being the only site of metastatic disease for long periods of time in some cases) that supports a loco-regional approach. Other salient features include the selective blood supply of liver cancer by the hepatic artery and availability of active drugs with suitable pharmacokinetic properties.

The ultimate goal of regional therapy is to improve the therapeutic index by increasing efficacy and decreasing systemic toxicity. Hepatic arterial therapy relies on two important assumptions: regional delivery of the drug leads to increased local concentration and therefore increased therapeutic response and regional delivery of the drug leads to decreased systemic exposure and reduced systemic toxicity. The suitability of any specific drug for regional therapy can be evaluated by the extent to which it fulfills these assumptions.

However, drugs that must be activated at a site other than the arterial infusion site have no regional delivery advantage.

It should be noted that although pharmacokinetic parameters may allow a selective increase in hepatic tumor exposure, the crucial target effect of a particular drug (e.g. DNA incorporation of a thymidine analog) might also exhibit non-linear kinetics. In this case, the impact on what actually is most important, the drug effect, rather than the increased drug concentration, might be less selective at high than at low dose rates. This is the concept of tissue-related pharmacokinetics and takes into account not only saturating pharmacokinetics in the tumor but also in systemic tissues. If at high dose rates, the plateau for the effect is higher in systemic tissues rather than for the tumor itself, loss of regional selectivity is observed.

The paradigm that increased dose will result in increased biologic effect has been challenged by the recent development of targeted agents active against cancer. Most cytotoxic drugs act on DNA or tubulin, exhibit a sigmoidal steep dose-response curve and dose selection is based on maximal tolerated dose. However, for targeted therapies, more is not necessarily better. Pharmacodynamic effect is thought to be the result of receptor occupancy and saturation. Optimal target inhibition occurs at a specific drug concentration, and increasing the dose will not increase the effect. Furthermore, at useful drug concentrations, the maximum tolerated dose may have not been reached. As this has been recognized, the need for new strategies to define the clinically active dose level for this kind of drugs is evident. The traditional phase I trial, useful for cytotoxic drugs dose selection, does not accomplish the goal for targeted agents. Other parameters including pharmacokinetic endpoints such as achieving a predefined target plasma level or direct measurement of target inhibition may be more relevant.

It is therefore very likely that as the field of interventional radiology continues to evolve, this notion of how our procedures impact the tumor microenvironment will become increasingly important and relevant to our practices. As a result knowing how drugs can be better delivered to tissue will be even more critical if we are to improve tumor responses and more importantly patient survival.

Disclosure
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1703.3

Radioembolization: what are the cellular changes?

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Learning Objectives:
1. To discuss the mechanism of action of radioembolization at a cellular level
2. To discuss how radiation induced cell damage relates to tumour death or tumour triggering
3. To analyze how understanding these interactions may lead in the future to better tumour control

Non-loaded microspheres trigger virtually no inflammatory response in the target tissue, with no evidence of either prolonged inflammatory reaction or fibrosis. Particles by themselves do not provoke any necrotic effect neither in the treated liver tumor nor in the surrounding non-tumoral parenchyma. The therapeutic effect of radioembolization is caused exclusively by the cytotoxic damage of radiation (Yttrium 90 is a pure beta-emitter).

The information available about histologic response to RE is scarce. For reasons not yet well understood (tumoral hemodynamics?), some nodules retain a large amount of particles centrally and others, only in the periphery. The intratumoral effect appears to evolve over time and begins with confluent areas of coagulative necrosis. There is no direct correlation between the number of days and the extent of necrosis; however, radiation needs some time to achieve its cytotoxic effect. It has been demonstrated that, within the first three months, the number of nodules without complete necrosis was significantly higher than after this period of time. Coagulative necrosis is associated with an increase in fibrinoid organization and at nine months the necrotic tissue becomes walled-off by a fibrous pseudocapsule. For this reason, the evaluation of the tumoral size is not the most adequate method to evaluate the radiologic response to RE. A decrease in the tumoral contrast uptake seems to reflect the degree of response earlier and more confidently.

Radiation will also affect the non-tumoral liver parenchyma included in the treated liver volume. At early stages some foci of sinusoidal congestion can be observed. Months after the treatment there will appear areas of hepatic fibrosis with a decrease in the size of the hepatocites. In cases of whole liver treatment, the presence of hepatic fibrosis will provoke portal hypertension which can have clinical and radiological manifestations. Four to eight weeks after the treatment some patients (<5%) will present jaundice and ascites. This unusual syndrome, radioembolization-induced liver disease-REILD, is caused by an endothelial injury at the centrizonal sinusoids and manifested as a veno-occlusive disease. This endothelial injury, due to radiation, appears more frequently in patients heavily pretreated with chemotherapy.

In patients who receive lobar or segmental treatments, the hepatic fibrotic response of the treated volume will be compensated by a contralateral liver lobe hypertrophy. Liver hypertrophy, caused by nodular regeneration, can be similar to that observed after

preoperative portal vein embolization.
Since the size of the microspheres used for RE is quite small (<30 microns) they can reach the terminal vessels that vascularize the bile ducts. For this theoretical reason, bile duct complications (i.e., stenoses) could be observed after RE. Cholecystitis is a complication that may appear in any patient treated by an endovascular procedure in which particles are infused into the cystic artery. It is not uncommon however, to find asymptomatic cases in which there is a decrease in the size of the gallbladder with histologic evidence of dense fibrosis associated with the presence of particles within the gallbladder wall.

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1703.4

Use of biomarkers as predictors of oncologic outcomes after intervention

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Learning Objectives:
1. To discuss the action of IR techniques on biomarker levels
2. To discuss how biomarker levels are related to treatment success/failure and how they can influence patient follow-up
3. To analyze how understanding these interactions may lead in the future to better patient management

The model of hepatocellular carcinoma (HCC) will be the aim of the presentation since it concerns various methods of interventional radiology such as local ablation techniques and endovascular techniques. Furthermore, in this particular tumor, evaluation of response after locoregional treatment may be difficult from radiological analysis as assessed on radiological-pathological correlation for patient treated by RFA or other methods before transplantation.
Biomarkers of cancer can be divided into tumor biomarkers obtained by biopsy (or resection) before any treatment and seric biomarkers mainly coming from cell proteins.
From tumor biopsy, some markers can be obtained both from genomic and proteomic analyses. Typically, HCC tumors are poly clonic meaning that different components may have different tumor behavior. This also emphasizes the limit of percutaneous signature. Methods of analysis will be summarized as well as the most common test available. Influence of this test on the risk of recurrence, influence on tumor invasiveness (vascular invasion, risk of metastases) will be given. Information from published results will be given.
Concerning seric markers, some are specific of certain activation pathways like angiogenic cascades like VEGF and HGF receptors and progenitors can be detected in the plasma. VEGF is probably the most explored signalic pathways explored in HCC. Recent studies have demonstrated that serum VEGF per platelet is correlated with tumor VEGF expression (mRNA and protein expression) making VEGF dosage a useful and simple tool that correlates with tumor vascular density, and clinically with more aggressive tumors with liver infiltration, venous invasion and distant metastases. It has been also demonstrated that high serum VEGF poorly influences outcome before chemo-embolization. High VEGF levels are correlated with poor response to treatment. Their influence on response to angiogenic treatment seems to appear in the literature (the higher VEGF A and C before anti-angiogenic the better response and overall survival). On the other hand, an increase in VEGF levels after TACE has also been documented. From this observation, development of combined treatment has been developed with combination of anti-angiogenic oral treatment such as sorafenib or sunitinib before TACE. Hypoxia-inductible factor-1 is a protein that targets genes involved in oxygen transport like erythropoetin, angiogenesis like VEGF, nitric oxide production, and endothelin1, but also cell growth and apoptosis through genes coding for insulin growth factor. HIF1 is a target for development of new treatment that could be combined with TACE. When a tumor is treated by TACE, the tumor hypoxia induces changes in tumor metabolism is based on HIF1 controlled glycolysis. Therefore, inhibition of HIF1 cascade could potentialize cell death after tumor embolization.
New embolic materials like DC beads and Y 90 have different impact on angiogenic cascades. Latest information about these new techniques will be given.
This presentation emphasizes the absolute necessity of a better understanding at the cellular level of our treatments. More precise information of the cellular effects of our different treatments not only at the macroscopic but also at microscopic and cellular levels is mandatory to improve our results. Furthermore, despite the good clinical results achieved with our techniques, long-term clinical success will probably result from combination of loco-regional treatments to systemic therapy. Method of combination can only result from this research.

Disclosure

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Special Session
How to treat an acute stroke patient

1704.1

Update on thrombolysis: intravenous and intra-arterial

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Neurologie, Klinikum Klagenfurt am Wörthersee, Klagenfurt, Austria.

Learning Objectives:
1. To learn briefly where intravenous thrombolytic treatment stands in terms of evidence based medicine
2. To learn briefly where intra-arterial thrombolytic treatment stands in terms of evidence based medicine
3. New treatments on horizon: intravenous - intra-arterial bridging therapy

No abstract available.

1704.2

Revascularization techniques especially focusing on recent mechanical revascularization concepts

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Acute Vascular Imaging Centre, Biomedical Research Centre Oxford, Oxford, United Kingdom.

Learning Objectives:

1. To understand different revascularization techniques and how mechanical revascularization differs from the pharmacological revascularization
2. To learn different mechanical revascularization techniques and when to use it
3. To learn technical tips to decrease the complication rate

The purpose of this talk is to understand the different revascularization techniques that have recently emerged and to show how mechanical revascularization differs from the pharmacological revascularization. The talk aims to explain the concept of different mechanical revascularization techniques and gives advice on when to use them. It aims to review current treatment options in acute ischemic stroke, focusing on the latest advances in the field of mechanical recanalization. These devices that recently made available for endovascular intracranial thrombectomy show great potential in acute stroke treatments. Compelling evidence of their recanalization efficacy comes from current mechanical embolectomy trials. In addition to allowing an extension of the therapeutic time window, mechanical recanalization devices can be used without adjuvant thrombolytic therapy, thus diminishing the intracranial bleeding risk. Therefore, these devices are particularly suitable in patients in whom thrombolytic therapy is contraindicated. IV and IA thrombolysis and bridging therapy are viable options in acute stroke treatment. Mechanical recanalization devices can potentially have a clinically relevant impact in the interventional treatment of stroke, but at the present time, a randomized study would be beneficial. In an effort to extend treatment availability to patients with stroke and to reduce the potential for intracranial hemorrhage, IA lysis is a viable option for those who present in the 3- to 6-hour time window, independent of the degree of neurologic impairment. Advantages and disadvantages of IA lysis, IV lysis, and combined IA/IV lysis will be discussed. Combination use of IA lytics and mechanical thrombectomy devices is increasing and may be successful when each single strategy failed. When IA lytics have been unsuccessful in lysing the clot, mechanical devices could successfully recanalize the occluded cerebral vessel and restore flow. The designs of the devices vary between their individual engineering concepts and their approaches to the clot, either proximally or distally. However, a significant concern is the risk of vessel penetration when the technique requires the interventionalist to navigate the embolectomy device distal to the clot. Stroke treatment improved when mechanical devices first became available. Although they were initially only accessible to patients who were part of trials, endovascular stroke interventions combined the use of IA thrombolytics, mechanical embolectomy devices, and angioplasty with or without stent placement. These procedures were implemented in patients who were either refractory to or ineligible for intravenous rtPA. The evolutionary journey of mechanical thrombectomy devices has traveled from adjunctive rescue treatment to frontline therapy. In essence, recanalization using mechanical means could not only extend the therapeutic window but also potentially reduce the number of bleeds that are frequently associated with thrombolytic therapy. Limitations of mechanical devices have been reported and attributed to vessel tortuosity, arterial stenosis, and inaccessibility of the thrombus due to its location and consistency. The ongoing registries of the Merci clot retriever and the Penumbra System as well as the IMS III trial should, in the future, provide further evidence of these emerging technologies. Early consideration of this technique in patients with acute stroke secondary to large vessel cerebro-occlusive disease may improve recanalization rates and clinical outcomes.

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1704.3

Complications and their management

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Learning Objectives:

1. To understand the mechanisms of complications in endovascular stroke treatment
2. To learn how to avoid complications in terms of right patient and tool selection
3. To learn how to manage the complications when they still set in

Every endovascular stroke treatment technique aims to recanalize the occluded vessel as efficient and fast as possible. Since the introduction of endovascular treatment techniques back in the 1950s, parenchymal as well as vascular complications have been reported. During the natural course of acute ischemic stroke, approximately 2% of all patients will suffer spontaneous symptomatic intracranial hemorrhage (sICH) due to hemorrhagic transformation of the infarct. The intra-arterial thrombolysis (IAT), locally applying fibrinolytic drugs (such as urokinase, pro-urokinase or rt-PA) increase this risk of sICH. The Proact II study (1) found sICH with neurological deterioration within 24 hours in 10% of patients undergoing intra-arterial thrombolysis. Despite this significantly increased risk compared to the placebo group, the percentage of patients with mRS 6 after 90 days is not elevated. To assess hemorrhagic complications, patients are monitored for neurological deterioration and follow-up imaging after 24 h is mandatory after stroke treatment. The underlying cause of sICH, the hemorrhagic transformation of the infarct, has no further endovascular treatment option and neurosurgical evacuation may be necessary (2). Vascular complications following IAT have been described but are generally rare.

In order to reduce or omit fibrinolytic drugs and therefore reduce the risk of sICH, mechanical recanalization techniques have been increasingly investigated and clinically applied in the recent years (3). As assumed, most studies on mechanical recanalization in conjunction with IAT have shown a lower incidence of sICH on the basis of hemorrhagic transformation. However, the large trial on the clinical application of the distal devices, the Merci device group in the Multi Merci Trial (4), has shown 5.5% clinically significant procedural complications and 2.4% device-related serious adverse events including intracranial vessel dissection and subarachnoid hemorrhage (SAH). The clinical trial on a different and proximal mechanical approach, the Penumbra system, has shown comparable complication rates (sICH 11.2%) including vessel perforations and SAH (5). The new generation of stent-like retrieves (Trevo System, Solitaire FR, BonNet etc) has not been evaluated in large clinical trials yet. The few data on this novel group of thrombectomy devices have shown high recanalization rates and fast recanalization times (6,7). To prevent thromboembolic events during retrieval of distal devices (e.g. Merci) and stent-retrievers, proximal balloon occlusion of the internal carotid artery (ICA) and aspiration at the balloon guiding catheter (flow reversal) is recommended.

To reduce vascular complications, tortuosity of access and target vessel, occlusion length, intracranial collateral flow and anatomical variants have to be taken into account before deciding for one of the various recanalization techniques.

In case of difficult access vessels such as tortuosity of stenosis of

the ICA, the application of the proximal balloon guiding catheter for stent-retrievers and distal devices is often complicated. Furthermore, it carries the risk of thromboembolic events and may cause cervical dissection due to balloon inflation.

Dislodging thrombus in previously unaffected vessel territories will in most cases worsen the clinical status and neurological outcome of the patient dramatically. This vascular complication does not only involve an additional brain area into the ischemic stroke but also disables essential pial collaterals to the previously affected territory. Vessels originating proximally to the occlusion site (e.g. ACA or fetal variant of the posterior cerebral artery from the ICA in MCA occlusion) have to be protected from thromboembolic events during stroke treatment whenever possible. Therefore, in some clinical settings the application of IAT and local disruption is safer than mechanical approaches and thrombus retrieval.

Due to the vessel diameter of below 2 mm the treatment of occlusions in M2-branches of the middle cerebral artery (MCA) and within the anterior cerebral artery (ACA) territory is limited using mechanical and especially distal devices. These areas of the vascular tree are more prone for vessel wall damage during mechanical manipulation.

The treatment of complications is complex and mainly tailored to the individual clinical situation. sICH is a frequent parenchymal complication following any kind of recanalization technique. Therefore, endovascular stroke treatment has to be embedded in an interdisciplinary environment including neurology, neurosurgery and neuroimaging.

The increasing application of mechanical recanalization techniques and the reduction of IAT seem to reduce the incidence of parenchymal complications. However, most likely due to the more intense mechanical manipulation, vascular complications such as thrombus dislocation, cervical/intracranial dissection and vessel perforation with consecutive SAH are observed. The knowledge of different recanalization approaches and the immediate treatment of vascular complications is often mandatory and lifesaving.

Therefore, the training for endovascular stroke treatment has to include the application of various different endovascular stroke treatment approaches as well as techniques to control complications including extra- and intra-cranial stenting and the use of liquid embolic materials.

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Disclosure

Global PI for the STAR-Trial (Evaluation of the Solitaire FR in acute straoke) -> From my point of view not relevant for this invited talk on complications.

Special Session
Renal denervation for resistant hypertension

1705.1

How renal denervation may be effective for the treatment of resistant hypertension

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Department of Nephrology, University Medical Center, Utrecht, Netherlands.

Learning Objectives:

1. To review the pathophysiology of resistant hypertension
2. To analyse the role of sympathetic activation in the development of resistant hypertension
3. To describe the basic mechanisms of catheter based renal denervation

Rationale

Hypertension is one of the most important cardiovascular risk factors. Lowering blood pressure indeed reduces this cardiovascular risk. Most hypertensive patients are classified as having "essential hypertension", i.e. hypertension without clear cause.

For decades, it has been thought that the sympathetic over-activity is an important contributor to the pathogenesis of hypertension. Especially, in the past 10-15 years much progress has been achieved in understanding the pathophysiology by studying various experimental and human conditions of chronic kidney disease. Hypertensive chronic kidney disease patients (CKD) have increased muscle sympathetic nerve activity (MSNA, which represents the centrally generated sympathetic nerve activity directed to resistance vasculature). Bilaterally, nephrectomized patients have MSNA comparable to controls, indicating that the signal that commands the brain to increase sympathetic outflow is generated in the diseased kidneys. Unilateral nephrectomy for the purpose of transplantation did not affect MSNA. Disease conditions characterized by sympathetic hyperactivity, quantified by the MSNA technique, include CKD, heart failure, essential hypertension, metabolic syndrome/obesity-associated hypertension.

In experimental studies, it was found that even a limited kidney lesion, not affecting GFR, results in neurogenic hypertension, which is reduced or prevented by kidney denervation. Both an ACE-inhibitor and an angiotensin II antagonist reduce MSNA (1). These data taken together indicate that in humans the diseased kidneys are the key players in the pathogenesis of increased MSNA. Our hypothesis is that kidney ischemia is of critical importance in the pathogenesis (for review, see reference 2).

Clinical relevance

There is much evidence that sympathetic hyperactivity is indeed harmful. Blood pressure in CKD patients correlates with MSNA, and blood pressure reduction during chronic ACE inhibitor or angiotensin II antagonist correlates with the decrease of MSNA. However, more importantly, there is substantial evidence that it also contributes to the development of cardiovascular organ damage, kidney failure progression and clinical outcome including mortality, and that these associations are partially independent of blood pressure (2).

New developments: renal denervation

If we accept the pathophysiologic mechanisms outlined above, it is not surprising that renal denervation might be a useful treatment strategy. Indeed, half a century ago, before the availability of antihypertensive agents, severely hypertensive patients were subjected to surgical denervation of the kidneys. This invasive procedure was abandoned because of severe side effects and the introduction of antihypertensive agents.

Recently, the concept of renal denervation experienced a renaissance by the far less side effect prone method of catheter-based renal denervation. Both afferent and efferent renal nerves are located in the wall of the renal artery. The technique of catheter-based renal denervation and first results are recently published and discussed in other presentations (3-5). Interestingly, in one patient MSNA, assessed in the peroneal nerve, was reduced after the procedure, providing direct support to the hypothesis that blood pressure lowering is caused by reduction of efferent sympathetic activity from the CNS to the periphery (6). The effect on MSNA after 12 months was even more pronounced than after 1 month.

For several reasons these data are potentially of relevance. First, they suggest that a single intervention has an antihypertensive effect lasting for prolonged periods of time, may be even years. Presently, it has only been tested in so-called resistant hypertension, defined as systolic blood pressure above 160 mmHg despite 3 or more antihypertensive agents. Second, given the convincing evidence linking sympathetic hyperactivity to poor clinical outcomes, it will be relevant to quantify the effects on clinical outcomes beyond blood pressure. Third, when data on longer term safety and efficacy of the procedure are available, it will be of interest whether other conditions may also benefit from this intervention, e.g. less severe hypertension, metabolic syndrome/obesity, sleep apnoea, CKD and heart failure. If a prolonged effect is demonstrated, it is likely that the procedure can be (very) cost-effective.

There is another reason why the introduction of this procedure is important. It will teach us more about the pathophysiology. The fact that this very localised single intervention has such pronounced systemic effects can only be explained by the pathophysiologic model outlined above and schematically shown in the figure. It will be particularly interesting to study in which patients this intervention is effective and in which it is not and also to work out predictors for the efficacy of the procedure. Given the fact that in experimental models hypertension is prevented by denervation, one might raise the argument why in humans it is only partially reduced. In this context, it is intriguing that available observational data suggest that the effects on blood pressure are increasing over time. It seems attractive to hypothesize that apart from a direct effect of the intervention on blood pressure there may be a second level of efficacy, i.e. the slow reversal of structural vascular and/or renal abnormalities. It seems logical that this takes some time to occur. Another explanation for a partial, instead of (near) total, reduction in blood pressure towards normal level could be that the procedure is only partially effective in destroying the nerves. Variability in efficacy of the denervation procedure itself may also explain the variability of the magnitude of the antihypertensive effect between subjects. From a theoretical point of view, MSNA assessment is the ideal method to evaluate the efficacy of the procedure. Unfortunately, this is unsuitable in every day clinical practice. Further, there are also nerves around the veins and ureters. The precise contribution of these nerves to circulatory functions is unclear. A suitable human "model" to test the effects of total renal denervation is unavailable, except for total nephrectomy. Experimental evidence shows that nephrectomy of an injured kidney results in (almost) complete normalisation of blood pressure. Finally, incomplete normalisation of elevated blood pressure may be explained by the assumption that other blood pressure increasing mechanisms may remain operational. It is important to realize that remaining circulating angiotensin II exerts a direct effect on the vasculature as well as on the sympathetic system, the latter both on the level of central nervous system and the periphery. Another interesting challenge is the fact that this "clean" method of sympatholytic therapy makes it possible to study the influence of sympathetic activity on various pathologies. For instance, it has been hypothesized that the interaction between insulin resistance and sympathetic activity might be bidirectional. First results seem to suggest that insulin sensitivity improves considerably after renal denervation, strongly supporting the role of sympathetic hyperactivity in its pathogenesis. Other interesting subjects could be the effect on inflammatory markers and on markers of vascular, renal hemodynamic and cardiac function and structure.

Are there any downsides? Obviously, there is concern about a detrimental effect on the anatomy of the renal arteries of this invasive procedure. Careful long-term follow-up of these patients is therefore mandatory. Regeneration of nerve function is very well possible, especially for efferent nerves. Afferent nerves are unlikely to regrow. Any anatomical and functional regeneration will be difficult to diagnose apart from a rise in blood pressure. However, given the above-mentioned pathophysiologic considerations, effects on afferent nerves are likely to be (much) more important, than any effect on efferent nerves. It seems unlikely, that there are unwanted effects with respect to short-term blood pressure regulation, since baroreceptor function is not affected. Because both afferent and efferent nerves may be destroyed, water and salt regulation by the kidney may be altered. No data on that subject are available so far. Finally, the procedure is still expensive.

Conclusion

Catheter-based renal denervation offers a fascinating novel treatment modality (7,8). The recently presented data provide sufficient rationale for further research on this methodology. The way to do it is by careful and detailed long-term analysis of efficacy and safety variables in patients before and after the procedure. The procedure may also promote better understanding of the underlying pathophysiology, thus helping to define which type of patients will especially benefit of the procedure. Future research should also include cost-effectiveness analysis.

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1705.2

Tools and basic technique

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Learning Objectives:

1. To review the available hardware for renal denervation
2. To review the appropriate skill, the technique and present tips and tricks
3. To review the complications and how to avoid them

Endovascular renal artery denervation (ERAD) is a new procedure to reduce renal and systemic sympathetic overactivity in hypertensive patients. The only clinically available technique as of mid 2011 is radiofrequency ablation using an endovascular approach.

In brief, the symplicity catheter (Medtronic Ardian) is introduced into each renal artery via femoral access. Discrete, low-power, radiofrequency ablations (2 min each) are applied to obtain up to six ablations separated both longitudinally and rotationally within each renal artery. During ablation, the catheter system monitors tip temperature and impedance, altering radiofrequency energy delivery in response to a predetermined algorithm.

Because the catheter used has not been validated for use in subtype of anatomical presentation, there is a need of anatomical work up before ERAD.

It is recommended, as it was in the inclusion/exclusion criteria of HTN 2 and the initial feasibility cohort to reject from ERAD the following anatomical conditions. Severe renal artery stenosis, renal stent, severe atheromatous aortic lesions, abdominal aortic aneurysms. These situations may not preclude totally the ability to perform the intervention but would require enhanced caution and even more accurate assessment of the risk /benefit ratio.

Apart from these situations, the use of symplicity catheter is recommended in renal arteries of ≥4 mm in diameter and 20 mm long before any major branch bifurcation. The technology has not been sufficiently tested in vessels of smaller diameter. The generator is controlled by an algorithm, and the tip of the ablation catheter constantly measures temperature and impedance and will shut-off, if certain thresholds have been reached. Unilateral treatment is technically possible but there is less evidence to recommend this approach. Patients with suboptimal anatomy that excluded them from the randomized arms of the HTN-2 study were treated in a registry. The results of this registry may help us better understand the effect of renal denervation in non-standard anatomies.

Because most of these patients have resistant hypertension and according to the accepted rules, renal artery imaging is often available in the patient file. However, it is our experience that recent CTA is the most reliable imaging technique in order to depict accessory arteries, measure length and diameters allowing comprehensive anatomical work up. The use of surface reconstruction coronal MIP and/or curved reformats are very helpful in this setting.

Denervation is an interventional procedure to treat a high-risk medical condition. Most of the patients in whom the intervention will be proposed will have macroscopically normal arteries. The intervention is technically easier than renal artery stenting, intra-arterial navigation in healthy arteries does not carry any specific difficulty and entering into the renal artery with a conventional 0.014 or 0.035 wire is not a problem.

The different steps of the denervation process are therefore as follows:

Femoral artery puncture at the groin, global angiogram to confirm renal artery anatomy (this step can be bypassed if pre-op imaging is recent and reliable and/or if some degree of renal failure is present). Alternative puncture site will likely be of interest if the intervention becomes routine and outpatient based. As of now, the system is not designed for brachial or radial approach.

Selective catheterization of the renal artery using a soft tip wire (in the latest, caution should be paid not to enter too distally into the renal arterial network to prevent damage to the kidney).

The use of a guiding catheter or a long sheath is a matter of debate. With the current Symplicity catheter, a 5 F long sheath is large enough. While it has the advantage of smaller puncture site it carries the risk of dissection when the repeated control angiograms are performed between each shoot.

We currently favor the use of 6F guiding catheter (after insertion of a short 6F sheath into the groin). The 2 most useful shapes are LIMA and RDC-1.

We choose the shape as follows: in case of sharply descending renal artery a LIMA can be used.

In case of relatively horizontal 1 or 2 first cm of the renal artery, an RDC-1 is better suited.

There are not many short (45-55cm) 6 F guiding catheter available on the market, and we have generally used the Boston Scientific ones.

Permanent flushing of the side port of the sheath/guiding catheter with heparinized saline is recommended.

Injection of a bolus 200 mcg of nitroglycerine into each renal artery is recommended in order to reduce spasm.

The current version of denervation catheter is of 5F caliber (and can be delivered through a 6F renal guiding catheter) and has a deflecting soft tip. The distal blunt tip carries the electrode that will deliver the radiofrequency current. Once in position into the renal artery, the handle is activated and the tip deflects toward the arterial wall ensuring good wall apposition. A quick angio confirms the position of the tip, and the generator can be activated. A drop in impedance as well a temperature rise will attest the quality of the energy delivery. It is of importance to note however that there are no direct measurements of actual denervation.

For control angiograms, most caution should be employed when injecting contrast through the side port. If the distal tip of the sheath/guiding is in close contact with the arterial wall forceful injection of contrast may very easily induce renal artery dissection.

After completion of the first 2 minute ablation just proximal to the bifurcation of the renal main, the catheter should be retracted at least 5 mm. The goal is to create an interrupted spiral pattern of 4-6 ablation points.

The same process is performed in the contra-lateral renal artery. In some cases, the immediate control angiogram shows small nipples on the arterial wall which are attributed to local edema . They lie at the level of the denervation point and when controlled at mid-term are not visible anymore. Their presence or absence has not been correlated to any positive of negative outcome in these patients.

Arterial spasm can be observed and is prevented by injection of nitrates into the renal artery as stated earlier. It is generally mild and does not lead to interruption of the intervention. In case of severe stenosis, the only effective treatment is interruption of the intervention on this side.

Permanent caution should be applied to prevent any clot formation during the intervention. We suggest full heparinization using ACT control to ensure and ACT above 200-250. Bolus heparin injection should be performed after femoral puncture.

Management of pain and per operative monitoring of the patient

ERAD is a painful procedure which usually requires between 30 and 45 min of intervention. Therefore, there is a need for sedation and analgesia. Pain is believed to be related to the heating of vessel adventitia and is usually acute with an on/off pattern, exactly matching the radiofrequency shoots. Patients describe a deep, exquisite lumbar pain, quite similar (or more pronounced) to that reported by those who experience dilatation or dissection of the renal artery.

Relatively high doses of analgesic drugs are sometimes required to control pain and that the best approach is to provide systematic analgesia prior to initiation of noxious stimulation. A good coordination between IR and anaesthesiologist ensures that opioids are administered at least two minutes before turning on the radiofrequency generator. Opioids may then be titrated according to EVA scale in order to optimize patient's comfort. Mild sedation is helpful to enhance patient confidence and facilitate IR's work by reducing stress and movements. On the other hand, the combination of analgesia and sedation carries a risk of respiratory depression that requires careful monitoring. Ideally, conscious sedation should be targeted to obtain a "modified observer assessment of alertness/sedation" (MOAAS) scale of 4 or 3, meaning that the patient remains responsive to verbal stimulation.

Conclusion

Renal artery denervation has already shown very promising results in the treatment of resistant hypertension. In the future, it will maybe also contribute to the treatment of other major cardiovascular diseases. The current approach using RF ablation is the first to show significant results and there is no doubt that other techniques to achieve denervation will be developed and tested in the near future. Interventional radiologists are well trained to be major players in this field both in research and in clinical practice.

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1705.3

Outcomes and trials

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Learning Objectives:

1. To review the recent trials on renal denervation
2. To elaborate on potential limitations of these trials
3. To define patients groups where interventional renal denervation could be offered

As of April 1 2011 there has been one international study group that up to now has investigated and published in 3 steps the introduction of the new renal denervation technique.

In the first step, the proof of principle and safety was shown in a cohort study of 50 patients with 1-year follow up. The patients had resistant hypertension with systolic blood pressure ≥ 160 mmHg on three or more antihypertensive medications including a diuretic. Five patients were excluded for the presence of a dual renal artery system. Blood pressure was reduced by 14/10, 21/10, 22/11, 24/11 and 27/17 mmHg at 1, 3, 6, 9 and 12 months. In one patient an intraprocedural renal artery dissection occurred. It can be concluded that renal denervation can safely be used to reduce blood pressure in treatment-resistant hypertensive patients.

In the second step, a randomised controlled trial was done in 106 patients with resistant hypertension. Patients were randomly allocated for renal denervation with previous treatment or to maintain previous treatment alone. The primary endpoint was changed in seated office-based measurement of systolic blood pressure at 6 months. In the denervation group the blood pressure was reduced by 32/12 mmHg which they did not differ from baseline in the control group. At 6 months 84% of the patients who underwent denervation had a reduction in systolic blood pressure of 10 mmHg or more compared to 35% in the control group. In conclusion, renal denervation can safely be used to substantially reduce blood pressure in treatment-resistant hypertension patients.

In the third step, the study group extended the cohort from the first study to 153 patients to prove that at two and a half years of follow up the results of the denervation treatment are durable. All these patients too had resistant hypertension. The blood pressure was reduced by 20/10, 24/11, 25/11, 23/11, 26/14 and 32/14 mmHg at 1, 3, 6, 12, 18 and 24 months. There were 3 pseudo-aneurysms and 1 dissection. This study shows that the results obtained with denervation are durable.

The 3 studies described above have several limitations. Up to now they have not yet shown that the outcome of these patients improved in hard outcomes measures such as mortality, acute heart disease and stroke. Such outcomes studies have to be done. Second the patient population studied is very limited. It is very well possible that in patients with less severe hypertension and less medication the denervation method could be useful too. In this respect the problem of patient non-adherence to and non-persistence with a lifelong pharmacological therapy for a mainly asymptomatic disease should be addressed and it should be investigated what the contribution of the denervation method could be in a wide range of hypertension patients. In these later studies not only hypertension but also hard long-term outcome measures should be studied. Besides the 3 studies referred here, no other studies on the effect and clinical outcomes are available yet.

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Special Session
Outcomes of BTK recanalizations

2401.1

Outcomes of angioplasty and bare stents

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Learning Objectives:

1. To learn about the results of current trials
2. To compare the results of PTA alone and stent
3. To learn which implication the study results should have on clinical practice

Infrapopliteal angioplasty is becoming the gold standard procedure for treatment of below-the-knee arterial disease. Compared to surgery this minimally invasive procedure shows a clear benefit of shorter hospital stays and reduced complications and periprocedural adverse events, especially in the frail patient cohort of elderly patients with critical limb ischemia (CLI). In addition, percutaneous angioplasty provides the opportunity to treat lesions in multiple tibial arteries during the same procedure or in a staged manner, whereas surgical revascularization is generally restricted to bypass a single tibial target.

Outcome data of percutaneous revascularization for the treatment of infrapopliteal disease suffer from many of the limitations of the observational surgical series in that they typically analyze retrospectively relatively small number of patients at individual centers. There is also inadequate information regarding the anatomy of the lesions treated. The duration of follow-up in endovascular studies is also significantly shorter compared with surgical series, in part due to the continuous evolution of endovascular therapy. Comparison across studies is problematic due to differences in baseline clinical characteristics and differing complexity of anatomic disease. Comparison with surgical series is also difficult, since the spectrum of patients treated using endovascular techniques is different from those treated using surgical bypass.

In patients with CLI the primary goal of treatment is typically prevention of amputation and salvage of a functioning limb. Reported results for infrapopliteal PTA usually focus on these outcomes with limb-salvage rates of 56–91%. In a large meta-analysis of series (including older ones) using PTA as the primary treatment modality, Romiti et al reported a limb salvage rate of 82.4% at 3 years, which is comparable with that of 82.3% reported in a meta-analysis by Albers et al of popliteal-to-distal bypass using similar methodology. Interestingly, this comparative clinical efficacy was achieved despite significantly lower primary and secondary patency rates in the PTA series. Both intraluminal and subintimal angioplasty can equally be used when treating patients with critical limb ischemia. Subintimal angioplasty is a valuable solution for long tibioperoneal occlusions. A large meta-analysis by Bown et al of over 2800 patients who had subintimal angioplasty for critical limb ischemia showed a limb salvage rate of 89.3%. In another large systematic review by Met et al of over 1500 patients who were treated with subintimal angioplasty a limb salvage rate of 80 to 90% was achieved.

Infrapopliteal stenting is indicated as a bail-out procedure in treating intimal dissections and abolishing elastic recoil of the vessel wall with maximum early luminal gain. Feiring et al. were the first who documented the safety and efficacy of infrapopliteal stent placement. They applied primary below-the-knee stent-supported angioplasty for restoring straight inline arterial flow in patients with infrapopliteal arterial disease. Bare or heparin-coated balloon-expandable stents were mainly used without any serious adverse events. The authors reported 1-year outcomes after primary infrapopliteal stent placement in 92 limbs suffering from either CLI (68%) or lifestyle-limiting claudication (32%). Technical success was 94% for de novo atherosclerotic lesions; clinical amelioration of CLI was achieved in 96% of the cases, with sustained clinical improvement at 1 year.

Recently, in an attempt to improve long-term patency, coronary drug-eluting stents have been placed below the knee and have shown significant promise in inhibiting restenosis of the infrapopliteal arteries and thereby reducing recurrent leg ischemia and repeat revascularization procedures.

The main limitations of currently available bare or drug-eluting balloon-expandable stent platforms are the small lengths available and the vulnerability to external compression and deformation at distal joint segments or pedal vessels. Taking into consideration that two thirds of all infrapopliteal lesions are occlusions with 50% of those >10cm long, it is obvious that long stents dedicated for the special features of infrapopliteal disease are needed. For this purpose long, thin-strut, low-profile, self-expanding nitinol stents designed and engineered specifically for the infrapopliteal arteries were developed. A small study by Kickuth et al confirmed the safety and feasibility of such a commercial device (Xpert stent), while in a larger study of the same stent Bosiers et al reported 2-year primary patency and limb salvage rates of 54.4% and 90.8%, respectively.

At the moment, there is only 1 long balloon-expandable stent device (Invatec's Chromis Deep) dedicated to the infrapopliteal segment; it is made of cobalt-chromium alloy and is available in lengths up to 8 cm. In a single center study, Dellose et al concluded that primary stenting using the Chromis Deep stent is a safe treatment strategy for infrapopliteal lesions in patients with CLI.

Prospective clinical trials are necessary to answer whether bare or drug-eluting, balloon-expandable or self-expanding, or metal versus bioabsorbable stents will have a positive impact on limb salvage to support their primary use in below-the-knee endovascular treatment.

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2401.2

Outcomes of drug eluting balloons and stents

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Learning Objectives:

1. To learn the results of current trials
2. To compare the results of drug eluting balloons and drug eluting stents
3. To learn which implication the study results should have on clinical practice

Critical limb ischemia (CLI) entails a high risk of major amputation without prompt and aggressive revascularization. Wolfe et al. classically described the poor prognosis of CLI in more than 6000 patients. If left untreated, CLI caused major amputation in 73% of patients with rest pain and in 95% of patients with tissue loss at 1 year. In the interest of prevention of limb loss, patients with CLI are candidates for revascularization attempts by surgical or percutaneous methods. Although infrainguinal bypass surgery remains the cornerstone of CLI treatment, the majority of the patients are ineligible because of diffuse infrapopliteal arterial occlusions, absence of suitable vein grafts, and multiple underlying comorbidities. Compared to surgery, angioplasty is a minimally invasive procedure with a clear benefit of reduced complications and periprocedural adverse events, especially in the frail patient cohort of elderly octogenarians. In addition, it may be repeated as necessary, and more than 1 vessel to the foot may be recanalized.

The primary goal of infrapopliteal angioplasty is to restore at least 1 straight line of blood flow to the distal foot. The secondary objective is to preserve the patency of the treated lesion for as long as possible to avoid recurrence of CLI symptoms. In the majority of the cases, infrapopliteal angioplasty may be combined with more proximal femoropopliteal endovascular procedures. Occasionally, it may be applied in tight distal anastomotic lesions of bypass grafts to avoid early graft failure and thrombosis. Reported complication rates range from 3 to 11% and include puncture site hematomas, vessel perforation, dissection, and distal embolism or thrombosis, which may be successfully managed endovascularly. The reported 30-day mortality rate of infrapopliteal angioplasty is <1.7%.

Scientific evidence regarding safety and overall clinical effectiveness of infrapopliteal angioplasty supports its application as a first-line treatment option for infrapopliteal obstructive arterial disease in the setting of CLI. The FIRE (Foundation for Interventional Radiology in Europe) registry organized by the Cardiovascular Interventional Radiology Society of Europe enrolled 396 patients with 409 critically ischemic limbs. An 83% cumulative limb salvage rate and a 91% cumulative survival rate were achieved after a mean follow-up period of almost 6 months. Univariate analysis within the FIRE registry showed that cardiac disease, carotid disease, and renal insufficiency were unfavorably associated with both mortality and limb salvage. A random effects meta-regression analysis of 18 studies published between 1984 and 1997 and including 1280 patients treated with infrapopliteal balloon angioplasty reported overall limb salvage rates of 79% at 1 year and 74% after 2 years. A more recent meta-analysis of 30 studies published between 1990 and 2006 reported 3-year limb salvage and patient survival probabilities of 82.4 and 68.4%, respectively. For comparison, the 5-year limb salvage rates using autogenous veins for infrapopliteal bypass range from 73 to 81%.

The enthusiastic results of drug-eluting stents in the coronary arteries were the impetus for their widespread application in other vascular territories, including but not limited to the intracranial arteries, the renal arteries and the infrainguinal arteries. A systematic review of the literature analyzing outcomes of stenting below-the-knee in 18 non-randomized studies, including 640 patients in total, has shown that sirolimus-eluting stents appear to be superior to bare metal and paclitaxel-eluting stents with regard to both angiographic and clinical outcomes. Eighteen nonrandomized studies were analyzed comprising 640 patients in total. After a median follow-up of 12 months, primary patency was 79% (95%CI, 72-86%), improvement in Rutherford class was noted in 91% (95%CI, 86-97%), target vessel revascularization was necessary in 10% (95%CI, 6-14%), and limb salvage was achieved in 96% (95%CI, 95-98%) of the cases. Head-to-head comparisons showed that sirolimus-eluting stents were superior to balloon-expandable bare metal stents in preventing restenosis and increasing primary patency (both p<0.001).

In line with the above results, recently released results from the PARADISE study (a nonrandomized single-center study in the United States investigating leg amputations in critical limb ischemia with below-the-knee angioplasty and drug-eluting stents) showed that the 3-year cumulative incidence of amputation was 6±2%, survival was 71±5%, and amputation free-survival was 68±5%. Siablis et al. have also recently released very positive angiographic and clinical outcomes with infrapopliteal sirolimus-eluting stents up to 3 years. At 3 years, infrapopliteal lesions treated with bail-out sirolimus-eluting stents were associated with significantly better primary patency (hazard ratio [HR], 4.81; 95% CI, 2.91-7.94; p < 0.001), reduced binary restenosis (HR, 0.38; 95% CI, 0.25-0.58; p < 0.001), and better repeat intervention-free survival (HR, 2.56; 95% CI, 1.30-5.00; p = 0.006) versus lesions treated with bare metal ones. The authors concluded that infrapopliteal application of sirolimus-eluting stents for CLI significantly improves angiographic long-term patency and reduces infrapopliteal vascular restenosis versus bare metal stents, thereby lessening the rate of clinically driven repeat interventions. The same group has recently published the long-term outcomes after primary placement of everolimus-eluting metal stents for recanalization of long infrapopliteal lesions compared to a matched historical control group treated with plain balloon angioplasty and provisional placement of bare metal stents in a bailout manner. Up to 3 years, lesions fully covered with everolimus-eluting stents were associated with significantly higher primary patency [hazard ratio (HR) 7.98, 95% CI 3.69 to 17.25, p < 0.0001], reduced binary restenosis (HR 2.94, 95% CI 1.74 to 4.99, p < 0.0001), and improved overall event-free survival (HR 2.19, 95% CI 1.16 to 4.13, p = 0.015) versus the matched historical control group. Significant inhibition of restenosis at 1 year has also been documented according to the preliminary reports of two European randomized multicenter trials investigating drug-eluting stents in the below-the-knee arteries; the ACHILLES trial comparing infrapopliteal sirolimus-eluting stents with plain balloon angioplasty and the DESTINY trial comparing everolimus-eluting stents with bare metal stents in the infrapopliteal arteries.

Although improved limb salvage remains the cornerstone endpoint for evaluation of all new infrapopliteal instruments and technologies, inhibition of neointimal hyperplasia by drug-eluting stents plausibly leads to improved vessel patency and sustained clinical improvement as reflected by the significantly improved Rutherford-Becker classification and reduced events of target lesion revascularization due to recurrent CLI. In contrary to drug-eluting stents that require permanent metal vessel scaffolding, the concept of drug-eluting balloons involves delivery of a payload of antirestenotic drug during balloon inflation in order to achieve high concentration in the vessel wall and inhibit neointimal hyperplasia while avoiding any systemic toxicity. Currently available drug-eluting balloon platforms deliver dry-state paclitaxel that is deposited on the balloon surface at a dose of 3µg/mm2. Preclinical trials have shown effective inhibition of restenosis in procine coronary arteries with balloons coated with a mixture of paclitaxel and iopromide. Soon after, the FemPac and the THUNDER trial randomized patients with femoropopliteal obstructive disease between paclitaxel-coated and plain old balloon angioplasty. A significant reduction of late lumen loss was noted in both trials that was maintained up to 24 months. At the moment there are no available clinical data on the use of

drug-coated balloon in the infrapopliteal arteries. However, there are 2 currently enrolling multicenter trials (the IN.PACT DEEP and the EUROCANAL studies) that aim to evaluate the results of drug-eluting balloons below-the-knee.
In conclusion, minimally invasive infrapopliteal angioplasty procedures are the new gold standard for the treatment of below-the-knee arterial disease, especially in patients suffering from CLI. Rates of patient survival, limb salvage and sustained clinical improvement are very promising, exceeding those of historical controls. Primary treatment of infrapopliteal arteries with drug-eluting stents is further raising the bar in the endovascular therapy of both critical limb ischemia and intermittent claudication. Drug-coated balloons may also be a worthwhile alternative option for the treatment of long infrapopliteal obstructive disease, but robust data about their performance in the below-the-knee arteries are still missing. Final results of multicenter randomized trials are eagerly awaited.

2401.3

How to manage complications

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Learning Objectives:
1. To learn about the most common complications
2. To learn how these complications may occur and how they can be avoided
3. To learn about the management of these complications

Recanalizations of long segment chronic total occlusions (CTO) of infrapopliteal arterial occlusions are now performed frequently.
Earlier below-the-knee (BTK) interventions were limited to short stenosis.
This increases the possibilities of procedural complications such as thrombosis, dissection, rupture and arterial spasm.
Optimal imaging equipment, appropriate CTO devices, balloons stents and atherectomy devices used carefully with good technique, along with adjunct pharmacologic agents such as vasodilators, anticoagulants and antiplatlet agents and thrombolytics will ensure good results and minimize complications.
Identifying and treating extensive arterial calcification in these vessels without damaging the arterial media is also extremely important in preventing dissections and subsequent spasms and thrombotic occlusions.
The various techniques to avoid mishaps and prevent complications and techniques to treat such complications once they occur will be discussed.

Disclosure
Honararium - Cardiovascular Systems,Inc.

2401.4

Guidelines for management of the diabetic foot

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Learning Objectives:
1. To learn the definition and specific clinical features of a diabetic foot
2. To learn about the different treatment tracks for a diabetic foot and their importance
3. To learn about the role of the IR

No abstract available.

Special Session
Portal vein embolization

2402.1

Indications

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Learning Objectives:
1. The rationale for PVE
2. Which patients are suitable?
3. Which patients are not suitable?

Patients with malignant disease confined to the liver may be suitable for potentially curative surgical resection. Surgical resection aims to remove all malignant disease from the liver leaving the disease-free segments. The most common indication for surgical resection is hepatic metastses from colorectal carcinoma. Five-year survival following surgical resection for hepatic metastases from colorectal carcinoma ranges from 25 to 40%. Patients may be declined surgery because the extent of the resection require to render the remaining liver free of disease. Portal vein embolisation (PVE) is accepted as a useful procedure in the preoperative treatment of patients selected for major hepatic resection. PVE redirects portal flow to the intended future remnant liver (FRL) to induce hypertrophy of the nondiseased portion of the liver and thereby may reduce complications and shorten hospital stays after surgery. Patients with a future liver remnant (FLV) estimated to be less than 25% of the total estimated liver volume (TELV) are more likely to develop postoperative hepatic failure. PVE is indicated in patients if the FLR/TELV is less than 25%. The aim of the PVE is to cause hypertrophy so the FLR exceeds 25% of the TELV permitting safer hepatic resection. In patients with underlying compromised liver function a ratio 40% FLV/TELV is desirable. Preprocedural liver volumes FLV and TELV are calculated from CT or MR volumetric data. The estimation of TELV may also be based on the patient's weight and estimated body surface area. Patients who are considered to be potential candidates for surgical resection are very unlikely to have any comorbidities that are contraindications for PVE. In patients with biliary dilatation, biliary drainage is recommended. Any coagulopathy should be corrected prior to PVE. PVE is typically performed 4-6 weeks prior to surgical resection. Some patients require a two-staged hepatic resection or combine hepatic resection with tumour ablation techniques to achieve a disease-free FLR. PVE is more likely to be required in cases where staged resection or tumour ablation is required. PVE is a well tolerated procedure, it has a low complication rate (minor<5% and major <1%) and a high technical success rate >95%. Following technically successful PVE patients may not have surgical resection 30-40%. The two most common causes for no subsequent hepatic resection following technically successful PVE are: disease progression (identification of extrahepatic spread, involvement of the FLR or involvement of the portal vein of the FLR) or a failure to achieve FLR/TELV > 25% post-PVE. The presence of systemic disease such as diabetes mellitus may limit hepatic hypertrophy. There is conflicting evidence regarding the effect of PVE on the metastasis rate of growth with some evidence to suggest the growth of the metastasis can be accelerated post-PVE, which could potentially cause disease progression resulting in the patient no longer being resectable. The role of chemotherapy combined with PVE prior to resection is unclear but is likely to further increase the number of patients considered suitable for surgical resection. The number of patients who undergo hepatic resection for malignant disease has increasing and consequently there is also increasing demand for PVE prior to surgery.

2402.2

Basic technique: how I do it

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Learning Objectives:
1. Describe the standard technique
2. How to cope with challenging anatomy
3. Which embolic agent?

Major hepatectomy carries a risk of major complications and mortality which is directly related to the liver volume left in place after surgery. In order to extend indications of major hepatectomy to patients who were not candidate to resection because of an insufficient future remnant liver volume, interventional techniques appeared such as portal vein embolization (PVE).

PVE is a technique of embolization which occludes portal branches of the liver that will be ultimately resected. Portal branches of the future remnant liver are left opened and all the portal flow is redirected towards these patent branches. The sudden increase in portal flow and the presence of hepatotrophic factors stimulate regeneration of the future remnant liver. The future remnant liver increases in volume rapidly within four to six weeks allowing surgery to be done.

Indications of portal vein embolization vary depending on the liver parenchyma status and to the planed hepatectomy. This also means that a precise evaluation of the liver status sometimes necessitates healthy liver biopsy as well as a precise volumetry of different segments of the liver has to be done in order to take the decision to perform PVE. Liver volumetry is performed by a multiphasic CT after injection of contrast media. Different volumes are obtained such as the total liver volume, the total functional liver which is a total volume minus the volume of the liver tumors and the future remnant liver volume which is the volume of the expected liver to be left in place after surgery. This also needs precise collaboration between surgeons and radiologists to decide which part of the liver will be resected and what will precisely be left in place. In patients with healthy liver, it has been demonstrated that there is no significant difference in post-operative morbidity and mortality when the future remnant is over 20% of the functional liver. Under this threshold, surgery is considered at risk and indication of portal vein embolization established. This threshold of 20% also depends on the liver status and patients who have received multiple courses of chemotherapy as well as patients with steatosis need more liver volume after surgery to have a safe resection. Patients with cirrhosis mainly with F4 fibrosis are considered at high risk such as patients with chronic biliary obstruction and patients with cholangiocarcinoma. In the later group ratio over 40% is mandatory to allow surgery.

Different techniques of portal embolization have been described in the literature. Most of the procedures are performed percutaneously and two portal vein accesses have been described:

1. The first one being called the ipsilateral technique, meaning that the right portal branches are approached under ultrasound guidance and subsequently embolized.
2. The contralateral approach means that the left portal branches are punctured in order to embolize the right portal branches.

The first technique eliminates the risk of left liver lesion during the puncture phase but it makes also impossible the use of N-butyl-cyanoacrylate for embolization and it makes also more complex to obtain portography at the end of the procedure since the catheter is passed through the embolic material. The left portal vein approach or contralateral technique makes catheterism easier but carries a risk of complications during the puncture phase like hematoma, portal vein dissection or hemobilia. These complications are rare but must be known before the procedure.

Almost all the embolic materials have been used for portal vein embolization but they can be divided into 3 groups of embolic material:

1. The first group consists in proximal occlusion with passive material such as coils or vascular plugs.
2. The second group is distal embolization with passive embolic material like spherical or non-spherical particles, or fibrin glue or gelfoam.
3. The latter group consists in N-butyl-cyanoacrylate, onyx or alcohol direct injection. This group has en embolic effect but also induces an inflammatory reaction around the embolic material in the portal spaces.

There is no randomized trial comparing groups of patients using the same inclusion criteria to compare which embolic material is the most efficient. However, large cohort studies have shown that the latest group seems to be more efficient in term of regeneration. This also has been demonstrated from experimental animal studies that have shown that N-butyl-cyanoacrylate or alcohol is the most powerful embolic agent to induce significant regeneration.

In case of hepatocellular carcinoma, portal vein embolization can be done two weeks after arterial embolization of the tumors, in the same segments. There is no described risk of liver ischemia and the association of arterial and portal subsequent embolization seems to provide better results in term of regeneration as compared to portal vein embolization alone.

Complications of portal vein embolization and during the first days after PVE are rare and mainly observed in patients with portal hypertension, cirrhosis or chronic liver disease. The expected rate of regeneration is between 40 and 80% for patients with healthy liver and is reduced in patients with cirrhosis, depending on the fibrosis core of the liver, four to six weeks after portal vein embolization. Another CT volumetry is performed to confirm liver regeneration after embolization. It allows showing if the threshold of 40 or 30% is achieved after portal vein embolization and permits a major resection.

Studies comparing survivals of patients who had portal vein embolization before surgery did not show any difference as compared to patients without portal vein embolization. This clearly states that portal vein embolization allows more patients to be treated with a curative intent, mainly for patients with multiple liver metastasis.

Portal vein embolization can also be combined in the same procedure to radiofrequency ablation of lesions localized in the future remnant liver, which allows treating by a combination of PVE, RFA and surgery patients with bilobar one percutaneous procedure and one surgical extensive hepatectomy.

Disclosure
Grants from Terumo, Biocompatible and Cook

2402.3

How to keep out of trouble

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Learning Objectives:
1. What are the complications?
2. How can we avoid complications?
3. How can we predict complications?

The incidence of complications related to portal vein embolization (PVE) is usually reported in the range from 0 to 15% although many of these complications are minor and do not prevent subsequent liver resection (1-6). For example, a large series of 188 patients reported complications in 12.8%; however, half of those were asymptomatic and detected only by imaging (1). A meta-analysis of 37 papers including 1088 patients listed the overall morbidity as 2.2% with no mortality from PVE (7). Although many authors state there has been no mortality directly related to PVE, one study (2) did report a patient who died 1 month post-PVE as a result of

multi-organ failure triggered by septic shock which may have been related to concurrent performance of biliary drainage and PVE. The thresholds set in the recent CIRSE Quality Improvement document are 20-25% for minor complications and <5% for major complications (8).

The first complication that one might encounter is inability to access the portal vein. This should be very rare, especially with ultrasound guidance, but it has been reported in 1 case out of cohort of 46 patients (4).

Often complications are mild self-limiting symptoms with the most common being pain or fever (7). True post-embolization syndrome is rare since there is little inflammation and usually no necrosis associated with PVE; however, mild fever has been reported in as many as 36% of patients (9). Other mild symptoms that have rarely been reported include ileus and nausea.

Given the vascularity of the liver, bleeding complications are not unexpected. Of these, subcapsular hematoma is most commonly reported at a rate of 3-4% (4-5). Arterial complications including arterial puncture, pseudoaneurysm, and hemobilia have all been described and are managed the same way they would be if they occurred during a biliary case. Necrosis of a segment of liver resulting from concomitant arterial injury during PVE has also been reported (10).

Transient liver failure occurs infrequently, for example in 6 patients out of 188 (3%) in Di Stefano's series (1). It is usually manifested by an increase in the liver function tests although jaundice has rarely been reported. The main problem is the acute portal hypertension that sometimes accompanies this. Some patients have developed ascites and others variceal bleeding as a result of the acute portal hypertension. Nagino et al (11) reported a case of acute hypersplenism, including splenomegaly and thrombocytopenia, along with ascites that developed within 2 to 3 weeks after PVE even though the liver pathology showed mild fibrosis and no cirrhosis.

Thrombosis of the main portal vein is one of the worst complications that can occur. There are several potential mechanisms of this. If there is extensive non-target embolization into the future liver remnant (FLR), then overall portal flow can be reduced enough to lead to thrombosis. Secondly, if the patient has underlying portal hypertension, portal flow may already be compromised and PVE further slows portal flow and may precipitate thrombosis of the main portal vein. Main portal vein thrombosis fortunately is rare but when it does happen it often eliminates the chance of having the planned surgical liver resection.

There are a few other rare complications. Pneumothorax has been reported in 2 of 47 (4.3%) procedures (4) although most series do not report this complication. Liver abscess and/or cholangitis was noted in only a few cases out of 1008 patients in a large meta-analysis (7).

How can we avoid complications?

Biliary sepsis is a rare complication that can be avoided by taking steps before PVE. When biliary dilation is present biliary drainage should be performed prior to PVE. Pre-procedure antibiotics are sometimes recommended to decrease risk of biliary sepsis. Proper patient selection is also important but will be discussed in the next section.

Several steps can be taken to avoid bleeding complications. Any coagulopathy should be corrected before the procedure. Ultrasound is used in many centers to guide the portal vein puncture. This should decrease the overall number of needle passes needed since it is not a blind technique. It should also facilitate access into a more appropriate peripheral portal branch. Ultrasound can also help choose a safe access route. In a case of subcapsular hematoma reported by Madoff et al (5), the bleeding was thought to have resulted from the transhepatic access going through a large tumor. Finally, use of a sheath provides easy access for catheter movement thus decreasing trauma to the parenchyma. A sheath also allows post-PVE embolization of the tract from the liver capsule to the portal vein to help avoid subcapsular hematoma or intraperitoneal hemorrhage. This can be accomplished by pushing gelfoam pledgets or coils through the sheath.

Choice of access, ipsilateral or contralateral, is often mentioned in discussion about avoiding complications. Theoretically contralateral access through the FLR should be riskier. Damage occurring during ipsilateral access should be less significant since that portion of liver will ultimately be removed. For example, while peri-catheter thrombus formation in the portal vein is certainly a possibility, it becomes a non-issue when the catheter is in the vein you are intending to embolize. Also, since the tract enters into the embolized vein one could theorize that there would be a slight decrease in the chance of bleeding out the tract. However, Kodama et al (4) showed no difference in the complication rates between ipsilateral and contralateral access. Similarly, a large series of PVE done from a contralateral approach (1) had virtually identical complications rates when compared to a large series of ipsilateral PVE cases (12). Even the rate of non-target embolization was comparable and low with each technique. Kodama et al (4) did note that complications were much higher when access was achieved through the posterior segment than anterior segments. It has been postulated that this is because the posterior segmental portal veins are more difficult to visualize.

To date no specific embolization technique has been identified that consistently reduces complications. Being careful to avoid reflux of embolic material into the PV supplying the future liver remnant is critical and in Asia balloon occlusion catheters are often used to prevent this. However, standard non-balloon catheters are safely used throughout Europe and the US. There has been no scientific comparison of balloon occlusion to non-occlusion techniques. The embolic agent also does not seem to make a big difference in complication rates. NBCA glue and particles plus coils are the two main embolization strategies used. There is no clear evidence that one is safer than another since different series using different agents report comparable complication rates. No randomized comparison has been done. Kodama (4) safely used absolute ethanol in the majority of their procedures. However, liver necrosis has been described as a complication of PVE with ethanol (13).

How can we predict complications?

The only absolute contraindications to PVE typically listed are overt portal hypertension or spread of tumor bad enough to contraindicate a major hepatic resection. The complication rates for PVE are known to be higher in patients with underlying liver disease compared to those whose liver parenchyma is essentially normal (14). Biopsy proof of cirrhosis also correlates with complications. In a series of 40 PVE patients, 2 developed portal thrombosis and both had frank cirrhosis on their histology (15). They also had 2 patients who develop transient ascites and both of those patients also had biopsies revealing cirrhosis. Di Stefano et al (1) also found a strong correlation between cirrhosis and post-procedural liver failure. In their study 5 of 30 patients with cirrhosis developed liver failure but this occurred in only 1 of 157 non-cirrhotic patients. The recent CIRSE Quality Improvement for PVE document recommends measuring the portosystemic gradient in cirrhotic patients and while it does not state that PVE is contraindicated it does state that there is major risk of perisurgical complications if the gradient is over 12 mmHg (8).

Can non-target embolization be predicted? There are no well documented predictors but some associations. Embolizing segment 4 has been associated with increased incidence of non-target embolization because of the difficulty of getting catheters well positioned in this segment (16). Also, numerous authors have expressed that using glue for embolization requires a moderate degree of experience. So although this has not been documented, one might presume that non-target embolization would be more likely in the situation of an inexperienced interventional radiologist trying to embolize segment 4 branches.

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Disclosure

Member Speakers bureau for WL Gore Inc member of medical advisory board for Navilyst

2402.4

Results of PVE and how to time surgery

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Learning Objectives:

1. What are the outcomes?
2. When should we time surgery?
3. How can we tell when PVE has not achieved the required result?

Numbers of patients with primary or secondary hepatobiliary malignancy, large hepatectomy is necessary to achieve curative resection. In these patients, a future liver remnant volume below 20% of the total liver volume leads to an increased risk of postoperative morbidity and mortality.

Transhepatic percutaneous portal vein embolization (PVE) is used to induce preoperative liver hypertrophy with regeneration rates between 4 and 21 mL/d, and relative gains in FLRV range between 30% and 65%, as reported for patients without cirrhosis or diabetes prior to standard right hepatectomy.

PVE can be performed utilizing the different approaches, material and technique. This presentation discusses PVE including patient selection criteria, anatomical and technical considerations, and patient complications and outcomes.

Special Session
High intensity focused ultrasound

2404.1

MRgHIFU vs. USgHIFU

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Learning Objectives:

1. To present current available techniques for focused US
2. To describe the advantages and disadvantages of each technique
3. To give perspectives on future developments

The local ablative effects of high-intensity focused ultrasound (HIFU(S)) were described first in the 1940s and 1950s. However, the interest in this technique was then low for several decades till the 1990s when new communications on image-guided HIFU were presented.

The ablative effect in HIFU is based on the local concentration of acoustic waves, which are concentrated (focused) - comparable to light passing through a burning glass – by an acoustic lens. Technically, this lens can be realized by a spherically arranged transducer system, acoustic lenses, parabolic reflection, or „direct manipulation" of the acoustic waves by phase-controlled transducer elements. In consequence, a focal energy density of 1.000 – to 10.000W/cm2 (for comparison: energy density of diagnostic US waves: 0.1 – 0.5 W/cm2) can be gained. The acoustic energy is absorbed by the tissue resulting in a focal temperature elevation within seconds called sonication, mainly caused by frictional heat. The size of the volume of sonication compares to the size of a rice grain. To destroy larger volumes many sonications have to be applied and arranged in such a way that the target tissue is completely "covered" by the sonication spots.

The effects of local tissue destruction by HIFU are complex and are also determined by additional physical phenomena as cavitation (i.e. formation of micro bubbles at higher US energies which may interact with the US field) resulting in very high local temperatures and shock waves due to bubble collapse. If these effects can be used in a

clinical setting is not yet clear and under investigation.
In comparison to "classical" thermal ablative treatment methods as RF- or MW-ablation heat sink effects (cooling by perfusion) are significantly less relevant in HIFU due to the very short exposure times in which the temperature rise is achieved. Nevertheless, HIFU-associated ablations can be compromised by several additional factors as, e.g. air filled structures within the US field, anatomical accessibility hindering the US-wave penetration (e.g. inter-costal approach), or deflection of US waves.
As in all other local ablative treatment methods treatment monitoring is a crucial factor in clinical applications. At present, real-time US and MRI are used for this purpose. In US-guided HIFU (USgHIFU) the diagnostic and therapeutic transducer are arranged confocally resulting in a defined relationship keeping the therapeutic focus within the imaging focus. The treatment effects are depicted by grey-scale or perfusion (CE-US) changes on the diagnostic US images. In contrast to USgHIFU MR-guided HIFU (MRgHIFU) provides superior diagnostic image quality with less spatial resolution but direct visualization of temperature changes applying thermal-sensitive sequences, however, the technical realization is much more demanding.
Over the last decades a wide variety of experimental system were evaluated, nevertheless, for clinical practice only a few HIFU systems are available, which can be divided into dedicated, intracorporal (e.g. endorectal: Sonablate®, Focus Surgery Inc. Indianapolis, USA; Ablatherm®, EDAP TMS S.A.,Vaulx-en-Velin, France; HAIFU-JC200/CZF/CZB Chongqing Technology Company, China) and extracorporal ("multiorgan": HAIFU-JC Chongqing Technology Company, China; HIFUNIT Shanghai A&S, China; ExAblate®, InSightec, Israel + GE Medical Systems, USA; Sonalleve®, Philips, Netherlands) and according to their inbuilt image-guiding systems (US-guidance: Sonablate, Ablatherm, HAIFU, HIFUNIT; MR-guidance: ExAblate, Sonalleve).
With respect to the present, still limited experience HIFU opens a wide spectrum of non-invasive treatment options for a large variety of indications in benign (e.g. uterus fibromas, prostate hyperplasia, breast fibromas) and malignant conditions (liver, kidney, pancreas , bone tumours), and adjuvant therapies ranging from chronic pain, over enhanced drug delivery, cardiac conduction or congenital anomalies to potentially tremor treatment.
Considering the generally high potential of HIFU up to now it is yet unclear if one or the other image guidance method will lead more, whereas availability, technical developments, cost effectiveness, market acceptance etc. will be of ample importance.

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2404.2

Update on the results on fibroid management

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Learning Objectives:

1. To define current indications for HIFU of uterine fibroids as compared to other techniques
2. To present technical updates of fibroid management with HIFU
3. To present results of fibroid ablation (series and trials)

Uterine fibroids are the most common pelvic tumor with an incidence of 20-40% in reproductive aged women. Although benign, fibroids are a clinically relevant problem because one-third of patients have significant and often disabling symptoms requiring therapy. Numerous therapeutic options including hysterectomy open or laprascopic myomectomy, uterine artery embolization and hormonal therapy are currently available in clinical routine. However, although hysterectomy is the most effective treatment eliminating the risk of recurrent fibroids there is a clear trend to less invasive therapeutic approaches. Among those, myomectomy and uterine artery embolization are most frequently used in clinical routine.
Almost a decade ago high intensity focused ultrasound (HIFU) emerged as a new treatment option in patients suffering from fibroids. The basic idea is straightforward: an ultrasound transducer implemented in the table of a MRI system allows for thermal ablation under image guidance. The advantages are overwhelming because the treatment is fully non-invasive, can be performed in out-patients and allows early return to physical activity.
Prior to the treatment session a diagnostic screening MRI of the pelvis including sagittal and axial T2 weighted turbo spin-echo as well as T1 weighted turbo spin-echo sequences before and after contrast injection should be performed. Based on these images the number, size, location and well as the signal intensity before and after contrast are determined. An optimal candidate for a HIFU treatment should not show more than 3 fibroids, with a maximum diameter of less than 10 cm. The distance from the body surface to the center of the fibroid should be less than 12 cm without any scars, bowel loops or bones within the beam path and no critical structures, e.g. nerves too close to the focus area. Additionally, the fibroids should show a homogenous low signal intensity on T2 weighted sequences and a homogenous contrast enhancement.
The procedure can be performed an on an outpatient basis. For the HIFU treatment patients are positioned lying prone on the MRI table and the anterior wall of the pelvis is acoustically coupled to the device by a gel pad and degassed water. A surface coil is placed on the patients back for signal reception and the table is advanced into the magnet positioning the pelvis in the isocenter of the scanner. Thereafter, T2 weighted sequences are acquired and transferred to HIFU planning systems. The operating interventionalist selects a fibroid to be treated and delineates the treatment area, which is filled with treatment cells thereafter. The cells showing a diameter from 4 to 16 mm and a length of 10 to 40 mm are positioned within the fibroid until the entire desired volume is covered.
Thereafter, the cells are sonicated in rapid succession under real-time temperature control using a dedicated MRI sequence and the proton resonance frequency (PRF) method. Depending on the cell size sonication takes 20-70 seconds followed by a short waiting time to avoid heating beyond the focus area. Depending on the time required for patient positioning and treatment planning as well as the number and size of the fibroids, the duration of the treatment typically ranges from 2 to 4 hours. However, recently introduced volumetric ablation techniques using feedback cells have shown to speed up the procedure. Finally, the extent of the successfully treated area can be measured on T1-weighted sequences after contrast injection delineating the non-perfused volume.
The HIFU treatment typically does not cause any pain requiring medication and the patients can leave the hospital a few hours after the end of the treatment. Although some patients show pain relief after HIFU treatments including only 20-30% of the fibroid's volume several study have shown that larger non-perfused volumes improve patient's outcome. Therefore, we always aim to treat as much of the fibroid as technically possible a reasonable treatment time. Several studies have shown that the extent of the non-perfused volume immediately after the HIFU treatment predicts fibroid volume reduction at 12-month follow-up.

2404.3

Expanded applications of focused ultrasound

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Learning Objectives:
1. To review current indications to focused US in cancer treatment
2. To describe the technique, limitations and complications of focused US
3. To discuss new and expanded applications of focused US

High-intensity focused ultrasound (HIFU) is an ablative tool that can be applied to many different clinical applications. It has advantages over other ablation tools in that it can deliver high energy through tissue to a target without harming intervening tissue. Ultrasound causes tissue damage through two primary mechanisms: conversion of mechanical energy into heat and cavitation. It is important to consider the local tissue environment and content through which the beam passes, because they have an important effect on the ultimate achieved temperature at the desired focus. Heterogeneous tissue can cause sound wave reflections that interrupt the beam or divert the focused energy to a slightly different location than theoretically predicted. For example, HIFU has limitations of ultrasound waves penetrating bone and gas. This makes focusing energy through the skull, for example, a significant challenge. It also makes procedures without an acoustic window due to bowel gas particularly challenging. HIFU can rapidly elevate the temperature at the focus to above 80oC leading to cell death in under a second of exposure. The volume of ablation following a single HIFU sonication is generally small and usually cigar shaped measuring approximately 1-3mm x 8-15mm. Therefore, several adjacent HIFU sonications are required in order to ablate a larger volume. Cavitation is less predictable and is based on the principle that ultrasound waves subjects the tissue molecular tissue to alternating cycles of compression and rarefaction during which gas can be drawn out of solution, creating bubbles. These bubbles oscillate in size and, ultimately, might collapse causing local energy release. Thus, the final tissue lesion is generated by a combination of mechanical stress and heat.

When coupled to an MR scanner, the heat delivered by HIFU can be measured with MR thermometry techniques. Non-invasive three-dimensional temperature maps are feasible with MRI and may be based on the T1 relaxation time, the diffusion coefficient, or proton resonance frequency (PRF) of tissue water. The PRF method is most frequently employed and uses fast spoiled gradient-recalled-echo sequences. The MR images during the ultrasound sonication are compared to images obtained immediately before that sonication, the changes in those images can be calibrated to generate a real-time feedback temperature mapping during the entire procedure, ensuring that the thermal ablation is located in the previous determined target while avoiding damage to the surrounding critical tissues. By initially using a lower level of HIFU energy, one can detect a small temperature elevation before providing the full energy level that would cause irreversible damage. This type of safety mechanism is employed in clinical MR-guided HIFU systems.

Clinically, HIFU has been most commonly applied to uterine fibroids. It has also been used to treat bone pain from metastatic lesions, focal prostate cancers, focal breast lesions, and liver cancers. Some of the more unusual applications have been creating non-invasive vasectomy, treating atrial fibrillation, arterial puncture closure for hemostasis, and focal delivery of genes.

In this lecture we will explore some of the research that has been done in non-traditional applications of HIFU.

Disclosure

We are investigators in a clinical trial of the Insightec focused ultrasound device.

2404.4

Update on the results on bone tumours

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Learning Objectives:
1. To review the conventional treatment of bone tumours
2. To describe the indications, technique, and limitations of HIFU
3. To present results of focused US in bone tumours as compared to other techniques including radiation therapy

No abstract available.

2404.5

Update on the results on breast cancer

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Learning Objectives:
1. To define the rationale for focused US ablation of breast tumours
2. To describe technique and results of phase I and phase II studies
3. To present potential future role of HIFU in breast cancer

Introduction

Over the past 5 decades, the treatment of breast cancer has evolved from highly invasive radical mastectomies to breast-conserving therapy that allows women to avoid severe disfigurement and related morbidity while providing equivalent survival benefit. More recently, the approach for nodal staging has also become less invasive with the adoption of sentinel lymph node biopsy as the current standard of care for patients with early-stage breast cancer. Continuing with this trend toward minimally invasive therapy, various ablative techniques have been studied for the treatment of breast cancer. Both thermal and cold techniques have been evaluated as potential treatment modalities. RFA, laser therapy, HIFU, and MW result in tumor destruction from significant heating of the tissue.

High-intensity focused ultrasound (HIFU) is a highly precise and completely non-invasive thermal therapy using focused ultrasound energy for burning and destroying the tumor tissue at depth within the body, selectively and without harming overlying and adjacent structures within the path of the beam. HIFU can be used to reach tumoral areas that are deep within the body, if there is an acoustic window for allowing for the transmission of ultrasound energy. HIFU has been applied in several clinical situations, being studied in the ablation of **breast fibroadenomas and carcinomas**. Preliminary reports underline a reduced toxicity with HIFU ablation compared with other ablation techniques because of the non-invasive nature of the procedure. Extracorporeal devices are used most commonly for intra-abdominal solid tumors by mean of transducers with a long focal length and both Ultrasound or MRI for targeting the organ.

Background

The JC HIFU system (which has been installed since 2007 at IEO) is an extracorporeal device using a 20-cm-diameter plane lead-zirconate-titanate disc transducers with an aluminium alloy lens with focal length of 16 cm, driven at 0.8 MHz. It operates at relatively high intensities up to 20,000 W/cm2. The imaging probe is located in the centre of the high-intensity focused ultrasound transducer allowing for real-time US image monitoring during treatment. Ultrasound is a form of vibrational wave which penetrates through soft tissues and can be focused with the described spherically curved transducer to target sites that represents the Acoustic Focal Region (AFR).

Guidance and monitoring of acoustic therapy is most important

to ensure that the desired region is treated and to minimize damage to adjacent structures. Real-time imaging, such as ultrasound, ensures that HIFU beam targeting is maintained within the correct area throughout the procedure. Sonographic guidance provides the benefit of using the same form of energy that is being used for therapy. The significance of this is that the acoustic window can be verified with sonography.

Imaging methods to assess HIFU treatment are similar to those used to assess the response to other methods of ablation such as radiofrequency ablation and include contrast-enhanced CT and MRI. In addition, the use of micro-bubbles ultrasound contrast-enhanced is also being examined as a method for evaluating efficacy of HIFU treatment. PET scan is another diagnostic tool currently used for oncologic applications it is used for assessing changes in metabolic activity after HIFU treatment. Several mechanisms are involved in the tissue damage induced by HIFU.

Localized heat generation due to absorption of the acoustic energy is the main biological effect in tissues. The heat rapidly raises high temperatures at the AFR from 55°C to 100°C, causing coagulation necrosis. The precise and well delimited US focusing minimizes the potential thermal damage to the tissue located along the acoustic pathway, because the energy is much lower outside the focal region. Mechanical phenomena, in addition to thermal effects, are associated only at high energies.

Cavitation can be defined as the creation or motion of gas bubbles within an acoustic field due to alternating compression and expansion of tissue as ultrasound waves propagate through it. It seems difficult to distinguish the thermal effects from either acoustic cavitation or vessel damage in HIFU ablation. Actually, they can occur simultaneously within the targeted tissue. Therefore, the **coagulation necrosis** induced by HIFU can be considered as the result of **biological effects** from a combination of **heat, cavitation** and **vascular destruction** on tissue. Combination between imaging and technologies for local therapy has made ablative procedures more reliable and practical, allowing for safe and feasible application of HIFU treatments in clinical practice.

US-guided extracorporeal HIFU has been recently used to treat patients with various kinds of malignancies, including liver, breast, kidney, bone, and soft tissue both in Asia and Europe. Investigation and applications of HIFU are growing rapidly worldwide.

European Institute of Oncology experience

Over the past decades, there has been a radical change in the surgical treatment for breast cancer moving towards a more conservative approach, achieving the same clinical efficacy and maintaining the integrity of the woman body. Interventional Unit and Breast Division at the European Institute of Oncology (EIO) are highly involved in clinical research to improve the effectiveness of breast cancer treatments reducing invasiveness and potential side effects of surgical treatments. Many papers have been published on the results on HIFU treatment for breast cancer. Although the results are very encouraging and significant, the small number of cases and the non-homogeneous of enrolling criteria and post histo-pathological and/or instrumental HIFU evaluation leave large space for scientific speculation.

Along this perspective, from the beginning of 2008, we started a feasibility study on breast cancer treatment by mean HIFU approach, paying particular attention to establish very restrictive criteria for patient recruitment. The study consists on HIFU treatment of selected breast cancer and surgical resection at least one week after treatment, in order to evaluate histological findings such as residual viable tumour, coagulative necrosis extension and so on.

All patients enrolled for HIFU treatment must meet all of the following **inclusion criteria**:

- Female subject, age > 18 years
- Diagnosis of breast cancer, confirmed by breast core-biopsy
- Single tumour
- Clinical stage cT ≤1,5cm; cN=any; cM=any
- Lesion boundaries visualized with US imaging
- Lesion circumscribed at least more than 5mm from skin or rib cage
- Lesion circumscribed at least more than 20mm from nipple areola complex
- Passed the HIFU simulation test
- Patient able to read, understand and sign the study specific informed consent form

The **exclusion criteria** are:

- Presence of skin ulceration and/or scar
- Presence of widespread pathological microcalcifications

Before HIFU treatment, all patients were subjected to a careful clinical assessment including anamnesis and pre-surgical routine tests. In addition, each patient was re-evaluated by a radiologist with high-frequency linear array US probe and digital mammography.

All HIFU treatments were performed in a single session under local anaesthesia plus MAC (monitored anaesthesia care) in order to improve the room time and preserving patient comfort and collaboration, although at the beginning of experience, general anaesthesia was used in order to avoid any possible external effects disturbing the treatment as pain, discomfort and involuntary movements. The day of procedure, skin surface overlying the lesion was degassed and degreased with 95° alcohol to remove micro-bubble of air within the acoustic pathway.

The day before surgery, the patient underwent radiological investigations (breast US and digital mammography) for verifying the changes in the tumour area, caused by thermal damage.

Surgical specimen was extensively examined histologically in order to verify the thermal damage and confirm the absolute integrity of the surrounding parenchyma.

Only 21 out of 61 patients (age range 41-73 years), initially included according to clinical reports at the first medical visit, were selected and then treated by mean of USgHIFU. Tumour lesions ranged from 5 mm to 15 mm. All patients, included in the study, were deemed candidate for breast conservative surgery that was performed after 1-6 weeks from HIFU treatment.

Great importance was given to the time of the procedure. Room time ranged from 3 hours 55 minutes to 1 hour 20 minutes. The overall treatment time, defined as the time from the beginning to the end of HIFU energy emission, ranged from 1 hour 57 minutes to 9 minutes. Sonication time, defined as the exposure time to HIFU energy, ranged from 16 minute 4 seconds to 37 seconds.

No side effects were observed after the HIFU treatment. Only soft local mammary oedema was noted overlying the lesion. Patients return home the same day of treatment or the day after if the treatment was completed in late afternoon, without any medication.

Between 1 and 6 weeks from the HIFU treatment, patients underwent conserving surgery associated with sentinel lymph-node biopsy or complete axillary dissection, if the sentinel lymph-node was metastatic. Macroscopic observation of surgical specimen showed the ablated tumour gray-white or gray-yellow in colour and felt firm on palpation. There was no evidence of haemorrhage in the central region of the treated lesion. Microscopic examination showed tumour cells with typical characteristics of coagulation necrosis induced by thermal energy.

Haematoxylin & eosin stain showed that cellular structure looked normal in some cancer cells, without any signs of tumour cell breakdown. The tissues maintained their cytologic staining characteristics giving an appearance similar to viable cells. Using conventional histological techniques, it was difficult to identify whether the treated tumor cells were dead or alive, in this region, under light microscope. Very interesting was the indirect detection of thermal damage in the immuno-histochemical evaluation of estrogens and progesterone receptors (ER and PR) expression. Protein denaturation indeed, caused by the high temperature, did not allow for dye staining in those cases which had shown receptor expression positivity in the pre HIFU treatment immuno-histochemical evaluation.

Another method to evaluate the effect of the HIFU was tested:

2,3,5-triphenyltetrazoliumchlorid staining (TTC) was used to estimate the capability of treated cells to absorb a viable dyeing at the gross examination. All lesions evaluated with this kind of method showed to be not stained.

This preliminary research, although limited to a small number of patients, but quantitatively comparable to those presents in literature, showed the USgHIFU treatment appears to be feasible and safe to destroy primary early breast cancer, without side effects.

Hence, histopathology evaluation performed on surgical specimen after HIFU treatment confirmed the correct ultrasound-guided targeting and release of thermal energy only within the tumour. Based on these premises, for the next year the Breast Division research activity will be directed towards different targets.

Technology upgrade was the other main issue within our research activity: the introduction of a new Real-time Variable-Band Linear Array 13-4 MHz US probe and a new dedicated HIFU transducer have been developed in order to improve the US guidance/monitoring and reduce treatment time, respectively.

Ongoing Clinical Research

The principal purpose arising from our initial experience is addressed to confirm the kind of patients would be the best suitable for this non-invasive treatment. Over this main issue, ongoing research is focused to continue the upgrade of HIFU technology in order to optimizing the technique and reducing the treatment time.

From the anaesthesiology point of view, our results indicated that local anaesthesia together with MAC is feasible for HIFU procedure and our encouraging results may change our patient's management in the future.

Regarding the histopathology point of view, specific methods will be improved for assessing cell viability after HIFU through the development of viable colour methods and cell cultures. As a so-called non-invasive technology, HIFU approach may play a key role in the future management of solid malignancies. The preliminary research activity and application of this new technology in patient care started more than one year ago and was limited to a small number of patients with short-term follow-up, in focusing the feasibility and safety of this new technique. Based on the preliminary results, US-guided HIFU treatment appears to be feasible and safe to ablate early breast cancers, without significant side effects, and can have a role in "multi-modal" management of patients with metastasis (liver and bone) from this tumor disease. The research activity is deeply integrated with the daily clinical work and the principal purpose arising from our studies are addressed to follow up all patients to ascertain which patient group would be the best suited to this non-invasive treatment. Over this main issue, ongoing research is focused also on implementation of HIFU technology in order to optimize the patient's approach technique.

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Special Session
Fibroid embolization

2405.1

How to improve referrals to your practice

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Learning Objectives:
1. To learn about the setup of successful clinical practices
2. To learn about the expectations of patients and referring physicians
3. To become familiar with the internet as a communication and marketing tool

This lecture is given from the perspective of a physician practicing in the competitive, fee-for service USA system. Some of the specifics of execution will differ from region to region based on the structure of medical practice.

Growing a fibroid embolization practice requires actions along a number of different fronts. The first is practice marketing to increase referrals. There are 3 targets for marketing - the public (patients), gynecologists with whom IR competes for treatment of fibroids, and gynecologists (or other physicians) with whom the IR does not compete for treatment of fibroids.

Patient education can include a vast array of activities. Information brochures about the procedure should be made available to patients. These can be placed in the IR office and in the Radiology waiting areas (especially ultrasound and MRI). They can also be placed in the offices of referring physicians (both primary care and Ob/Gyn). If permissible within the medical system, advertisements can be placed in popular magazines or in public spaces. A public information seminar, properly advertised, can yield a room full of potential patients eager to hear about treatments for fibroid disease. Such a seminar can also build one's relationship with a referring Gyn by asking him or her to be a speaker at this seminar.

A gynecologist who has an office-only practice and does not perform surgeries is a natural ally for the IR. These physicians have a choice of referring fibroid patients to IR for UAE, or to another gynecologist who does surgery. In the latter case, they risk never seeing the patient again. The same dynamic holds for non-gynecologists who provide basic Gyn care. In the USA many family practitioners do this.

Gynecologists who treat fibroids surgically are the most difficult to win over to referring patients for embolotherapy, since UAE directly competes with their own practice. In these situations the IR has to show expertise in patient management and case selection for UAE, as well as be familiar with the fibroid treatments that Gyns provide in order to have a productive conversation. The emphasis in building relationships with these physicians has to be on ensuring that patients are fully informed of their options for treatment, regardless of who provides the treatment.

Ideally there should be cooperation between IR and Gyn, providing a team approach to care. This would include an attempt to offer each patient the treatment or treatments that are best for her as an individual (so far as that can be determined).

The second issue is communication with the referring physicians. Every patient encounter should result in a note of some sort that must be sent to the referring physician. This keeps them aware of the patient's progress, and also demonstrates both the quality of care provided and the dedication of the IR to providing quality ongoing care.

The third is providing high-quality patient care. This is not limited to technical expertise, but includes pre-procedure and post-procedure care. One of the things that is most likely to result in referrals being turned off is when the referring physician is left to provide aftercare for a procedure which he or she did not perform. This apparently continues to be one of the major reasons that embolotherapy is not a more commonly requested fibroid therapy in the USA.

All of the above are programs that can be implemented to build a practice. Above and beyond programs, it is critical to build relationships with referring physicians and patients. Being available to see, treat, and follow patients; demonstrating commitment to and caring for your patients; and performing at the highest level are more important than any program.

2405.2

Embolization of the ovarian artery: when and how

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Learning Objectives:
1. To learn about the different types of ovarian arteries
2. To learn about possible treatment options
3. To become familiar with the literature about ovarian artery embolization

The ovarian artery is a common secondary supply to the uterus, especially when large fundal fibroids are present or there has been previous pelvic surgery or uterine artery embolization. In one study, abdominal aortography prior to uterine artery embolization demonstrated ovarian collateral supply in 25% although their detection influenced treatment in only 6% (Binkert et al 2001).

The ovarian arteries are paired structures which usually arise from the anterior aspect of the abdominal aorta between the level of the origin of the renal arteries and the inferior mesenteric artery. In approximately 25% of cases, one of the ovarian arteries arises from the renal artery. Each artery runs obliquely behind the peritoneum inferiorly and laterally to the pelvic brim where it turns medially to enter the suspensory ligament of the ovary. However, as the role of the ovarian artery in supplying fibroids is increasingly recognised (Barth & Spies 2003), numerous variations in it vascular origin have been reported (Horton et al 2010, Smoger et al 2010). The origin of the ovarian arteries can be quite challenging to catheterise and a MIK catheter can be very useful.

With regard to technique, it has been recommended that embolization is performed distal to the ovary to avoid ovarian dysfunction in premenopausal women (Andrews et al 2000). This is difficult to achieve even with a microcatheter as the artery is extremely tortuous, may not be hyertrophied and spasm easily induced, so embolization is often performed from a proximal position using particles. Reflux into the aorta is a particular concern if the catheter cannot be advanced very far into the artery. Retrograde reflux into the aorta from embolization into the uterine arteries can also occur in the presence of a large utero-ovarian anastomosis.

Embolization of the ovarian arteries is required if they are shown to be supplying the fibroid and >90% infarction is to be achieved. Utero-ovarian anastomoses have been shown to be associated with higher rates of intervention after UAE (Kim et al 2008). An ovarian arterial supply of >10% of the fibroid load is considered to warrant ovarian artery embolization (Scheurig-Muenkler et al 2010). This is identified by means of MR angiography (Mori et al 2010) or during the procedure if a defect is identified in the contrast opacified uterine contour during fluoroscopy. Flush aortography is necessary to confirm this at the time of the procedure but is not advocated as a routine in an effort to reduce radiation doses (Pelage et al 2003). Even when it is confirmed that the ovarian arteries are a significant source of supply to the fibroids, ovarian artery embolization is avoided in younger women who desire fertility due to the concern that embolization may adversely affect ovarian reserve.

There is very limited evidence about the effect of ovarian artery embolization on ovarian reserve and permanent amenorrhoea.

Although a case series of 6 women over 44 years of age reported no cases of amenorrhoea after ovarian artery embolization (Barth & Spies 2003), another series of 13 women resulted in 2 cases of permanent amenorrhoea in women of 47 and 48 years of age (15%) (Scheurig-Muenkler 2010).

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2405.3

Techniques and results for adenomyosis

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Learning Objectives:

1. To learn about the imaging finding of adenomyosis
2. To learn when and how to adjust embolization technique
3. To become familiar with the outcome in the current literature

No abstract available.

2405.4

How to decide when to perform repeat embolization

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Learning Objectives:

1. To learn about the timing when to re-embolize
2. To learn about the importance of the ovarian artery for failure
3. To become familiar with the results after re-embolization

No abstract available.

Special Session
Haemodialysis access

2501.1

Venous stenoses: PTA or stent grafts?

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Learning Objectives:

1. To report on the frequency of peripheral venous stenoses
2. To learn about the results of stent grafting
3. To discuss pros and cons of PTA and stent graft

No abstract available.

2501.2

How to manage the non-maturing fistula

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Learning Objectives:

1. To learn how to diagnose non-maturation of a fistula
2. To learn about the indications for treatment of non-matured accesses
3. To learn about the endovascular treatment options

Prerequisite for hemodialysis is a functional vascular access. Whereas in the US many patients are dialyzed via catheters, in Europe the majority of patients is provided with AV-shunts. Placement of autogenous arteriovenous (AV) fistulas is preferred over prosthetic grafts as they are associated with a lower incidence of death and access-related complications such as hematoma, pseudoaneurysms, and infection, as well as having a higher primary and secondary patency rate (1). AV fistulas typically require one to three months to "mature." While KDOQI recommends fistula placement six months prior to the initiation of dialysis (2), this is widely not the case for a variety of reasons. Fistula maturation requires adequate arterial inflow, adequate venous outflow, and the ability of the vein to dilate to increase blood flow enough to allow repetitive cannulation for dialysis. The three main reasons for maturation failure are: arterial and venous problems and the presence of accessory veins (3, 4). Vascular mapping before arteriovenous fistula creation has been shown to result in decrease of non-matured arteriovenous fistulae. For optimal results, both arterial and venous evaluation is required for fistula creation (5). The identification of delayed or missing maturation is not very complex: beside physical examination as the basis of every fistula evaluation there is ultrasonography and fistulography. During the physical examination any visible large venous branches should be noted. If there is doubt over the suitability of the fistula, a duplex ultrasound is very helpful. Ultrasound can determine vein diameter, areas of stenosis, significant accessory veins, and blood flow. A draining vein <4 mm in diameter and a blood flow <500 ml/min indicate a fistula that is unlikely to mature in more than two-thirds of patients without some type of intervention. Knowing the nature and location of the lesion is essential for adequate diagnostic fistulography puncture allowing therapeutic intervention in the same setting. Any fistula that fails to mature adequately and demonstrates abnormal physical findings should be studied aggressively and abnormalities that are detected should be corrected before a plan to create a new access is made.

Two different types of therapy can be offered: endovascular and surgical.

Endovascular treatment:
The two main endovascular treatment options, depending on the underlying pathology, are balloon angioplasty and vein obliteration. In a prospective observational study, all patients with early failure underwent evaluation and treatment. Vascular stenosis and the presence of a significant accessory vein alone or in combination are found to be the culprits in most instances. Venous stenosis was present in 78% of the cases. A majority of these lesions (48%) were found to be close to the anastomosis. A significant accessory was present in 46% of the cases. Percutaneous balloon angioplasty was performed with a 98% and vein obliteration with a 100% success rate. After intervention, it was possible to initiate dialysis using the fistula in 92% (4). Venous stenosis within the body of a fistula is best treated with balloon angioplasty. Juxta-anastomotic stenosis may be treated surgically or percutaneously. A prospective non-randomized study of or patients showed that outcomes were similar using angioplasty or surgery. Restenosis rates were significantly higher following angioplasty (6).
Surgical Treatment:
The surgical approach is usually performed under local anaesthesia, the vein is mobilised proximally and reanastomosed to the proximal part radial artery. This procedure is more difficult at the elbow and it is often easier to attempt balloon angioplasty, reserving surgery for those that fail. Poor arterial inflow should be identified preoperatively by ultrasound, but this is not always possible. Part of the assessment of the non-maturing fistula should include detailed assessment of the inflow circuit. Arterial stenosis greater than 50% coupled with poor flow should undergo angioplasty. If this fails to improve fistula flow rates, it is unlikely that surgical bypass will be of help.

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2501.3

Treatment of central venous stenosis

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Learning Objectives:
1. To learn about the indications for treatment of central venous stenosis
2. To learn about the endovascular treatment options
3. To learn about the caveats of central vein intervention

Central venous stenosis or obstruction affects the superior or inferior vena cava and their major branches. The majority of cases (approximately 90%) are caused by malignant disease, and here mainly lung cancer and lymphoma. But other tumor entities like metastases or thomoma can be responsible as well. Benign etiologies of central venous stenosis encompass fibrosis or neointimal hyperplasia due to indwelling catheters, hemodialysis shunts, trauma, inflammation or radiation therapy among others. Paget von Schroetter disease (effort thrombosis, thoracic inlet syndrome) is another reason for central venous stenosis and needs to be considered separately. Depending on the cause and clinical symptoms there are the options for surgical or interventional therapy. Neither for malignant nor for benign causes of central venous stenosis surgery is the preferred method. The exemption to this rule is effort thrombosis in young individuals without any history of indwelling catheters or other underlying disease. These patients should be treated by surgical decompression and anticoagulation. Due to external compression of the subclavian vein neither balloon angioplasty nor stenting will produce sufficient results. In case of malignancy, direct surgical repair as well as bypass surgery is often quite difficult to perform. Furthermore, the need for chemotherapy and/or radiation in these patients does not favour surgery as treatment option. In the end, however, the lesser invasiveness of interventional procedures makes them the treatment of first choice, since the results of both treatment strategies are similar. Looking at the reasons for benign central venous stenosis it becomes clear that the resulting scarring makes direct surgical repair difficult. Minimal invasive therapy of central venous stenosis is usually able to alleviate clinical symptoms without affecting any possible treatment regimens of the underlying disease. In principle, four different techniques are available: percutaneous transluminal angioplasty (PTA), stenting, thrombolysis and mechanical thrombectomy. Usually the first two techniques will be combined to achieve optimal treatment results. Thrombolysis and mechanical thrombectomy are no first line interventional therapies for central venous stenosis. Again effort thrombosis can be the exception; but thrombolysis is only performed as a temporary measure before surgical decompression.
Considering the location of central venous stenosis one can differentiate between superior (SVC) and inferior vena cava (IVC) syndrome, central stenosis of the major venous branches and varia. The SVC is mostly affected by lung cancer and lymphoma. The IVC syndrome can be caused by malignant disease or retroperitoneal fibrosis. An increasing number of patients with IVC syndrome are due to postoperative scarring after liver transplantation. Central venous stenosis of the larger veins is most often due to indwelling catheters. Hemodialysis shunts of the arms are another frequent cause. The changed physiology of venous flow is suspected to be the cause, but the underlying mechanism is not clearly understood.
If central venous stenosis is suspected ultrasound is an easy available screening tool. But for complete evaluation of the central venous system either computed tomography (CT) or magnetic resonance imaging (MRI) will be used and usually give a better overview compared to venography by catheter angiography. The latter however offers the advantage of direct interventional treatment options and is therefore still considered the gold standard by some interventionalists. Since easy availability of CT and because CT offers the advantage of simultaneous and easy staging of malignant disease, I deem computed tomography to be the gold standard for initial diagnosis. The contrast material should be injected via the affected side (or simultaneously from both sides). A first pass scan followed by a late venous phase scan 100–180 s after contrast injection should be performed. Using MRI there are no restrictions concerning radiation exposure, which makes it ideal for follow up. Technically, multiple phases after contrast material injection can be acquired, until sufficient contrast enhancement in all veins is seen.
In case of malignant SVC or IVC syndrome the primary placement of stents has shown excellent results. But it has to be considered that there are no data on long-term patency of these stents. While this is of no major concern for those malignancies with poor long-term prognosis, in case of lymphoma for example, the relative poor

patency rates after central venous stenting have to be kept in mind. In patients first presenting with clinical signs of SVC syndrome and showing a mass to be responsible for this, a histological diagnosis should be acquired before deciding on treatment. Of course this depends to some degree on the gravity of the clinical situation. Balloon expandable as well as self expanding stents of different brands have been used for treatment of SVC syndrome due to malignant disease. Self-expandable stents will be used nowadays, because they do not carry the risk of being permanently crushed by external forces. The stent length should be chosen to overlap the central venous stenosis by at least 10 mm on both sides when possible. In case of SVC syndrome it will usually suffice to place one stent extending in to one brachiocephalic vein. But placement of one stent in each brachiocephalic vein with both stents extending into the SVC is possible.

In case of benign central venous stenosis PTA is the preferred method over stenting. Balloon sizing should try to achieve an overdilation of 10% to 20% compared to the neighbouring normal vessel diameter. The primary patency rates have been reported to be comparable, but there was a significantly better secondary patency rate for PTA over primary stenting. In case of elastic stenosis stenting might be warranted, but should not be the first choice. It has to be kept in mind that there are many collaterals available. Consequently, one needs only to alleviate the clinical symptoms and should avoid treating images. Despite a residual stenosis stenting is quite often NOT necessary. We had some success with drug-coated balloons for recurrent benign central venous stenosis. But this technique should only be applied as last resort before stenting or in clinical studies.

In case of central venous stenosis due to thrombosis thrombolysis via a local catheter can be applied. Standard contraindications of thrombolysis do apply. Using rtPA an initial dose of 1 – 2 mg/h can be used up to a maximum dose of approximately 25 mg. Even in successful cases the underlying cause of the thrombosis has to be evaluated. Mechanical thrombectomy can be used for treatment of central venous thrombosis. Either simple PTA or the use of dedicated thrombectomy devices is possible. But the tortuous anatomy and thin venous vessel walls might yield higher complication rates for thrombectomy devices. At least from a theoretical point of view the likelihood of pulmonary embolism might be greater for mechanical thrombectomy compared to thrombolysis or primary stenting, although some thrombectomy systems can even remove part of the thrombotic material from the circulation. One should be well experienced with thrombolysis or thrombectomy if applying these techniques for central venous stenosis. In any case, covered stents should be available in order to be able to deal with rupture and bleeding.

In conclusion, central venous stenosis should be treated in symptomatic patients only. The preferred methods for malignant compression are stenting, for external compression yielding to effort thrombosis is surgery and for other benign cause is PTA. The patients should be well informed about the high likelihood of recurrent disease and the possibility of retreatment.

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2501.4

How to diagnose and treat steal syndrome

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Learning Objectives:

1. To get familiar with the clinical presentation of steal syndrome
2. To present the possible mechanisms of hand ischaemia and its diagnosis
3. To present the techniques of treatment and results

The clinical problem

Dialysis access-associated upper extremity ischemia is a serious complication that may lead to major amputation. The risk of symptomatic ischemia is below 2% in forearm fistulas but ranges from 5 to 15% in elbow accesses (1). However, due to the increasing age and proportions of diabetics in incident dialysis patients, this is a growing problem.

There are 3 mechanisms interacting in the development of hand ischemia: lesions of the feeding arteries, the steal of the fistula on the arterial supply to the hand and sometimes venous stagnation or hypertension (2-3). The absolute priority is to rule out stenosis or occlusion of a major artery that might be easily accessible to PTA (4).

Mild to moderate symptoms of digital ischemia are common immediately after construction of a dialysis fistula, but in most cases symptoms resolve with development of collateral flows. Chronic ischemic syndrome will develop and worsen if residual flow to the hand is insufficient to maintain basic metabolic needs of soft tissues (5). Unfortunately, the diagnosis of hand ischemia is often overlooked and delayed by dialysis nurses and nephrologists who monitor or treat the fistula and not the hand.

A 1-4 scale of classification for access-induced ischemia can be used to outline the severity of the disease (grade 1= pale/blue and/or cold hand with no pain, grade 2= pain during exercise and/or dialysis, grade 3= ischemic pain at rest, grade 4= ulceration, necrosis and gangrene).

For grade 1, conservative treatment is possible most of the time. For grade 2, imaging is indicated at least to search for an arterial stenosis treatable by dilation. For grades 3 and 4, interventional treatment is indicated (6).

Steal syndrome is likely to disappear if the access is ligated, but creation of a new arteriovenous access on another extremity also carries a significant risk of recurring peripheral ischemia. Correction of steal syndrome must therefore be attempted, the aim being both to preserve the access and to improve distal arterial supply to the hand (6-7).

Non invasive testing

Clinical diagnosis is easy at the stage of skin ulceration. In the pain stages, non-invasive testing with measurement of digital pressure, calculation of the digit-to-brachial index (DBI) are important steps. Any decrease indicates insufficient arterial supply. As for the lower limbs, stages 3 and 4 occur when digital arterial pressures are below 50 mmHg and digit/brachial index below 0.6. Under compression of the vascular access, which is not easy in all cases, these respective values rise significantly. These tests show high sensitivity but a poor specificity. However, they help to distinguish steal syndrome from other conditions such as carpal tunnel syndrome, calciphylaxis (local acute formation of calcium concretions), destructive arthropathy, algodystrophy.

Ultrasound examination of all the arteries of the entire limb with vascular access flow-rate measurement is a preliminary compulsory stage in the decision-making process. In experienced hands, US examination can provide the diagnosis of significant arterial stenoses and indicates the direction of the flow in the artery distal to the anastomosis. The measurement of fistula flow rate is essential to the surgical strategy.

Magnetic resonance angiography with gadolinium injection is not a

reasonable technique because of the risk of nephrogenic systemic fibrosis. Computed tomography angiography is a diagnosis method deleterious to the venous reserve of the patient since cannulation of a "large healthy vein" is necessary for contrast injection, and this cannot be performed through the fistula although dialysis fistulas are meant for such venous cannulation. Overall, concomitant dilatation of diagnosed arterial stenoses is not possible to-date using these 2 imaging modalities.

Upper limb arteriography

Despite the value of US examinations, invasive angiography is mandatory to define the treatment strategy. Angiography includes opacification of the whole arterial tree from the ostium of the subclavian artery to the fingers, with runs under compression of the vascular access. Visipaque is by far the best contrast medium because it does not cause any pain, and this helps the patient not to move the hand during angiography.

The site of cannulation for angiography depends on the clinical presentation. Retrograde cannulation of the arterialized vein or graft can be considered in elbow fistulas, and a 4F catheter can be pushed through the anastomosis into the proximal brachial artery up to the subclavian level. In forearm fistulas, retrograde catheterization of the elbow artery is the best approach, which allows for reflux of the dye up to the ostium of the subclavian artery. It must be kept in mind that in 15 to 20% of patients the radial artery (less frequently the ulnar artery and rarely the interosseous artery) has a high origin from the axillary or brachial artery, far above the elbow joint, and that the artery cannulated at the elbow level can be either the radial artery or the common trunk to the ulnar and interosseous arteries. When no pulse is felt at the elbow level (which is rare) a femoral approach has to be considered. In all cases, it is of paramount importance to be sure that all collaterals originating from the axillary artery are filled with a sufficient volume of iodine when performing the runs centred on the elbow, forearm, hand and fingers, in order to be sure to dye all arteries involved in the distal arterial supply. There are 7 points to be analyzed and recorded when performing angiography for hand ischemia ipsilateral to a dialysis fistula:

- search for arterial stenoses, occlusions or emboli,
- kinetics of opacification of arteries distal to the anastomosis,
- quality and kinetics of opacification of collaterals,
- search for additional arteriovenous communications (previous fistulas) or stumps of former fistulas,
- quality of palmar arches,
- opacification of digital arteries, with runs under compression of the fistula
- venous outflow of the fistula

Place of interventional radiology

Any significant arterial stenosis located upstream from the anastomosis should be searched for and treated (usually by dilatation) since this can improve or cure the patient in many cases. However, some patients are not improved, probably because the increase in arterial inflow mainly benefits the fistula and not the hand. The (rare) major potential complication is embolisation of debris into the outflow and noteworthy the vertebral artery when the stenosis is located in the pre-vertebral segment of the subclavian artery. At the forearm level, dilatation of a stenosis on the proximal radial artery feeding the fistula will have no or little effect on distal ischemia since the resulting increased flow will run into the fistula and not into the distal radial artery. In contrast, dilatation of a stenosis on the ulnar artery whenever technically feasible automatically increases flow to the hand and can cure some patients (8). Unfortunately, only short stenoses are safely amenable to dilatation, whereas the ulnar artery often shows extensive disease or occlusion. Similarly, short chronic occlusions can sometimes be recanalized and fresh clots (iatrogenic embolism complicating a recent declotting procedure of an elbow fistula) can be aspirated or thrombolyzed. The kinetics of opacification of the artery distal to the anastomosis is of special importance. If the flow is reversed, ligation or embolisation of the distal artery may be an easy and effective treatment since this manoeuver stops the steal exerted on collaterals. Many patients with an elbow fistula have undergone previous attempts at creation of a more distal fistula. It is not rare to see evidence of a residual arteriovenous fistula in the forearm that is ineffective for dialysis but responsible for detrimental residual steal from the distal circulation. Such residual fistulas can be embolized or surgically ligated. Similarly, a residual stump at the anastomotic site of a former fistula or graft can remain patent and be a "nest" for local clots that may then escape into the arterial outflow. Spontaneous opacification of the digital arteries up to the finger pad is only seen in mild ischemic syndromes. If spontaneous opacification of digital arteries is not obtained, runs under compression or transient occlusion of the fistula should be performed. If arteries become clearly opacified under fistula compression, healing after treatment of the cause of the steal is likely. When no arteries are visible necrosis is predictable. In contrast, spontaneous hypervascularisation of a finger tip indicates an inflammatory response and rules out the responsibility of insufficient arterial inflow or steal in the genesis of pain or tissue loss: differential diagnoses such as calciphylaxis, infection, arthropathy, etc. should be considered.

Confirmed distal arterial hypoperfusion syndrome is an absolute contraindication to dilatation of any kind of stenosis located on the arterialized vein or graft, except in very rare cases of concomitant venous congestion causing hand edema. The resulting increase in fistula flow would mean increased steal on the arterial supply to the hand, with worsening of symptoms. Similarly, it is difficult to predict steal syndrome after overgenerous dilatation of a stenosis in any kind of arteriovenous access. A poor ulnar artery is probably a good indicator of the risk of subsequent development of distal ischemia.

In very rare cases, ischemic symptoms can be explained by chronic abnormal venous reflux to the hand as a result of stenosis or occlusion of the main outflow vein.

Surgery

Surgery has to be considered when there is no indication for percutaneous dilatation. No single treatment is the panacea, and close clinical monitoring is mandatory in the days and weeks following dilatation or surgery.

Surgical techniques aim either to reduce fistula flow or to increase distal perfusion. In cases of high flow fistulas (above 1 L/min), flow reduction techniques include banding and RUDI (Revision Using Distal Inflow). Banding aims at creating a narrow vessel segment within the access, close to or at the anastomosis (9). Interventional nephrologists recently described a new approach for banding calibrated on a dilatation balloon (10). Unfortunately, banding is frequently either too tight, resulting in access thrombosis, or too loose and ineffective. Convincing publications are lacking. RUDI techniques include ligation of the proximal radial artery, which forces the fistula to be fed by the ulnar and the interosseous arteries via palmar arches and collaterals, and techniques leading to replacement of the brachial artery by the radial inflow artery. A graft can be interposed between the radial artery and the elbow vein, with of course concomitant closure of the previous brachial anastomosis in both cases (11).

In low or normal flow elbow fistulas, DRIL (Distal Revascularistion Interval Ligation) is the most popular technique (12-13). A graft is interposed between the proximal brachial artery and the distal brachial artery in order to improve flow to forearm arteries. Concomitantly the distal brachial artery is ligated as close as possible to the fistula in order to prevent steal by retrograde flow to the fistula. In forearm fistulas, single distal radial artery ligation (DRAL) is performed as close as possible to the anastomosis, with no distal bypass (14). Surgical series of DRIL and DRAL report immediately favourable results.

The most recently described technique is called PAI (Proximalization of the Arterial Inflow). The initial elbow anastomosis is ligated and a graft is interposed between the axillary artery and the elbow vein (15). The optimistic results (84% clinical success rate) of the only 2

series reported to date have to be confirmed.

Summary

In conclusion, hand ischemia associated with the presence of an ipsilateral arteriovenous access for dialysis is an increasing and potentially dramatic problem. Diagnosis, imaging and treatment are often difficult and require a multidisciplinary approach. Digital pressure measurements are essential to assess the diagnosis in non typical cases. The radiologist has the easiest role, providing full arterial mapping of the limb and dilating significant stenoses. Many nephrologists and dialysis nurses underestimate the problem, and this can make it difficult to achieve appropriate follow-up of patients.

Finally, the worst and most dramatic cases are the consequence of elbow fistulas. This is a serious reason to encourage the creation of fistulas in the forearm, even in cases of suboptimal arteries or veins at pre-operative mapping.

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Special Session
TIPS update

2502.1

TIPS in children

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Learning Objectives:

1. To review the indications for TIPS in children
2. To describe the special technical considerations
3. To present the results and complications

Pediatric experience with transjugular intrahepatic portosystemic stent-shunt (TIPSS), first described in 1992 by Kerns, is limited to case reports and small series and long-term results are lacking. Limiting factors to the wide-spread use of TIPSS in children include the lack of adequate pediatric device, technical difficulty because of the small size of the portal and hepatic veins and the presence of anatomical variants.

Although the complications of portal hypertension in children are similar to those in adults, the underlying disease processes differ substantially. The main causes of portal hypertension in children are biliary atresia (40-45%), congenital hepatic fibrosis, a1-antitrypsin deficiency, mucovisidosis, Budd-Chiari syndrome, veno-occlusive disease and portal vein thrombosis. Current indications for TIPSS placement in children include control of acute and recurrent variceal bleeding (gastroesophageal, intestine, jejuno-jejunostomy or stoma) due to sinusoidal or post-sinusoidal portal hypertension, medically refractory ascites and hepatic hydrothorax.

Although children requiring long-term treatment of complicated portal hypertension are more commonly considered for surgical portosystemic shunts because of an improved patency, possible long-term indications for TIPSS include congenital hepatic fibrosis due to polycystic kidney disease, cystic fibrosis and other conditions in which liver function may stabilize or improve with treatment, such as infectious or autoimmune hepatitis or cholangitis.

TIPSS after liver transplantation is feasible but could be very challenging especially after split liver transplantation because of the risk of extrahepatic portal vein puncture. In this clinical setting, patency of the hepatic artery should be verified before TIPSS to avoid major ischemic complications.

Special technical considerations:

1. Technical differences between pediatric patients and adults to perform TIPSS include, for the pediatric group the need for general anesthesia and for shorter size of metallic stent and technical modifications to access the portal vein. For the choice of the type of stent, anticipation of future liver growth and interference with liver transplantation should be kept in mind.

2. Smaller sheaths (<9 fr) and puncture systems (>16G) than those used for adults paradoxically increase the difficulty of the procedure in children because cirrhotic livers in children are rock-hard, especially in case of biliary atresia due to extensive fibrosis at the portal triad and the small size of the portal vein. Therefore, despite very small portal and hepatic veins in children, adults standard needles (Colapinto or Roesch-Uchida) are commonly used for TIPSS creation. Often a mismatch between needle size and vessel diameter necessitates ultrasound monitoring and subtle guidewire maneuvers to enter the portal vein. Another condition impending sometimes the portal vein puncture is the peripheral course of the major hepatic veins displaced by hyperplastic parenchymal nodules.

3. Various manoeuvers for visualizing the portal system could be useful in case of failed blind punctures of small or tortuous intrahepatic portal branches:

- Transhepatic placement of a 0.018-in wire into the portal vein under sonographic guidance.
- Transabdominal ultrasound guidance of transjugular portal vein puncture.
- Indirect portal venography by wedged hepatic vein injection using CO2, with combination of road-mapping or overlay function.
- Transfemoral placement of a guidewire into the hepatic artery.
- Transplenic portal vein targeting.

4. Alternative approaches in case of failed conventional jugular approach have been reported and include

a. direct percutaneous transhepatic porto-hepatic connection under sonographic and/or fluoroscopic guidance, the so-called "Gun-sight technique" using two loop snares placed within an hepatic vein and a portal vein,

b. direct connection between the suprahepatic IVC and the portal vein in BCS patient with hepatic vein and inferior vena cava thrombosis,

c. combined direct percutaneous transhepatic and trans-femoral approaches.

5. Unlike adults for whom covered Viatorr stents (WL Gore) are usually and widely preferable, the strategy for stent selection in children depends on a variety of anatomic and clinical factors including the measured size of the main portal vein and hepatic vein on US, age less than 3 years and weight less than 30 kg. Because they are available in a wide range of size and length and could be initially under dilated and later completely dilate or even over dilated according to the liver growth, bare stents has been more commonly placed in children rather than covered stents. Both self-expanding (Wallstent, Boston Scientific) and balloon-expandable stents (Palmaz, Cordis, Johnson&Johnson) have been used, alone or in combination in order to combine flexibility and conformability of the first and the radial force of the second, especially in case of extensive portal fibrosis associated with biliary atresia. The combination of a covered stent placed within the parenchymal tract to avoid acute thrombosis and delayed stenosis with bare stents extending proximally and distally has been applied successfully in children. Appropriate stent positioning in relation to the portal and hepatic veins is important in potential liver transplant candidate. A malpositioned stent could increase the difficulty of transplantation by hampering vascular control or completion of the anastomosis to the hepatic or portal vein.

There are few data on the clinical use of e-PTFE covered stent for the management of portal hypertension in children. Covered stent-graft has been used to treat TIPSS-biliary fistula and to revise previously malfunctioning shunt created with a bare stent in 2 patients. Recently, Mermuys reported a good medium-term patency of e-PTFE-covered stent TIPSS in 4 children. The advantageous use of conventional covered Viatorr stent in children by reducing the high rate of restenosis, reported up to 89% at 7 months, with bare stent is counterbalanced by the required minimal diameter of the portal vein and the nitinol skeleton which cannot be over dilated during the growth of the liver. The improved medium- and long-term patency of e-PTFE covered stent could avoid the need for repeated shunt revision under general anesthesia and, in the case of stable liver function, liver transplantation could be postponed or even cancelled, especially in case of acute or subacute Budd-Chiari syndrome. Placement of a second parallel TIPSS in order to accommodate the increased portal venous flow with growth may be an alternative technique.

6. Children submitted to TIPSS should have close follow-up including Doppler ultrasound at 1 day, 1 week, 3 months and then at every 6-month interval, so that eventual stenosis or occlusion can be diagnosed early. Oral anticoagulation is recommended for at least 3 months, and ideally maintained forever or until liver transplantation in case of small TIPSS with diameter less than 8 mm.

Results

Published procedural success rate in children ranges from 78 to 98% (80% after the first attempt), lower than in adults (95%).

Complication rates in children are similar to those of adults except for an increase in the need for endovascular reintervention to maintain mid- and long-term patency. This fact results from small vessel size, from lower shunt diameter (6 to 9 in children versus 9 to 12 in adults) and the preferential use of bare stent instead of covered stent.

Other expected complications of TIPSS in children may be technical problems, such as intraperitoneal bleeding, biliary fistula, injury to the vessels or inappropriate size during growth.

Hepatic encephalopathy appears to be less problematic in children (15%) than in adults (20-30%). The reason for this difference is not clear but could be related to more favourable circulatory or central nervous system adaptation to the changes incurred by the procedure.

To our knowledge, TIPSS placement for the treatment of complication of portal hypertension in children has been reported in 81 patients (7 series including 3 to 12 patients and 31 case reports). Refractory or recurrent variceal bleeding is the primary indication for portal decompression in more than 90%. The reported technical success rate is 92, including the need for a second attempt in 11 patients. The clinical success rate ranges between 86 and 93% in terms of controlling variceal bleeding. Refractory ascites was improved in 75% of patients. Thrombocytopenia due to severe hypersplenism is consistently improved in only one-third of patients. This indication is still controversial. Early stenosis or occlusion need reintervention during the first month in 25%. 88% of children need reintervention during the first year follow-up. TIPSS serves as a bridge to elective liver transplantation in 49 patients (61%). No case of failed transplantation after TIPSS has yet been reported. Improvement of general condition after TIPSS in 8 children with preserved liver function has postponed or even obviated the need for transplantation.

The definitive management for children with cirrhosis is liver transplantation. TIPSS placement provides a useful treatment bridge prior to transplantation, allowing for improving nutrition thereby making the patient a more suitable candidate for liver transplantation. However, the procedure is more difficult than in adults, especially in children with biliary atresia and/or advanced peri-portal fibrosis and the frequency of reinterventions is higher compared with adults. The use of covered stent, sometimes in combination with bare stents, seems feasible in children.

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2502.2

Should TIPS replace banding as primary therapy for severe variceal haemorrhage

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Learning Objectives:
1. To review the etiology of variceal bleeding and the medical endoscopic treatments
2. To give an update on recent trials on early TIPS efficacy for variceal bleeding
3. To critically discuss the results of early TIPS in comparison with medical and endoscopic treatment

At the time of the diagnosis of chronic liver disease (CLD) and cirrhosis, gastroesophageal varices are present in 50-60% of patients; 10 years later, 90% of these patients have developed gastroesophageal varices, whereas in only 1% the varices have disappeared (1-3). The risk of bleeding from gastroesophageal varices is 25-35% for both alcoholic and non-alcoholic CLD with the majority of initial bleeding episodes occurring within the first year from the time of diagnosis. For those patients who survive the initial episodes of bleeding, the risk of recurrent bleeding approaches 70%, and the mortality for each episode of bleeding is 15-50% (4). On the basis of the Child-Pugh Classification, the risk of variceal hemorrhage and the mortality rate is increased in patients with advanced stages of CLD and in patients showing large varices (5). A Child–Pugh score above 9 has been identified as an independent risk factor for death, with a hazard ratio of 1.45 for each 1-point increase in the score (6). Based on the angioarchitectural and radiographic classification of thoracoabdominal collateral vessels, grade IV (visible thoracoabdominal varices from two or more cephalic collateral vessels) is the most frequent in patients suffering from acute, severe variceal bleeding (7).

Refinement in clinical management strategies for patients with cirrhosis and its complications appear to continue to contribute to improved patient outcomes, and retrospective studies have shown a decrease in in-hospital mortality associated with variceal haemorrhage over the past two decades (8, 9).

In patients with variceal haemorrhage, the two accepted indications for TIPS have been (a) acute variceal bleeding that cannot be successfully controlled with pharmacologic agents or with mechanical compression or endoscopic techniques and (b) recurrent variceal bleeding in patients whose conditions are refractory or intolerant to conventional medical management, including sclerotherapy and pharmacologic therapy (10). Reports of the use of TIPS in these situations have shown rebleeding rates of 23%–40% after 2 years and suggest a substantial improvement in survival.

Results of both randomized and nonrandomized studies have strengthened the evidence that TIPS is more effective than endoscopic therapy in the prevention of variceal bleeding (11). The main problem with TIPS compared to endoscopic therapy is an increased risk of encephalopathy of about 29% (7%–55%), compared to 19% (4%-44%) after endoscopic therapy. Our data suggest that TIPS and adjunctive embolotherapy of gastroesophageal collateral vessels significantly lower the rebleeding rate in comparison to TIPS alone, and an extensive adjunctive embolotherapy of varices may allow us to use a smaller shunt diameter with a consecutively lower rate of encephalopathy (7). The cumulative long-term rebleeding rate in our patients after 4 years was 32%. The long-term rebleeding rate in patients undergoing TIPS in combination with adjunctive embolotherapy of gastroesophageal collateral vessels was only 19% in comparison with 47% in patients undergoing TIPS creation alone, and this difference was statistically significant (7). The rate of encephalopathy de novo was 12%. Our data analysis showed an independent overall effect of variceal embolotherapy on rebleeding (P<.001), and there was an inverse correlation between the risk of mortality due to rebleeding and variceal embolotherapy.

The key changes in the 2009 guidelines are new recommendations on the use of covered versus bare stents in the creation of the TIPS (12). The use of expanded polytetrafluoroethylene (ePTFE)-covered stents is now preferred. The lower risk of shunt dysfunction and perhaps improved outcomes using covered as opposed to bare stents are the basis for this recommendation.

Despite all these improvements, however, the mortality at 30 days among patients in Child–Pugh class C is still 32%, and 75% of the patients who require TIPS as rescue therapy to control index bleeding are in Child–Pugh class C (13).

Recently, García-Pagán et al. (14) reported the results of a randomized, multicenter study that compared early TIPS with optimal medical therapy (endoscopic therapy plus vasoactive drugs) in patients at high risk for rebleeding who were either in Child–Pugh class B with active bleeding at endoscopy or in Child–Pugh class C. After the acute bleeding, the medical-therapy group received endoscopic therapy until obliteration of the varices, followed by surveillance, beta-blockade (in 80% of patients), and nitrates (in 39% of patients). Thirty-one of the 32 patients randomly assigned to the early-TIPS group underwent shunting within 72 hours after endoscopy, and the portal-pressure gradient was reduced to less than 12 mm Hg in all but 2 of these 31 patients. This study shows the benefit of early TIPS in patients with Child–Pugh class B or C diseases which are at high risk for uncontrolled bleeding with standard therapy. Patients who were randomly assigned to receive TIPS had a significantly better chance of remaining free of bleeding than did those who received the standard care (97% vs. 50%), possibly owing to a greater reduction in portal pressure with TIPS than could be achieved with pharmacologic therapy. The rate of survival at 6 weeks was 97% in the

TIPS group as compared with 67% in the medical therapy group, as a result of reductions in rebleeding, sepsis, and liver failure. Hepatic encephalopathy was observed in 12/31 (38.7%) patients in the medical therapy group versus 8/32 (25%) patients in the TIPS group (no significant difference).

Summary: Refinement in clinical management strategies for patients with cirrhosis and its complications appear to continue to contribute to improved patient outcomes. TIPS should be done by a multidisciplinary dedicated team and instead of taking a wait-and-see approach, the team should consider the early use of TIPS with an e-PFTE–covered stent as first-line therapy rather than as rescue treatment if rebleeding occurs in high-risk patients with Child–Pugh B or C disease. Further, our data suggest that the long-term rebleeding rate in patients undergoing TIPS in combination with adjunctive embolotherapy of gastroesophageal collateral vessels is significantly lower than in patients undergoing TIPS creation alone.

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2502.3

Should TIPS become primary therapy for severe ascites

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Learning Objectives:

1. To review the etiology of refractory ascites in cirrhotics and the medical treatments
2. To present an update of recent trials and meta-analyses
3. To discuss the prognostic factors or subgroups of patients where TIPS should be first option for refractory ascites

Ascites due to portal hypertension affects survival and quality of life. Apart from discomfort ascites formation signals poor prognosis and bears the risk of kidney function deterioration and spontaneous bacterial peritonitis (1).

Abdominal fluid retention occurs in patients with cirrhosis because of the development of portal hypertension in concert with splanchnic vasodilatation, renal sodium retention and active renal vasoconstriction. As the liver cirrhosis progresses, the ascites becomes more resistant to diuretic therapy and refractory ascites develops (2). According to the criteria of the International Ascites Club refractory ascites is defined as an abdominal fluid collection that cannot be mobilized or the early recurrence of which cannot be satisfactorily prevented by medical therapy. The term refractory ascites has two different meanings: diuretic-resistant ascites and diuretic intractable ascites. Diuretic-resistant ascites does not respond to an intensified diuretic treatment of up to 400 mg/day spironolactone, up to 160 mg/day of furosemide and sodium restriction to a maximum daily intake of 5,2 g of salt/day (3, 4).

Portal hypertension elevates the hydrostatic pressure within the hepatic sinusoids and increases transudation of the ascites fluid, rich in plasma proteins, into the peritoneal cavity. Accumulation of ascites represents, in principal, a shift of the balance between production and resorption of free peritoneal fluid to the side of production (4). Once refractory ascites occurs, the patient has a poor prognosis with 50% probability of death within 12 months. Liver transplantation should be considered in these patients without delay (2).

Hepatic hydrothorax occurs in patients with ascites when there is direct communication between the peritoneal and pleural cavities. In most patients the defect is in the diaphragm that overlies the dome of the liver. Hepatic hydrothorax is due to an accumulation of ascitic fluid migrating through the diaphragmatic defect (5-8).

Spontaneous bacterial peritonitis (SBP) is a monomicrobial infection of ascites. The diagnosis is confirmed when ascitic neutrophil count is more than 250 cells/mm^3 in the absence of an intraabdominal and surgically treatable source of sepsis. SBP is frequently asymptomatic, its in-hospital mortality has been reduced to approximately 20% with early diagnosis and appropriate treatment (2).

Among therapeutic approaches to cirrhotic ascites have been taken repeated large volume paracenteses (LVP), peritoneovenous shunts and TIPS. Peritoneovenous shunts have been abandoned because of a lack of efficacy in comparison to others methods and high rate of complications (2, 3, 9).

Serial therapeutic paracenteses are effective in controlling ascites in patients who truly fail diuretic treatment. However, this treatment may result in protein depletion, aggravates malnutrition, and predisposes to ascites infection. Some patients may have benefit from intravenous albumin infusion after large volume (i.e. 5-10 l) paracenteses (2).

Since the TIPS is quite effective in decompression of portal hypertension, its use in treatment of refractory ascites is widely accepted as the most common indication for TIPS nowadays. Multiple

meta-analyses (10) have been published including trials comparing TIPS and LVP. They reported much better control of refractory ascites with TIPS (up to 62 %) than with LVP (up to 24 %). However, the survival and transplant free survival were similar. Encephalopathy occurred more in TIPS group than in LVP group of patients (39 % versus 23 %) (1, 11-13).

TIPS resulted in a secondary decrease in the activation of the renin-angiotensin-aldosterone system, and increases sodium excretion. TIPS also improves body cell and muscle mass contributes to the weight gain in malnourished patients with cirrhosis and hypermetabolism (14).

The patients with an ejection fraction between 40% and 50% and those with diastolic dysfunction may have a higher risk of heart failure after TIPS and limited survival. The ejection fraction of patients with liver cirrhosis is usually higher than 70%-75% due to hyperdynamic circulation of these patients (15, 16).

The patients with renal insufficiency either due to organic or due to functional causes are poor responders to TIPS (17). The preTIPS eradication of the SBP seems to be crucial in our practice. A diagnostic paracentesis is mandatory in all candidates for TIPS. An appropriate antibiotic therapy is followed in positive patients (2).

However, there are several limitation of all these mentioned studies on treatment of refractory ascites with TIPS from our today´s point of view. Even in last published study TIPS (13) procedures were performed using bare stents which have much worse long-term patency than dedicated polytetrafluoroethylene-covered stents (18). The introduction of these stent-grafts improved clinical efficacy of TIPS (19). In addition, introduction of rifaximin into treatment of hepatic encephalopathy significantly reduced its risk in patients after TIPS (20).

Conclusion

A thorough selection of patients with refractory ascites and hepatic hydrothorax is the key for successful treatment with TIPS. Scoring of patient using Model for End-Stage Liver Disease (MELD) has been validated to predict early mortality after TIPS (21). Patients with MELD more than 15-18 or bilirubin level >4.0 mg/dl should be informed of their poor prognosis and TIPS performed only in the absence of other possibilities. An ejection fraction of greater than 50% should be required in these patients. TIPS may convert diuretic-resistant ascites into diuretic-sensitive ascites. Therefore, continual diuretic therapy after TIPS and titrating this therapy to reach natriuresis is recommended (2). Technical and medicamentous advances have been introduced in TIPS practice to improve shunt patency and increase effectiveness of treatment of hepatic encephalopathy. Consequently, new studies are required to re-assess the role of TIPS in the treatment of refractory ascites (22). As soon as TIPS creation would be proved to have positive effect on survival, and risk of encephalopathy would be acceptable or medically controlled, then TIPS may become primary therapy for severe ascites.

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2502.4

The role of TIPS as a bridge to liver transplantation

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Learning Objectives:

1. To review the indications and timing of TIPS as a bridge to transplantation
2. To review the outcomes of liver transplantation in patients with and without TIPS before surgery
3. To review the indications and results of TIPS in transplant patients

Indications to perform liver transplantation (LT) are not within the scope of this abstract. The aim is to discuss the clinical benefit of TIPS in patients who are already in the waiting list for LT or in whom the indication to perform LT is being established.

Indications to perform TIPS in patients waiting for LT may be similar to those of the "general population". They include the palliation/treatment of symptomatic complications in patients, mainly cirrhotic, suffering from portal hypertension. Patients with advanced deterioration of the liver function (Child B or C) who are waiting for LT and present with non-controlled bleeding from gastro-esophageal varices or refractory ascites will clearly benefit from the creation of a TIPS.

A few years ago, patients with acute/subacute Budd-Chiari Syndrome (BCS) were believed to benefit from TIPS as an effective therapeutic tool while on the waiting list for transplantation. However, several large studies have demonstrated that TIPS should no longer be considered as a bridge to LT but as a definitive treatment option in BCS. García-Pagan et al have shown that TIPS improves survival and that it should be considered the treatment of choice for BCS. Nevertheless, there is a small subgroup of patients with deteriorated liver function who should be promptly identified, because they will need LT after TIPS.

The presence of portal thrombosis has been a relative contraindication to LT. If complete it makes the surgical procedure difficult and, when associated with hepatofugal portal flow, increases the rate of post-operative portal complications (thrombosis). Several published series have demonstrated that TIPS can be safely performed in patients with acute and chronic portal thrombosis. If associated with the embolization of portosystemic collaterals, there is a marked improvement of the hepatopetal portal flow. Therefore, it could be said that TIPS is a very effective tool in patients with liver insufficiency and portal thrombosis who are waiting for LT.

There is little information regarding the performance of TIPS in liver transplant recipients with failing grafts as a bridge to retransplantation. Series published by Choi et al and Saad et al demonstrated less effectiveness in the management of refractory ascites in this subgroup of patients than for those with native livers.

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Special Session
Controversies in non-vascular interventions

2503.1

MRgHIFU for fibroids will replace UFE

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MR-guided focused ultrasound has been utilised in the treatment fibroids for the past decade. It is a slowly evolving technique with improving technology throughout all this period but the potential it holds out is for the completely non-invasive destruction of deep tissue areas such as fibroids with almost no complications and almost no post-procedural complications and morbidity. The fibroids most suitable for focused ultrasound treatment are uterine masses below 15 cm in diameter with fewer than five fibroids in total. Uterine sizes above this usually contain too much volume of fibroid material for effective timely MR-guided focused ultrasound procedures to be carried out, although it is possible to carry out the procedures on larger fibroids over two or possibly three treatment sessions. Similarly, multiple fibroids are problematic due to the amount of sonication sites that need to be chosen. To carry out focused ultrasound safely, a suitable acoustic window must be available to reach the targeted fibroids and this predominantly means an anterior acoustic window free of bowel obscuration must be achieved. Bowel potentially reflects focused ultrasound due to its gas content and may cause unpredictable areas of heat buildup which could potentially cause a bowel perforation. Obsessional attention to eliminating bowel from the beam pathway must therefore be carried out. Similarly, currently it is believed that fibroids which are very hyperintense on T2 weighted MR images respond much less well to focused ultrasound than the more classical fibroids which show low signal T2. Therefore conventionally these fibroids are considered less suitable for focused ultrasound. Recent technology upgrades, however, have allowed much more intense power concentrations to be developed within individual sonications which may allow much more effective treatment of medium-sized hyperintense fibroids than was previously available. No effective evidence as yet is available for this but early anecdotal work suggests that new technologies allow significant improvement in the treatment of hyperintense fibroids.

A significant amount of successful pregnancies have been achieved in patients post of MR-guided focused ultrasound with no excess of complications in those pregnancies. Earlier pathological studies also showed that there was no collateral damage adjacent to the uterus in patients who underwent MR-guided focused ultrasound. These findings suggest that focused ultrasound may be a much more effective way of preserving patient's fertility following treatment for their fibroids in comparison to both of myomectomy and uterine artery embolisation.

Complication rates following MR-guided focused ultrasound are

extremely low and almost no post-procedure adverse symptomatology is experienced due to the nature of the underlying ablation which utilises coagulative necrosis rather than ischaemic necrosis as is seen in uterine artery embolisation.
The relative low morbidity of the procedure allows patient is to be treated entirely on an outpatient basis with a swift return to work and other normal activities in less than 24 hours associated with a rapid improvement in symptomatology within the first menstrual period. The cost effectiveness of this type of procedure therefore is remarkably high despite the apparent high initial cost of the capital outlay for the equipment.
Disclosure
I act as a consultant to insight Tec the manufacturers of MR guided focused ultrasound equipment.

2503.2

MRgHIFU for fibroids will not replace UFE

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Uterine fibroids (leiomyoma, leiomyomata, myoma, and fibromyoma) are the most common pelvic tumor in women. The treatment for fibroids includes medical therapy (oral contraceptives, GnRH agonists), myomectomy (hysteroscopic, laparoscopic, and open), hysterectomy (laparoscopic and open), and uterine artery embolization (UAE). Magnetic resonance-guided focused ultrasound (MRgFUS) combines MR imaging to define the target and to control and monitor the ablation, and an ultrasound transducer that controls and delivers the focused ultrasound beam, this allows a non-invasive approach for the treatment of uterine fibroids.
Although MRgFUS may be appropriate for some of patients with uterine fibroids, there are some limitations. Patients with multiple fibroids probably more than 3 are not good candidates for MRgFUS. Although it may be possible to determine a fibroid that is most likely to be causing the patient's symptoms, it leaves the patient with multiple fibroids that may be contributing to the patient's symptoms. There seem to be fibroids that are more responsive to MRgFUS, at least with some of the equipment that is widely available at this time. Fibroids that are homogeneous and hypointense (dark) on T2 seem to respond better than fibroids that are heterogeneous and hyperintense (bright) on T2. The fibroids should be enhancing. Patients cannot have contraindications to MR imaging such as cardiac pacemakers, sensitivity to MR contrast agents, severe claustrophobia, or those who exceed the size limitation of the MRI scanner. Abdominal scarring or bowel loops in the path of the ultrasound beam are contraindications to MRgFUS. In some patients it is possible to displace the bowel, but it may not be possible. Obese patients may have so much subcutaneous tissue that the fibroid is largely out of the range of the ultrasound beam. The uterus maybe severely retroflexed and the fibroid is located posteriorly again placing it out of range of the ultrasound beam. The ultrasound focus depth is limited to 12 cm for standard protocol.
The fibroid may not be able to be treated completely because of its proximity to bowel, bone, spine, nerves, or other structures. Some of the new equipment maybe able to make adjustments to allow treating around these structures. However, it is likely that there will still be incomplete treatment of some fibroids. It is not clear what the long-term results are for fibroids that are incompletely treated with MRgFUS. Continued perfusion may over time lead to recurrent fibroid symptoms.
Clearly there is a correlation between the volume of thermal ablation and the clinical outcome. It is clear that the nonperfused tissue volume (NPV) should be as high as possible as there is a close relationship between the NPV and outcomes. If the NPV is greater than 40% the percentage of patients having an alternative therapy is 17%. If the NPV is between 20 and 30% then 35% will have alternative therapies, 10-20% NPV then 44% had alternative therapies, and if 0-10% of the fibroid was nonperfused at the end of the treatment then 48% had alternative therapies. The signal characteristics can be a predictor of the success of treatment. In one study, the fibroids were categorized on the basis of the signal intensity of the T2-weighted images. Fibroids were categorized as: type 1, low signal intensity on T2; type 2, intermediate intensity; and type 3, high intensity. The intensities were measured in relationship to the intensity skeletal muscle (type 1), or myometrium with type 2 having an intensity higher than skeletal muscle but lower than the myometrium, and type 3 with a signal intensity equal to or greater than the myometrium. The type I fibroids had the best result with 31%, type 2 was 20.5% and type 3 was 16.5%.
Large uterine fibroids are difficult to treat with MRgFUS primarily because of the time required to perform the procedure and/or the requirements for multiple treatments. One approach that has been proposed to try and solve this problem is to pre-treat the patients with large fibroids with gonadotrophin-releasing hormone (GnRH) agonists. GnRH agonists (Lupron is commonly used in the United States) are used by gynecologists for treating fibroids prior to hysterectomy or myomectomy. GnRH agonists appear to affect the uterus and myoma volume by the result of decreased levels of estrogen and progesterone, but other mechanisms may be involved, including induction of myoma degeneration and hyaline necrosis, a decrease in the size or number of leiomyoma cells, a reduction in extracellular matrix, or a decrease in blood flow to the uterus. The GnRH agonists reduce the fibroid size, which decreases the time required to treat the fibroid and may allow more patients to be eligible for the procedure. Approximately 20% of patients that are clinically eligible have fibroid volumes that are too large for the procedure (or at least to be enrolled in the study that was being performed).
Potentially, the desire for fertility would be a reason for performing MRgFUS. If MRgFUS is able to decrease the size of the fibroid and allow for a more normal endometrial cavity, it is possible that fertility may be improved. Since many patients with large fibroids or multiple fibroids are going to require an abdominal myomectomy, it is possible that this non-invasive approach should be the first option. Certainly concern for premature ovarian failure, at least a theoretical concern for uterine artery embolization, would not be a concern with MRgFUS.
Adenomyosis, or at least a focal adenomyoma may also be an appropriate use for MRgFUS. There has been some work that indicates that adenomyosis may respond to MRgFUS and more research is needed in this area.
There have been continued improvements to the equipment and the techniques in MRgFUS and continued changes will of course change the ability to treat fibroids, by increasing the speed, and the fibroids that are possible to access. It seems clear that not all patients with fibroids are candidates for MRgFUS, but that should not be a reason not to use MRgFUS in patients who are good candidates. What is important is to properly select patients so that a patient who is likely to benefit is treated and one who is unlikely to respond is treated in another manner. It is important that there be some trials between various treatments for uterine fibroids. One of the most critical is a randomized comparison with UAE since the UAE technique is the least invasive of the alternative techniques. Such a trial may help to better define the criteria for using one technique or another, and better define the appropriate criteria for MRgFUS treatment.
Disclosure
I am on research protocol with Insightec

2503.3

Covered stents are better than non-covered for malignant biliary strictures

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Malignant biliary strictures occur when a tumor or tumor infiltrated lymph nodes narrow the caliber of the bile ducts obstructing the bile outflow towards the duodenum with subsequent biliary stasis. If the bile is not drained a chain reaction of biochemical changes occurs that leads to infectious condition, multiorgan failure and death [1]. The tumors that may cause malignant biliary stenosis are mainly pancreatic adenocarcinoma and cholangicarcinoma. Both are tumors that are detected late and therefore inoperable in most of the cases, with rather poor prognosis. In such cases adequate palliation is paramount for the quality of life of the oncologic patient. The aim of palliation is to avoid another episode of jaundice patient's life permitting the continuation of chemotherapy and avoiding the stress and the complications of a new intervention.

Palliation may be offered either surgically or with metallic self-expandable stents. The initially used plastic stents have been quickly replaced from metallic ones as the latter have shown to offer a more valid and cost effective option for the palliation of malignant jaundice [2]. Both surgery and metallic stents seem to offer similar overall survival but the latter are likely to be associated with lower early complications rate, procedure-related mortality, and cost, offering a better quality of life for the patient [3-7]. In more recent studies, palliative surgery has shown more promising results than in the past due to the use of modern and less invasive surgical techniques; however, these results are described in single center retrospective studies and depend mainly on local expertise [8, 9]. Surgical treatment is associated with longer hospital stay, higher initial morbidity and mortality, but re-intervention rate appears to be low. Stent treatment offers lower initial mortality and morbidity rates, but leads more frequently to late biliary complications and re-interventions caused by clotting of the stent, tumour in- or/and overgrowth and gastric outlet obstruction [3-6].

In order to improve stent's performance and to offer a palliative method leading to fewer re-interventions for the oncologic patient, covered metallic stents have been developed [10-15]. Initial data on covered stents were controversial but recent studies have shown more promising results [16- 22].

Covered stents have been compared to uncovered stents in five articles in the literature. In particular, in prospective randomized study of 2004 by Isayama et al [16], the authors have used a handcrafted, partially covered self-expandable Ultraflex Diamond Stent (Microvasive; Boston Scientific Corporation, Natik, Massachusetts, USA) with polyether-type, 50–60 mm thick polyurethane and have shown higher mean survival and patency rates in the covered stent group but without statistical significance. There was statistical significance only in the obstruction rate that was lower for the covered stent group.

In another study by Park et al [23], commercially available silicone-covered Wallstent (Microvasive Endoscopy, Boston Scientific Corp, Natick, MA) were compared with the historical data of uncovered Wallstents and shown minor superiority of the covered stents without any significant difference in survival and patency rates. In another retrospective study by Yoon et al [24], the data from covered and uncovered Wallstents were compared offering very similar results but without statistical significance.

In two tumour oriented, prospective randomized studies from our group Viabil (W. L. Gore & Associates, Flagstaff, AZ, USA) stents were compared to Wallstent (Boston Scientific, Watertown, MA, USA) and Luminexx Biliary Stent (C. R. Bard Inc, Murray Hill, NJ, USA) stents in patients with cholangiocarcinoma and pancreatic cancer, respectively. We only included patients with strictures distant from the hilum (Bismuth type I). In both studies ePTFE/FEP covered stents have shown to offer a statistically significant longer patency. There were higher survival rates for the covered stent group with statistically significance for the cholangiocarcinoma group. The difference from the other studies apart from the different stent was the tumour-oriented study and the fact that the patients that were included were expected to have a median survival time of more than three months in order to avoid any influence of the results from patients' early mortality.

The relative lower six-month patency rate of the bare stent group was mainly attributed to dysfunction due to tumour ingrowth which is still the main problem of bare metal stents particularly in the cases where the patients survive more than three months. According to Boguth et al [25], epithelization of a bare metallic endoprosthesis does not occur until the first three to six months, then granulation tissue is formed, giant cells are recruited and tumor ingrowth through the stent`s open cells occurs. This happens more likely in case of invasive malignancies like cholangiocarcinoma or pancreatic adenocarcinoma, whereas it is quite unlikely when the stricture is due to enlarged lymph nodes. No significant difference was noted regarding overall cost in the two groups even though the cost of a single session is higher for the covered endoprostheses. This is probably due to the fact that re-intervention rate was higher for the bare stent group.

Therefore covered stents **are** superior to uncovered stents when:

· Covered stents are used in patients that may survive more than three months.

· Covered stents are used for tumours that may cause ingrowth.

· Covered stents with membrane that prevents from tumour ingrowth are used.

· Covered stents are deployed to strictures distant to the hilum.

For all the remaining subcategories of biliary strictures there is not enough evidence of covered stent superiority over uncovered ones.

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2503.4

Covered stents are not better than non-covered for malignant biliary strictures

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No abstract available.

2503.5

Thermal treatment for herniated discs

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Radicular pain due to disc herniation is generally successfully treated by conservative therapies including periradicular steroid injections. However, after a minimum of 6 weeks of failure of conservative therapies, treatment aiming to decompress or to remove the discal herniation is considered.

Conventional open surgery produces suboptimal results and is associated with a high risk of epidural fibrosis. In opposition, percutaneous techniques offer a minimally invasive alternative for disc decompression. Their principle is to remove a small amount of the central nucleus to achieve a drop of pressure inside the herniation, considering that the disc is a closed hydraulic space. Thus, percutaneous disc decompression is only indicated for contained disc herniations. In opposition, extruded disc herniations and free discal fragments are not indicated for percutaneous treatment. Other contra-indications include spinal instability, narrow canal and severe disc collapse.

Many techniques of percutaneous disc decompression are available.

a) Chemical techniques: since chymopapain is no longer available, intradiscal injection of ethanol or ozone has been proposed to achieve disc decompression. However, prior discogram should be performed to check the absence of annular rupture to avoid extradiscal diffusion of the chemical agent. Moreover, the volume of nucleus destruction is not precisely controlled and may cause a severe secondary discal collapse.

b) Mechanical techniques: different percutaneous devices aiming to extract a small amount of nucleus are available.

c) However, thermal nucleotomy devices seem to offer better clinical results as they combine mechanical decompression and thermal destruction of intradiscal pro-inflammatory proteins. Thermal techniques include laser nucleotomy and radiofrequency coblation (nucleoplasty).

Principles of laser nucleotomy:

The principle of percutaneous laser disc decompression is based on transformation of light energy into thermal energy to vaporize the nucleus and achieve decompression. Laser energy is transmitted into the disc through a thin optical fiber.

Principles of radiofrequency nucleoplasty:

This technique uses a low-energy bipolar radiofrequency electrode that produces ionization of the sodium atoms in the nucleus. This creates a focused high-energy plasma field which disintegrates the intramolecular bonds in the nucleus (coblation). Coblation works in a much lower range of temperature, when compared with laser.

Technique of percutaneous thermal disc decompression:

Discal puncture is performed using conventional approaches used for discography: posterolateral approach for lumbar and thoracic levels, anterolateral approach for cervical levels.

An 18-gauge spinal needle is used for coaxial insertion of the laser fiber. Laser energy is then applied using discontinuous shots of 15-20W to achieve nucleotomy. Optimal positioning of the fiber tip is mandatory to avoid thermal damage to the adjacent vertebral endplates.

A 17-gauge coaxial needle is used to insert the nucleoplasty electrode for lumbar and thoracic levels. For cervical levels, a dedicated 19-gauge nucleoplasty electrode is available. After proper positioning of the electrode, several coblation channels are created to achieve decompression.

Results:

No randomized controlled studies are available to prove the efficacy of percutaneous nucleotomy techniques. However, numerous retrospective studies show promising results with thermal-based nucleotomy techniques, with 70-80% of satisfactory response on radicular

pain. These results seem to be significantly better than with pure mechanical technique. These techniques are associated with a very low rate of complications. The risk of thermal damage to the adjacent vertebral endplates is reduced with nucleoplasty compared with laser nucleotomy, as coblation works in a much lower range of temperature.

Conclusion:

Percutaneous nucleotomy is a minimally invasive treatment for discal decompression when radicular pain is refractory to conservative therapies including periradicular steroid injections. Thermal-based techniques seem to offer better clinical results than pure mechanical decompression devices and the volume of nucleus ablation is better controlled than with chemical techniques. However, a successful treatment is based on a strict patient selection.

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2503.6

Non-thermal treatment for herniated discs

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No abstract available.

Hot Topic Symposium
Image-guided ablation replaces surgery in resectable liver tumours

2701.1

Image-guided ablation can replace surgery in resectable liver metastases: pro

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Hepatic metastases may occur in up to 80% dependent on the primary malignancy. Considering the general oncological (isolated hepatic tumor load; prognostic benefit), and technical (size, number, location of hepatic metatases; expected hepatic functional reserve) framework surgical resection is still considered to be the method of choice – even if this statement never had been verified by RTCs.

Nevertheless, in clinical reality only 20 – 30% of patients with liver metastases may qualify for resection. In consequence, the majority of patients need other or at least modified therapeutical pathways including adjuvant or neoadjuvant chemotherapy and more and more image guided local ablative therapies. The latter encompass chemo- (transarterial chemoperfusion/-embolisation), thermo- (radiofrequency-, Laser-, microwave-ablation, high intensified focused ultrasound), and radio-ablative (radio embolisation, interstitial brachytherapy etc.) techniques.

Particularly, the thermal-ablative techniques gained wide acceptance over the last years since ample evidence could be presented that this methods can be applied as primary but also complementary therapies in resectable and non-resectable metastatic disease. Furthermore, recent data confirm that in multimodality therapy concepts progression free survival and overall survival in patients with primarily unresectable and with unfavorable prognosis poorer results comparable to surgery can be achieved.

Minimally invasive, image-guided therapies will not replace surgical resection, however, this therapy modalities are eligible in a large number of cases and should be implemented consequently in multimodality treatment regimens according interdisciplinary consensus of oncologists, interventional radiologists, and surgeons.

2701.2

Image-guided ablation can replace surgery in resectable liver metastases: con

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Complete resection of resectable liver metastases, particularly in the setting of metastases from colorectal cancer, is considered the gold-standard of care for such patients and carries the option of cure. If a limited number of liver metastases is present that – for any reason – cannot (or not completely) be resected, then image-guided ablation represents an excellent option for treatment. In fact, under optimal conditions – and looking at individual lesions, image-guided ablation, e.g. using radiofrequency, can lead to a complete destruction of the tumor, and, thereby, also achieve an R0-situation.

Although prospective, randomized studies do not exist, the data from the literature suggest inferior results after image-guided ablation as compared to surgical resection. E.g. in patients with numbers and sizes of liver metastases suggest resectability (e.g. in patients with up to 5 metastases) 5-year survival rates are between 24 and 33% are reported for ablation vs. about 40 to 50% after surgical resection (Gillams 2009). Moreover, the time-to-progression – particularly due to local tumor recurrence – has been reported to be shorter after ablation than after resection.

Although, in a optimal setting, local ablation can lead to complete destruction of tumor nodules, highly variable rates of local tumor recurrence (between 3.6 and 60%) have been reported in the literature, suggesting major variability in the completeness of ablation. Finally, ablation does not allow for pathologic quality control of the intervention. In addition, small additional metastases may be overlooked in the setting of transcutaneous ablation, where the diagnostic gold standard of intraoperative ultrasound is missing.

Thus, surgery remains the gold standard of treatment in patients with resectable liver metastases (Wong 2010). However, local ablation is important method that can be very effective in complementing surgery in order to achieve a tumor-free condition. Also, for some metastatic lesions in critical locations (e.g. those that would require resection of large amount of healthy liver parenchyma for a small tumor nodule), local ablation should be considered instead of resection in a curative intent. In the end, interdisciplinary discussion of each individual patient is required taking into consideration all clinical parameters, but also the experience of the individual surgeons and interventional radiologist.

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2701.3

Image-guided ablation can replace surgery in resectable HCC: pro

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No abstract available.

2701.4

Image-guided ablation can replace surgery in resectable HCC: con

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No abstract available.

Honorary Lecture
Josef Roesch lecture

2702.1

Evidence based medicine and carotid stenosis treatment

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Atherosclerotic stenosis of the carotid artery is a major cause of disabling stroke or death and constitutes a huge medical, social, and economic problem. It was not recognized until 1875 when Growers described a patient with hemiplegia that could be attributed to an occluded left carotid artery. In the last century Hunt noticed a relationship between carotid artery disease and stroke but the management of this disease was suggested for the first time in 1951 by Fisher who stated the following: "It is even conceivable that some day vascular surgery will find a way to bypass the occluded portion of the artery during the period of ominous fleeting symptoms."
In 1954 successful carotid endarterectomy to surgically manage atherosclerotic disease of the carotid artery was performed. Carotid endarterectomy (CEA) has proven its effectiveness in preventing imminent stroke in several prospective randomised clinical trials comparing CEA to the best medical treatment. Endovascular treatment for carotid artery stenosis was for the first time used by Mathias in 1978.
With the development of stents the endovascular treatment has been undergoing a continuous evolution due to changes in stent design and endovascular technique; from the initial use of balloon-expandable to self-expanding stents and then from closed-cell to open-cell stents. The introduction and continuous improvement of devices preventing emboli as well as increasing operator experience have further enhanced the effectiveness of the procedure.
Within the last 20 years, the use of carotid artery stenting (CAS) has been gradually expanding. Although CEA has been the gold standard in carotid stenosis therapy, it has been seriously challenged by the newcomer CAS. Therefore, considerable interest has developed in determining whether endovascular treatment is safer and more effective than surgery for the treatment of carotid stenosis. The medical profession plays a central role in critical evaluation of the evidence related to devices and procedures for the management of disease. Properly applied, thorough expert analysis of the available data documenting absolute and relative benefits and risks of the new procedures is of major importance in improving and optimising the effectiveness of patient care. Data generated with the methodology of evidence-based medicine (EBM) give basis to the formulation of clinical practice guidelines.
Randomised trials directly comparing CAS with CEA have produced conflicting outcomes. Initially, the SAPPHIRE study showed promising results. It proved that CAS is not inferior to CEA and showed low periprocedural complication rates as well as low rates of restenosis in high-surgical-risk patients. The SAPPHIRE trial has indicated carotid stenting as an effective alternative to carotid endarterectomy, however, these results could not be confirmed by later trials. Higher complication rates after CAS were found in the SPACE trial and in the EVA-3S trial. This even lead to a premature termination of the latter study.
Whereas many single-centre case-series and large registries have indicated that CAS can be performed with acceptable periprocedural complications rates, randomised trials directly comparing CAS with CEA have produced conflicting results. Therefore, a widespread use of CAS was not warranted at that time and continuous efforts were needed to optimise the technique. According to EBM rules, level-one evidence of the safety and efficacy of one treatment mode over the other is only provided by a randomised controlled trial, with results reported by registries considered less valid. On the other hand, the outcome of a trial may not be always generalised and introduced into common practice because of specific selection of patients and qualities of the institutions participating in the study. Recently, the results of two big trials were presented: the North American Revascularization Endarterectomy vs. Stenting Trial (CREST) and European International Carotid Stenting Study (ICSS). The CREST study showed no inferiority of CAS with embolic protection to CEA. This trial, with defined standards for operator experience, led to a conclusion that in addition to an aggressive medial therapy there are two equivalent treatment options for symptomatic and asymptomatic carotid stenosis: CEA and protected CAS. The results of the CREST trial were discrepant with the EVA-3S, SPACE and ICSS trials which failed to reach the same conclusion due to a higher stroke rate in the CAS group. These differences were mainly due to trial methodology, particularly because of insufficiently rigorous vetting standards used for carotid stent operators. Numerous studies showed that inexperienced operators without a well defined protocol achieve poorer results in CAS. Unproven experience with carotid catheterisation, as a condition for participation in the trial in all the European studies, is perhaps the most important factor responsible for the overall high rates of stroke reported in these studies.
Although interpretation of the results of stenting versus surgery trials for carotid stenosis is still controversial, recent guidelines on the "Management of Patients with Extracranial Carotid and Vertebral Artery Disease", published this year in JACC, stated that carotid stenting is comparable to carotid endarterectomy. Even though prestigious organisations shaped these guidelines, this conclusion is premature and unjustified in the opinion of many researchers in view of the data accumulated over the past 5 years. The debate concerning whether best medical treatment, endarterectomy or stenting is the most appropriate treatment is even fiercer, and each of these alternatives has advocates.
At the time of Osler, the opinions of senior physicians, based on experience, were regarded as the gold standard on which clinical management was based. Even with the dramatic change in understanding and practice with the introduction of evidence-based medicine, controversies exist, because the evidence may be of doubtful quality and its circulation limited. Experts may disagree on the general values of the accumulated evidence and its application in an individual case. To transfer results from research to practice it is necessary to consider values important for the patient and those of the profession. Clinicians are obliged to find the best way to incorporate sometimes deficient knowledge generated by research with other forms of medical knowledge to choose the best option for each patient.

It is inevitable that controversy will remain in everyday clinical discussions as long as there are advances in medicine, for which the public and medical world continuously hope. Despite the introduction of the more measured era of evidence-based medicine, controversy should continue to stimulate us all to a critical use of our knowledge.

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Special Session
Varicose veins

3001.1

Clinical and ultrasound evaluation of the patient

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Learning Objectives:

1. To become familiar with the anatomy of the superficial venous system
2. To learn what significant reflux is
3. To learn tips and tricks of ultrasound examination

Incompetent valves in superficial, deep, and perforator veins result in venous hypertension in the lower extremity. Over 25% of the adult population has a detectable abnormality related to this process, most often varicose veins or telangiectasias. In 3--8% of the population chronic venous insufficiency results in swelling, pain, hyperpigmentation, dermatitis, and ulceration. Venous ulceration occurs in 3.5 per 1000 per year in patients older than 45 years, and is recurrent in 75%. The etiology of the valvular incompetence is multifactorial. The pathophysiology of the skin changes is not completely understood, but it is linked to the high venous pressures. Venous pressures may rise to over 80mmHg at the ankle in patients with severe disease. The volume of refluxed blood is also important in development of symptoms. Although the initial abnormality is located at the venous valve, the end organ that is damaged is the skin with the subcutaneous tissues. A classification has been developed to describe patients with chronic venous diseases (Table 1). A complex modification (Venous Severity Scoring) has been proposed that includes the degree of disability, severity of symptoms, and location and type of venous abnormality. Telangiectasias and reticular veins are so common that they are considered by many to be normal manifestations of aging. Incompetent small perforator veins result in dilatation of

the subdermal venous network. Telangiectasias are flat, red blemishes that blanch on pressure with slow return of color. When return of color is brisk, or the lesion is pulsatile, an arteriovenous malformation should be suspected. Reticular veins are small, superficial, thinwalled veins that lie close to the surface of the skin. Varicose veins are dilated, tortuous superficial veins that distend when the patient is upright and can cause aching. Rarely, varicose veins can rupture resulting in major hemorrhage. The dilated veins collapse and symptoms improve with elevation of the extremity. Valvular incompetence in the greater saphenous vein contributes to over 75% of varicosities, with isolated perforating vein incompetence accounting for the remainder. The characteristic skin changes of venous insufficiency are thickening, scaling, and brownish discoloration. There is almost always associated edema, and patients report itching and burning sensations. The color changes are largely irreversible. Lower-extremity venous ulcers are the most severe manifestation of venous valvular insufficiency. These lesions must be distinguished from arterial, traumatic and diabetic ulcers in order to initiate appropriate therapy. Venous ulcers are shallow, irregular, associated with characteristic skin changes, and are located in the medial aspect of the supramalleolar region. Incompetence of the deep and perforating veins, with or without saphenous vein reflux, is present in more than 80% of these patients. Isolated saphenous vein reflux is unusual in patients with advanced disease (skin changes and/or ulceration). Imaging of patients with chronic venous insufficiency is aimed at determining the location and extent of reflux. Ultrasound with Doppler and color flow is highly sensitive and specific (both 95%) for valvular incompetence. Identification of incompetent perforating veins is 80% sensitive but very specific. The examination is performed with the patient standing; otherwise, reflux can be missed. Maneuvers to induce flow reversal are important, and include Valsalva, an automated pressure cuff that inflates and deflates rapidly, or manual augmentation. The exam is easiest when the patient is standing on a dedicated platform that allows the examiner to sit or stand comfortably while interrogating the veins from the ankle to the groin. The greater saphenous vein (GSV), short saphenous vein (SSV), popliteal, femoral, and common femoral veins should be evaluated for patency and reflux. The GSV and SSV should also be examined for diameters, evidence of prior thrombophlebitis, and communication with the deep veins. Both the GSV and SSV insertions into the deep veins must be visualized. In women, veins that track into the ipsilateral introitus should raise the possibility of a pelvic contribution to the reflux. Segmental evaluation is important to localize the abnormal vein segments; thus, the entire length of the GSV, and the SSV to at least the lower border of the gastrocnemius muscle should be interrogated. Reversal of flow that lasts less than 0.5 seconds is normal. Flow reversal for 0.5--2 seconds is suggestive of valvular incompetence, while reversal for longer than 2 seconds is diagnostic. Dilated, incompetent perforating veins underlying venous ulcers may also be identified by US. Contrast venography currently has a limited role in the diagnostic evaluation of patients with chronic venous disease. Conventional ascending venography may be performed prior to intervention to localize incompetent perforating veins when US has been unsuccessful. A radiopaque ruler should be placed adjacent to the leg to permit precise localization of the venous abnormality. Descending venography can localize reflux and define the extent when US is unsatisfactory. Table 1: Classification of Chronic Venous Disease Class: 0= Normal, 1=Telangiectasias or reticular veins, 2=Varicose veins, 3=Edema, 4=Skin changes (pigmentation, venous eczema, lipodermatosclerosis), 5=Skin changes as above with healed ulceration, 6=Skin changes as above with active ulceration.

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Disclosure

Consulting: AGA, BIO2, Crux, Delcath, Hatch, EV3, Guerbet, Venti Grant support: NIH, Gore Speaker: Cook, Gore

3001.2

RFA: equipment, technical tips and tricks

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Learning Objectives:

1. To become familiar with the current RFA equipment
2. To learn about advantages of RFA
3. To learn tips and tricks from the expert

Background:

Endovenous ablation for varicose vein has become an accepted treatment for varicose veins. The concept is to treat venous reflux by occluding the insufficient varicose vein through heating from inside the vein. The obvious advantage over stripping is the minimal invasive approach allowing an outpatient treatment with nearly no recovery time. The technology is widely used in the United States. In Europe, the technology is less popular. The most likely reason for the difference is the lack of insurance coverage in most European countries.

There are two main technologies to apply heat to the vein wall: laser ablation or radiofrequency ablation. Both technologies showed excellent occlusion rates of over 90-95%. During the lecture the different RF technologies are described as well as the differences between f RF ablation and laser ablation.

Radiofrequency (RF) ablation techniques:

There are two different RF techniques. On one hand, the "classical" RF application during which the vein walls is denaturized by a current from a bipolar probe. The system is called Radio Frequency-Induced Thermotherapy (RFITT) from Olympus. The advantage of that system is the multifunctional use of the console also for other RF applications. More commonly RF waves were used to heat a 7cm element at the tip of a catheter. With this Closure Fast system from Covidien the vein is treated by simple heating without a current running through the vein wall. The concept is to sequentially heat the vein wall to 120 degree Celsius for 20 seconds. The temperature of the probe is held at 120 degree Celsius by changing the Wattage to the heating element. After each heating cycle the catheter is pulled back 6.5cm allowing a small treatment overlap to avoid untreated segments. In order to maximize success rate the most cranial segments are treated twice.

Differences of RF techniques compared to laser ablation:

One problem of endovenous techniques is the lack of a standardized heat application to the vein wall. The Closure Fast uses a clearly defined step by step treatment algorithm which allows a uniform heat application. Compare to the old Closure system the time required to ablate a certain vein length with the Closure Fast is much faster and similar to the time for laser ablation.

In order to make a new minimal invasive treatment option most attractive the discomfort during and after the treatment should be as low as possible. Comparative studies between RFITT and laser (Goode et al. Eur J Vasc Endovasc Surg 2010; 40(2):246-253), respectively Closure Fast versus laser (Almeida et al. JVIR 2009; 20:752-759)

showed less pain and less bruising after the procedure. The favourable effect lasted for about 2 weeks. No long-term differences were observed.
There are however also advantages for the laser ablation: in general, the one-way equipment is less expensive for the laser fiber compared to the RF probe. Also, the light at the end of the laser fiber can help to localize the fiber tip in addition to ultrasound guidance. The profile of the RF system is 6F, respectively, 7F compared to 4F of certain laser systems. The smaller profile may facilitate access and ease of advancing the system through the varicose vein.
Conclusion:
RF ablation and laser ablation have both excellent long-term results. The post-procedural discomfort (pain and bruising) seems less for RF ablation technique, but the question is does it justify the higher equipment cost?
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Almeida et al. JVIR 2009; 20:752-75.

3001.3

Laser: equipment, technical tips and tricks

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Learning Objectives:
1. To become familiar with the current laser equipment
2. To learn about advantages of laser
3. To learn tips and tricks from the expert

Lower extremity venous insufficiency is one of the most common vascular conditions encountered in the population at large. The estimates of the prevalence of this condition vary widely, and are generally in the range of 30% to 35% of women and 10% to 15% of men in Western society. Varicose veins are the most common presentation of lower extremity venous insufficiency. The most common cause of lower extremity venous insufficiency is reflux in the great saphenous vein secondary to a incompetent saphenofemoral junction. The treatment of varicose veins may be for either cosmetic or symptomatic reasons. The traditional historical treatment was surgical stripping and ligation with ancillary phlebectomy of tributary varicose veins. There has been significant evolution of the treatment of lower extremity venous insufficiency in the last 15 years, with the innovation of ultrasound-guided endovenous ablation for the treatment of axial vein insufficiency. More recently there has been considerable refinement in the technique of endovenous ablation and treatment of branch varicose veins with adjunctive sclerotherapy or microphlebectomy.
The first application of endoluminal laser was described by Dr. Bone in 1999. A technique for treating the entire incompetent great saphenous vein and eliminate venous reflux was first reported by Drs. Min and Navarro in 2001. Endovenous laser treatment (EVLT) acts by a mechanism of non-thrombotic venous occlusion of the target vein, by the delivery of laser energy into the vein lumen via a laser fiber. Lasers with wavelengths including 810 nm, 940 nm, 980 nm, 1040 nm, 1320nm and 1470 nm have all been used successfully for endovenous laser ablation. The key to a successful EVLT treatment is to maximize the contact between laser fiber and vein wall to create sufficient damage to the vein resulting in wall thickening, non-thrombotic occlusion, and eventual contraction and fibrosis of the treated vein. The indications for EVLT treatment include varicose veins causing symptoms despite conservative methods such as compression stockings and exercise; treatment or prevention of complications arising from chronic venous hypertension such as bleeding, superficial venous thrombophlebitis, venous dermatitis, venous ulcers and improvement of cosmetic appearance.
In the last 10 years EVLT has evolved into an accepted option for the treatment of underlying truncal vein reflux causing varicose veins. Patients with varicose veins should undergo a careful history, directed physical exam and duplex ultrasound imaging prior to consideration for EVLT. It is critical to determine the underlying source and pathophysiology of the varicose veins to create an anatomic map and proper treatment plan to ensure clinical success. There are no absolute contraindications for EVLT. The relative contraindications include absent pedal pulses limiting compression stocking use, liver abnormalities limiting local anesthesia administration, pregnancy, breast feeding, inability to ambulate, or uncorrectable coagulopathies. After a proper clinical evaluation and creation of a treatment plan, the patient is placed in a supine position for treatment of the great saphenous vein, or in a prone position for treatment of the small saphenous vein. In the majority of cases, the incompetent truncal vein is directly accessed using Seldinger technique and ultrasound guidance. Tributary veins may also be directly accessed, but are prone to venospasm and are more difficult to access and traverse with a guidewire. The target vein is usually punctured at the lowest or in the most distal segment where the vein is incompetent or dilated, for ease of access and to ensure the entire incompetent segment is treated. Venous access is obtained with a 19-gauge or 21-guage needle, using real time ultrasound guidance and single wall puncture technique. It is helpful to keep the procedure room warm and utilize reverse-Trendelenburg table position to maximize target vein distension and minimize collapse to ease venous access. Once venous access is obtained a 5 or 6 french vascular sheath is inserted over a .035 inch guidewire to the saphenofemoral or saphenopopliteal junction under real time ultrasound guidance. A bare tipped laser fiber is then inserted through the sheath to the distal tip of the sheath. The sheath is retracted and the laser tip is exposed and positioned 1 cm distal to the saphenofemoral or saphenopopliteal junction. Confirmation of the location of the tip of the fiber can be confirmed by direct visualization of the red aiming beam of the laser.
One of the key steps to the EVLT procedure is correct delivery of perivenous tumescent anesthesia. Tumescent anesthesia is a form of local anesthesia delivery, which utilizes large volumes of dilute anesthetic solutions permitting anesthesia of large areas. Proper application of tumescent anesthesia should eliminate any pain during laser activation. Tumescent anesthesia also acts to maximize safety and efficacy of the EVLT procedure. Proper delivery of tumescent anesthesia in the perivenous space will ensure apposition of the laser fiber to the vein wall and achieve circumferential contact between the vein walls and laser fiber tip. This will allow adequate transfer of laser energy to the target vein walls resulting in vein wall damage and subsequent fibrosis. The perivenous tumescent anesthesia surrounding the vein also acts as a protective barrier to prevent heating of non-target tissues, including skin, nerves, arteries or deep venous structures. After the administration of tumescent anesthesia, the positioning of the tip of the laser fiber at the superficial and deep venous junction is again confirmed and repositioned if necessary. It is absolutely mandatory that the tip of the laser fiber does not enter the deep venous system to prevent deep venous thrombosis. The laser is then activated as per the individual operator's settings and the vascular sheath and laser fiber are withdrawn as a unit. There are many different energy settings and energy deployment which are beyond the scope of this document. After the sheath and laser fiber have been removed a dressing is applied to the venous access site, followed by class II (30-40 mmHg) thigh high or pantyhose graduated compression stockings. The stockings are applied on the procedure table immediately the procedure, and before the patient gets up off the procedure table. The compression stockings should be worn from morning to night for two weeks after the procedure to prevent recanalization of the treated vein. Ancillary ambulatory phlebectomy or sclerotherapy may be performed immediately after the EVLT procedure or in a delayed fashion after several weeks to treat any residual branch varicose veins. Most patients will

note significant improvement in appearance and symptoms at 4 to 8 weeks after the procedure date.
Clinical success after EVLT is defined as permanent occlusion of the treated vein segments with successful elimination of related branch varicose veins and improvement in clinical symptomatology. Most patients will develop bruising of the overlying skin at the site of the EVLT treatment. This is of no clinical consequence and usually resolves in 1 to 2 weeks. Some patients will experience mild discomfort over the treated vein beginning hours after the procedure and resolving in 24 to 48 hours. Many patients will also note a delayed tightness and mild to moderate tenderness over the treated vein, particularly over the distal segment. This sensation described as pulling will usually start at the end of the first week after EVLT and resolve in 4 to 6 weeks. This delayed pain is most likely secondary to venous contraction and fibrosis as the treated vein undergoes permanent closure. Most patients are followed up with duplex ultrasound at 2 to 6 weeks after the procedure date to ensure the treated vein is closed. Most patients are also followed up at 6- or 12-week intervals after the procedure date to ensure the treated vein is closed and perform adjunctive procedures to treat residual branch varicose veins such as sclerotherapy or ambulatory phlebectomy.
A recent meta-analysis demonstrated an overall closure rate of the treated vein in the range of 93% at 3 months and 1 year, 95% at 3 and 5 years. Several studies have reported that EVLT is more effective than venous stripping and other endovenous procedures in terms of obliteration and very low recurrence rates in the range of 1-5%. Complications included pain, edema, erythema, bruising, hematoma, hypo- or hyperpigmentation, superficial thrombophlebitis and DVT. Bruising occurs in 40% of patients in the treated area with no medical consequence and resolves in 1 to 2 weeks. Moderate pain has been reported along the treated vein in up to 50% of patients over the treated vein within the first week of the procedure. Superficial thrombophlebitis has been reported in up to 12 % of patients with no long-term medical consequences. Transient paresthesia occurs in less than 10% of patients over the treated vein, and this usually resolves in 2 to 6 weeks. Deep venous thrombosis has been reported in the range of 1 to 5% after the procedure, usually resulting from extension of thrombus for the saphenous vein into the common femoral vein with no cases of pulmonary embolus reported to date.

3001.4

How to treat collaterals: phlebectomy? Foam sclerotherapy?

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Learning Objectives:
1. To become familiar with the different techniques of ancillary therapies
2. To learn when to use which technique
3. To learn tips and tricks from the expert

Endovenous ablation of various sorts (laser, RF) is now accepted as the gold standard treatment for venous insufficiency. Although in a minority the ablation of refluxing truncal veins is sufficient treatment in itself, most patients require or request additional adjunctive treatment to achieve a good and long lasting result.
It is vital that any doctor undertaking venous insufficiency treatments becomes familiar with and experienced in the various adjunctive methods available to deal with:
• Residual varicose veins after truncal ablation
• Incompetent perforator veins
• Thread veins
• Pelvic venous reflux
• Abnormal veins in other sites, e.g. breasts, hands

This talk will introduce the audience to the myriad of adjunctive techniques at the interventional radiologist's disposal including the use of:
• Compression hosiery/bandages
• Foam sclerotherapy
• Veinwave and superficial laser
• Microsclerotherapy
• Microavulsions
• Coagulum aspiration
• Pelvic venous embolisation
• RF/laser ablation of perforators

Compression hosiery/bandages: all patients having any type of venous treatment are required to wear compression hosiery for 2 weeks after treatment. This has to be class 2 and no expense should be spared sourcing good quality stockings as the most frequent complaint is of the discomfort of the stockings. Compression stockings alone are an unsatisfactory treatment but their use can be helpful in determining if venous ablative treatment is likely to help symptoms if these are atypical of venous disease.
Foam sclerotherapy: foam sclerotherapy using either polidocanol or STD mixed by use of a three-way tap between two luer loc syringes is a very effective means of ablating branch varicosities. Some practitioners use foam sclerotherapy as a primary treatment for truncal vein ablation but the author is of the view that laser or RF provides a simpler quicker and more durable result for this application.
Veinwave and superficial laser: veinwave is a very effective treatment for small red thread veins especially on the face and to a lesser degree on the legs. The author considers superficial laser treatment for thread veins to be less satisfactory than microsclerotherapy.
Microsclerotherapy: The use of injection of 0.2% liquid STD is the treatment of choice for thread veins on the legs. It is injected in small quantities through a 30G needle.
Microavulsions: Microavulsions using cheap disposable vein hooks and mosquito forceps are an excellent means of removing branch varicosities. It can be undertaken without significant discomfort using tumescent local anaesthesia. The author usually undertakes this at follow-up visit but it can be done at the time of the EVLA or RF ablation if only one leg is treated. With EVLA of both legs, the dose of local anaesthetic is too great to allow both EVLA and microavulsions at the same visit.
Coagulum aspiration: The use of a large bore cannula to aspirate retained coagulum is useful in some patients to minimise discomfort and skin staining after foam sclerotherapy.
Pelvic venous embolisation: Embolisation of the ovarian and internal iliac branches which supply leg varices is a useful technique but is rarely required.
RF/laser ablation of perforators: Either laser or RF can be used to ablate incompetent perforators which are a frequent source of varices or truncal reflux. It is undertaken under tumescent anaesthesia.
We will also look at the important adjunct of how to market a vein treatment service and how to reduce costs of supplies.
A large list of necessary equipment that is useful as follows:
10 MHz linear portable ultrasound scanner, RF generator, diode laser generator 810 nm 15 watts, Veinwave generator, laser ablation kit, 0.035" hydrophilic guide wires, occlusion balloon catheters, RF catheter kit for perforators, 7fr vascular sheath, micropuncture kit, 3 way tap, luer loc syringes 20 and 5 ml, spinal needles, butterfly cannulae 21 g, N saline, mosquito forceps, disposable vein hooks, gauze swabs, 14G cannulae, sterile US gel, size 11 blade, large sterile patient drape, sterile scissors, disposable underwear, 1% lidocaine 5 ml, lignocaine 2% with adrenaline 20 ml, STD 0.2, 0.5, 1, and 3%, Diclofenac 100 mg slow release tablets, skin prep e.g. Videne, and cohesive 4" limited stretch compression bandages.

Disclosure
I am a share holder in SDL medical a laser supply company.

Special Session
Percutaneous treatment of chronic back pain

3002.1

MR imaging of back pain

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Learning Objectives:
1. To present imaging features and correlation to disease
2. To discuss advantages and disadvantages of MR versus CT
3. To discuss the potential advantages and disadvantages of dynamic and load bearing imaging

Back pain is a common problem of chronic disability in working population affecting two thirds of adults during their lifespan.
In terms of anatomy, the discovertebral junction consists of the end plate- disc- end-plate joint of the anterior column and the two facet joints of the posterior column, strengthened by ligaments and muscles. The intervertebral disk is composed of an outer ring the annulus fibrosus and an inner ring the nucleus pulposus. The annulus fibrosus is composed of dense fibrous lamellae and fibroblasts which account for T2 hypointensity. The nucleus pulposus consists of collagen and proteoglycans that create the central T2 hyperintensity of the normal disk. There is rich innervation of the peripheral layers of the annulus fibrosus, the vertebral end plates, the facet joints and ligaments, whereas the inner part of the disk lacks vascularity and innervation. Consequently, the disk itself does not incite pain, but may lead to pain by stretching of the outer layer or the ligaments or by nerve compression and inflammation.
Hydration of the disc and annular integrity are important for absorption and transmission of loads to the vertebral column; disc degeneration, with preceding age, leads to loss of these capabilities. MR imaging can assess disc degeneration of variable stages by means of disc signal and morphology on T2-weighted images. Loss of the integrity of the annulus fibrosus results in outward expansion disc material, i.e. bulging, protrusion, extrusion and sequestration The term herniation is defined as the displacement of disc material beyond the normal margin of the intervertebral disc space and has been used interchangeably with extrusion and protrusion. Annular fissures may extend radially or concentrically and involve one or more layers of the annulus. Annular fissures may provoke pain by mediating inflammatory response or be completely asymptomatic. A herniated disc may have no contact with nerve roots, thus not inducing pain, or be in contact and cause deviation or compression of the nerve root with neurologic symptoms and pain.
Changes of bone marrow adjacent to the endplate of degenerated discs are common. On MR imaging these changes have been classified by Modic into three types: type I (inflammatory), type II (lipid) and type III (sclerotic). Type I changes are associated with stress, instability and pain and may convert to type 2 or normal. Change of type 2 to type 1 may indicate accelerated degeneration or superimposed pathology such as inflammation.
Degeneration of the facet joints can be a source of pain either by irritation of pain fibers from the joint capsule or by nerve root compression.
Degenerative changes of the disc and facets cause stenosis of the spinal canal, lateral recesses and neural foraminae. Spinal canal stenosis and spinal lateral recesses are optimally assessed on axial images, whereas sagittal images are very helpful for the evaluation of neural foraminae.
Alignment abnormalities, including spondylolisthesis and scoliosis are common sequelae of degenerative disc disease. Spondylolisthesis is most common at L4-L5 level and is due to more sagittal orientation of the facet joints at this level.
MR imaging, including T1, T2 and short-tau inversion recovery imaging, is the method of choice for the assessment of degenerative spine disease. Dynamic MR imaging has been proposed as complementary to standard supine MR imaging providing more functional than strict anatomic information. Dynamic imaging can be performed in an upright open MR system that allows flexion and extension, or in the supine position with axial loading. Dynamic MR has been employed to diagnose occult herniation, assess motion between spinal segments and evaluate canal or foraminal width under axial loading. However, the impact of dynamic MR imaging on therapeutic decisions needs further evaluation.
Back pain is generated by three mechanisms which, most often, act in combination: instability with facet arthropathy, mechanical compression of nerve root or by biochemical mediators of inflammation that induce pain. Disc degeneration itself does not cause pain and does not have any predictive value for future development of symptoms. Patients may complain of back pain without significant abnormalities on MR imaging and vice versa. Neural compression correlates with pain more than morphologic alterations of the disk does. Modic et al have found that one-third of patients with disc herniation have significant reduction over six weeks and two thirds over six months, findings that apply to the conservative management of spinal stenosis.

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3002.2

Back pain and sciatica: what can we offer?

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Learning Objectives:
1. To describe possible techniques of treatment for disc disease
2. To correlate clinical and imaging findings to treatment
3. To review and present recent studies on percutaneous disc treatments

No abstract available.

3002.3

Facet joint syndrome: definition and treatment

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Learning Objectives:

1. To present imaging features that differentiate facet from disc disease
2. To present different treatment for facet disease
3. To present patient management and review literature

Facet joints are a very common but underestimated source of pain. A recent study showed that facet joints are responsible of at least 31% of cases of low back pain. Facet joints are responsible of a well-defined syndrome that can be diagnosed by detailed history and physical examination. However, establishing a diagnosis of facet syndrome is difficult because findings are nonspecific; moreover, the assessment of the role of facet joints in low back pain is difficult because usually pain depends on more concomitant factors. Lumbosacral facet syndrome is characterized by low back pain that may radiate to the buttock and posterior thigh, without a precise dermatomeric distribution. Pain typically does not radiate below the knee. The pain is usually worst in the morning and it is exacerbated by rest, hyperextension and torsion movements. Imaging can show facet joint osteoarthritis and sings of instability; however, a mismatch between clinical and imaging findings is frequent. Several interventional procedures have been developed for the management of facet syndrome; they can be divided into joint injections and medial branch of the dorsal ramus nerve block procedures. Intra-articular facet joint injections have a diagnostic and therapeutic role. Diagnostic injection of local anaesthetic is performed to confirm the clinical diagnosis of facet syndrome. If the joints are the source of pain, the patient experiences rapid pain relief after the injection. For therapeutic injection a long acting steroid is added to the anaesthetic to produce more durable pain relief. The technique of facet injections is easy and this procedure can be safely performed on outpatient basis. The contraindications are referred allergy to the proposed drugs and uncorrected haemorrhagic diathesis. The procedure can be performed under fluoroscopic or CT guidance; the choice mostly depends on individual preferences of the operator and equipment availability and no outcome differences have been observed. However, fluoroscopy is usually faster than CT guidance, especially is multilevel injections are needed. Otherwise, CT-guided injections are easier to perform and avoid operator exposure. When using a C-arm or an angiography system, fluoroscopy-guided injections are performed with the patient in the prone position. The target joint is localized and the tube is angled laterally since the posterior opening of the facet joint as 2 parallel lines. Since facet joint is a curved structure, access can be difficult if the tube is too much angled, because the anterior opening can be imaged and confused with the posterior opening. A 9-cm length 22-G spinal needle is directed toward the posterior opening of the joint or toward the inferior recess and local anaesthetic is injected along the course of the needle. This step can be performed without live fluoroscopy and spot images are needed only to check the needle position. When the needle is close to the joint, live fluoroscopy can be useful to enter the narrow joint; however, the needle can be directed simply by tactile sensations. When the needle enters the joint loss of resistance is often felt. Contrast agent injection is useful to confirm the intra-articular position of the needle. Then, 0.5 ml of local anaesthetic and 0.5 ml of a long acting steroid are injected inside each joint. We usually inject bupivacaine and triamcinolone acetonide. If the procedure is performed only for diagnostic purposes, 1 ml of anaesthetic is injected. This amount of injected substances should not be exceeded because the capacity of a lumbar facet joint is 1.0-1.5 ml: excessive intra-articular injection can result in capsular damages. The procedure can be easily performed under CT-guidance. With the patient in the prone position, 3-mm thickness images are obtained to determine entry site and angle of approach. The needle is advanced toward the posterior opening of the joint by a paravertebral oblique or vertical approach (depending on the obliquity of the joint rim). Contrast injection is not needed because CT images clearly show if the tip of the needle is intra-articular. CT-guidance is very useful in case of very narrowed joints or in the presence of large osteophytes obscuring joint access. The site and number of joints treated depend on the side and the level of the symptoms; however, it is difficult to precisely localize the pain to one level, so in most of cases we treat in the same session L3-L4, L4-L5 and L5-S1 joints bilaterally. Some physicians inject the steroid-anaesthetic mixture at periarticular level, arguing that the efficacy of this procedure is comparable to intra-articular injections. There is disagreement as to whether intra-articular injection is preferable to periarticular injection. However, there is no reported evidence that the efficacy of these two different approaches is the same. The efficacy of facet joint injections has been validated by many studies showing that this procedure offers pain relief in 40-54% of patients at 6-month follow-up, even if the efficacy of the procedure is lower at longer follow-up clinical evaluations. However, the true efficacy of facet joint injections is uncertain and is still debated. The reasons are the different technical approaches adopted in the published series and the often criticisable patient selection. Some published studies include patients merely complaining of low back pain, without differencing patient with clinical findings of facet syndrome. Therefore, in our opinion the key for a good success of this procedure is clinical patient selection. A recent study reported that the outcome of the procedure is significantly higher if patients are selected by means of bone scintigraphy with SPECT. A promising and interesting innovation is the intra-articular injection of sodium hyaluronate in the facet joints, as well established for other synovial joints. This treatment seems to be more effective than steroid injections, especially in the long term. Sometimes imaging shows facet joint synovial cysts at the anterior aspect of the joint; the cysts can be responsible of radicular compression and related symptoms. The same technique described for facet injections can be used for the management of the cyst. Intra-articular-injected contrast agent usually fills the cyst because of a patent communication, therefore the cyst can be aspirated and steroids injected for pain relief. Medial branch nerve block techniques have been proposed as a valid alternative to joint injections for the management of facet syndrome. All these procedures are based on the denervation of the facet joint to achieve pain relief. The medial branch of the dorsal ramus of the spinal nerve root innervates two adjacent facet joints. Branches from one nerve root innervate both the level of the exiting root and the next lower level (i.e. L4-L5 facet joint is innervated by branches from the medial branch of both L4 root and L3 root). Therefore, denervation of a single facet requires block of medial branch at the same and at the upper level. Medial branch block can be obtained by simple perineural injection of steroids and anaesthetics but the results of this procedure are similar or lower than intra-articular injection. Alternatively, rhizotomy can be induced by alcohol injection or radiofrequency denervation. The site of rhizotomy is the notch between the transverse process and the superior articulating process. To achieve chemical denervation, 1.5 ml of 95% ethanol is usually injected for each level. Medial branch block can be performed under fluoroscopic or CT guidance; however, CT should be preferred whenever it is possible because it ensures precise needle positioning. Denervation is usually temporary but it can be permanent after alcohol rhizotomy. Radiofrequency rhizotomy provides some short-term improvement in pain and functional disability but in the long-term the efficacy of this treatment is still controversial and success rates range from 11 to 78%. Recently, percutaneous kryorhizotomy has been proposed as a new procedure to achieve facet denervation. In this procedure, a 1.3-mm device is positioned under imaging guidance in the site of the medial branch. CO_2 inflation

for two minutes creates a frozen area at the probe's tip producing rhizotomy. Denervation is temporary and pain reduction is observed in 50% of cases after 6 months and 40% after 12 months. Finally, very recently, focused ultrasound MR-guided interventions had been also proposed. The preliminary results confirm that this new approach could be promising and even easier than those previously reported.

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3002.4

Sacroiliac joint syndrome: definition and treatment

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Learning Objectives:

1. To describe pertinent anatomy and distinct clinical features
2. To show possible treatments
3. To review literature and show possible future developments

Clinical diagnosis:

Sacroiliac joint pain (approx. 25% of patients with lower back pain) is clinically characterized by pain exacerbated upon putting strain on the supporting ligaments and joint space and is typically localized over one or both SI-joints. However, often diagnosis is made by exclusion of a variety of other possible causes of lower back pain. In selected cases, MRI is helpful in detecting early sacroiliitis as it is essential for the exclusion of other possible causes of lower back pain. Nervous structures innervating the SI-joints belong to the lateral branches of the posterior primary rami from L2 to S3; however, large variations of patterns have been described.

Rationale:

Pathophysiologic basis of SI-joint pain include a variety of entities such as inflammatory arthritis, degenerative processes, fractures or benign and malignant tumors. If all other causes are excluded by clinical and imaging findings, symptomatic treatment (i.e. SI-joint-injections) can be considered. Para- or intra-articular injections do have a diagnostic value (i.e. to confirm or exclude SI-joint-syndrome) and if successful, thereafter a therapeutic role which can be temporary or potentially definitive. Temporary effect is provided by a mixture of local anesthetics with steroids, while definitive treatment can be achieved using thermoablation.

Technique:

SI-joint-injections can be performed through a dorsal approach guided by fluoroscopy or preferably by low-dose CT. Two different locations have been described: the medial border of the SI-joint or the demitting S1-3 foramina. In cases of inflammatory SI-joint-disease, intra-articular injection is possible. Usually, after confirmation of correct needle placement using small amounts of contrast media, 40 mg triamcinolon followed by 2 ml of a combination of 1.5 ml 0.5% bupivacain and 0.5 ml contrast is used for the treatment. Image documentation of needle position prior to injection, of contrast media depot at the desired location as well as final documentation is mandatory for all interventions.

For definitive neuro-ablation, radio-frequency-ablation can be performed using standardized protocols similiar to those used in facet joint ablation (80°C for 60 sec). A prolonged improvement of pain (up to 12 months) can be anticipated if intervention is properly performed.

In cases of symptomatic osteoporotic sacrum fractures or tumor infiltration of the sacrum or the SI-joints, CT-guided cement-injection (i.e. sacroplasty) with or without thermoablation of the tumor might be indicated. Careful evaluation of neuroforamina is important to avoid neurologic complications. Therefore, CT-guided intervention is by far superior to fluoroscopic-guided intervention.

Results:

In our experience, diagnostic infiltration of symptomatic SI-joint do have a significant impact on patient management in up to 50% of patients with suspected SI-joint pain. Repeated infiltration with bupivacain and steroids in selected patients is performed.

In cases of symptomatic tumor infiltration of the sacrum and/or SI-joints, as with osteoporotic sacrum insufficiency fractures, clinical results are excellent with often dramatic improvement of pain.

Conclusion/take-home-points:

1. SI-joint often cause of lower back pain (LBP).
2. Clinical evaluation essential to rule out other causes of LBP.
3. SI-joint-injections has often diagnostic rule.
4. Temporary or definitive pain improvement can bee achieved by SI-joint-injections and/or RFA.
5. Scaroplasty is highly effective in osteoporotic or tumorous sacrum fractures.

Special Session
Vascular malformations

3003.1

Classification of vascular tumours and malformations

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Learning Objectives:

1. To describe the classification of vascular tumours and malformations
2. To review the indications for treatment of vascular tumours and malformations
3. To review the contra-indications for treatment of vascular tumours and malformations

Vascular malformations and vascular tumors are grouped under the name of vascular anomalies. Many different nomenclatures have been used in the past attributing to confusion and misunderstanding about the nature of this disease entity. The clinical and biological classification as proposed by Mulliken and Glowacki in 1982 and adopted by the ISSVA (the international society for the study of vascular anomalies) offers a simple way of classifying the different entities and has been widely accepted as the standard. According to Mulliken and Glowacki vascular anomalies are divided into vascular tumors and malformations.

1. Vascular tumors are tumors with rapid disproportional growth and can further be subdivided in haemangioma (infantile haemangioma (classic type, not present at birth) and congenital haemangioma (present at birth and further subdivided into NICH (non-involuting congenital haemangioma) and RICH (rapid involuting congenital haemangioma) and rare congenital tumors like tufted angioma and kaposiform heamangioendothelioma). The infantile haemangiomas

appear after birth, exhibit a proliferation phase, followed by a plateau phase and finally an involution phase. The whole cycle can take up to ten years. In principle, haemangiomas will regress spontaneously. Treatment is only indicated when complications occur (bleeding, ulcers etc). The congenital haemangiomas are present after birth. The clinical picture resembles infantile haemangiomas; however, the proliferative phase seems to have taken place in utero.
2. Vascular malformations can be further subdivided into high flow and low flow malformations
2a. Low flow malformations - capillairy malformations - venous malformations - lymphatic malformations (micro and macrocystic) - mixed malformations
2b. High flow malformations - arterio-venous malformations - arterio-venous fistula.
Both high and low flow vascular malformations can be seen in combination with other anomalies in several syndromes (Maffucci, Blue-rubber bleb nevus syndrome, Klippel-Trenaunay syndrome etc.) The clinical picture of high and low flow malformations is quite different. The low flow venous malformation for instance is characterized as a soft easy compressible swelling and if located superficial often a blue discoloration of the skin is noted. On plain X rays sometimes phleboliths are found. If present they might be an indication that a consumption coagulopathy is present and further blood testing of fibrinogen and D-dimers is indicated. The high flow malformations on the other hand exhibit as a pulsating mass, and often on auscultation a bruit is heard. The swelling can be painful. Necrotic areas can develop and if shunting is high cardiac complications can develop. Imaging of vascular malformations should be directed by clinical assessment of the type of malformation to be expected, clinical symptoms and need for treatment. Imaging needs to be tailored to the individual patient although general rules can be applied. Duplex ultrasound together with a clinical assessment is often sufficient to make a proper diagnosis. This is especially true for the pediatric population. If more information about extent of the lesion is needed MR is often used in case of low flow lesions (venous/lymphatic) and MRA or CTA in case of high flow lesions. Angiography is always needed if a AVM is diagnosed and treatment is planned. High frame rate imaging and selective injections are the only option for a proper evaluation of the nidus architecture of the AVM. Exceptions to these general rules however can be necessary. It is further essential to realize that this is a difficult to treat disease entity. Although it is a benign disease patients can often not be treated curatively. Involvement of other disciplines is often needed. A long time commitment should be offered to the patient. This can only be realized if the interventional radiologist is a member of a vascular malformation team. If such a team is not present patients should be referred.

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3003.2

High flow vascular malformations: how I do it

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Learning Objectives:

1. To review the technique of embolization in high flow AVM
2. To review the results of embolization in high flow AVM
3. To review the complications of embolization in high flow AVM and how to minimise them

• All AVMs are present at birth but only 40% are clinically apparent at this time.
• An increase in size during childhood, and especially around puberty, is common and many individuals present at this time because of the increasing prominence of the malformation which may be associated with new or worsening symptoms including pain, ulceration and haemorrhage.
• Progression of high flow malformations may also occur in response to pregnancy or trauma, which may be accidental or iatrogenic; for example, proximal surgical ligation or embolization of feeding arteries; and subtotal resection.
• On clinical examination a pulsatile soft-tissue swelling if usually evident with prominence of draining veins.
• The differential diagnosis of a vascular soft tissue tumour should be considered although a history of a long-standing, pre-existing swelling or the clinical finding of an associated overlying cutaneous stain will help make the diagnosis.
• Magnetic resonance imaging is the modality of first choice to demonstrate the extent of the AVM and MR angiography may be helpful to document its angiographic anatomy.
• Not all arteriovenous malformations require treatment.
• The most important aspect of embolization of these malformations is an understanding of the anatomy of vascular communications within them as these have a bearing both upon the method of vascular occlusion and on the final result.
• High-flow lesions are best classified according to their angiographic anatomy as this has a major bearing on treatment approach and outcome.
• AVMs with an arterio-venous and arteriolo-venous angiographic anatomy generally respond very well to embolization and are often best treated via a direct puncture or retrograde venous approach; AVMs with an arteriolo-venulous angiographic anatomy are the most difficult lesions to treat by embolization although many of these will contains some arteriolo-venous components, the treatment of which may improve symptoms.
• The general principle of embolization is that occlusion is performed at the site of the abnormal arteriovenous shunts and not in the vessel proximal to this point.
• The embolization of arterial feeding vessels, which was performed for many years with metallic coils or particulate matter, is akin to proximal surgical ligation and must be avoided. It has little effect upon symptoms in most individuals and renders subsequent treatment more difficult because the arterial inflow vessels have been occluded.
• If the embolization is directed, however, at the AV communications from an arterial approach, via a direct percutaneous puncture or retrogradely from the venous side, and these are totally obliterated – often with a liquid embolic agent – then a long-term improvement in symptoms can be achieved.
• AVMs with a largely intraosseous component are especially well suited to treatment by embolization; these are usually best approached by a direct puncture of the dilated venous component of the malformation within the bone.
• The cure of a high flow vascular anomaly is uncommon although there is no doubt that radiological and clinical obliteration of more malformations has come with a better understanding of their radiological anatomy and the use of agents that are directed at the AV shunts themselves rather than at the proximal feeding vessels.
• Long-term symptomatic improvement is achieved in the majority of individuals.

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3003.3

Low flow vascular malformations: how I do it

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Learning Objectives:
1. To review the technique of embolization in low flow AVM
2. To review the results of embolization in low flow AVM
3. To review the complications of embolization in low flow AVM and how to minimise them

Low flow vascular malformations are the commonest lesions encountered in the vascular malformation field. According to the Mulliken and Glowacki classification first proposed in 1982, the umbrella term of vascular anomalies is divided into two distinct categories: haemangiomas plus other vascular tumours, and vascular malformations [1]. Vascular malformations are further categorised by vessel or channel type: venous, lymphatic, capillary, arterial, or mixed. Venous, lymphatic and capillary malformations are typically considered to be low flow lesions, while arterial malformations are high flow.

Capillary malformations, such as port wine stains, are very common but there is very little role, if any, for interventional radiology in their management. Although arterial malformations (true 'AVMs') are frequently discussed in the literature and attract a great deal of attention, venous and lymphatic malformations are seen far more commonly, and are usually more straightforward to treat. The remainder of this abstract will discuss only venous (VM) and lymphatic (LM) lesions.

Patients with all but the simplest of low flow lesions should be managed by a multidisciplinary team [2]. This should include interventional radiology (IR), plastic surgery, orthopaedics, dermatology, and haematology where necessary. In particular, LMs have a preponderance for the head and neck region, and complex lesions often require airway management by an ear, nose and throat (ENT) specialist. Ultrasound (US) is useful in patient assessment, particularly in paediatrics where most lesions are superficial. In almost all cases, US allows a distinction to be made between LM and VM. Most lesions also require MRI, which allows accurate delineation of the lesion, and assessment of potential complications such as joint involvement and airway compromise.

Patient selection for treatment should be made in conjunction with the multidisciplinary team. Considerations include pain, disability or dysfunction, cosmetic issues and complications such as recurrent infection in LMs. The expectations of the patient and family should be actively managed, as many patients expect a complete cure and this is rarely possible. Most macrocystic LMs will respond well to one or more sclerotherapy procedures but most other lesions require long-term management; treatment should be seen as part of the management of the malformation rather than a cure.

Most sclerotherapy procedures are performed under general anaesthesia, as injection of sclerosant is often painful and some procedures can be lengthy.

Venous malformations:

The treatment of choice for VMs is almost always sclerotherapy [3-6]. There are a variety of agents available but the commonest is sodium tetradecyl sulphate 3% (STS). Alcohol is an alternative agent but is very aggressive in its effects and is associated with higher complication rates; success rates do not seem to be better than with STS. The lesion is usually approached percutaneously, under US guidance. A two-needle technique is advocated, particularly for lesions with slow venous outflow, allowing an escape route through the second needle when contrast or sclerosant is injected through the first needle, and thereby minimising the risk of extravasation. If using foam, the first few needles should be placed deep within the lesion so that the foam does not obscure the whole lesion for subsequent US-guided needle placement during the procedure. Contrast is then instilled via one or both needles under fluoroscopy guidance, to delineate the lesion and allow assessment of outflow. Opacification of large outflow veins, particularly if they are part of the normal deep venous system, should warn the operator not to proceed or to apply a tourniquet above the lesion where possible, to occlude outflow. Note that obstruction of outflow increases the risk of extravasation of sclerosant around the lesion and the serious risk of arterial reflux of sclerosant, which should be avoided at all costs. With or without a tourniquet, fluoroscopy techniques should be optimised so that any trace of arterial reflux is seen early and the sclerosant injection halted, so that the risk of non-target sclerotherapy is minimised.

STS should be opacified with contrast. Many operators advocate mixing STS with air (STS:contrast:air = 2:1:1) to create a foam solution. This acts to displace the blood within the lesion, rather than mixing with it, so that sclerosant contact with the entire endothelium is maximised. Sclerosant is instilled until there is some resistance to injection or until the lesion is well filled. This often requires several injections at various sites within the lesion, and on each occasion the same meticulous procedural steps should be followed. The total dose of STS should not exceed 0.5ml/kg, or a total dose of 20-30ml per session, and is often lower. Operators should be wary of the effects of local swelling, which can be considerable with STS, and consider multiple sessions, each with a lower dose of sclerosant, so that swelling is manageable and patient compliance with treatment increased. This is particularly the case with facial lesions, where bruising and swelling are considerable, and lesions affecting joints, where swelling can cause pain and decreased function in the post-operative period.

Most operators advocate post-operative compression of the malformation for several days, using either a simple bandage or a compression garment, which should have been fitted for the patient prior to treatment. Urine may be discoloured for up to 24 hours post-treatment and active hydration should be encouraged. Patients should be warned that the lesion will appear much worse for 7-10 days post-treatment; children, in particular, should be prepared for this, as it can be distressing. Regular analgesia may be required, although the visual effects are often worse than the symptoms.

The two major complications of sclerotherapy are skin breakdown and nerve damage. Skin breakdown occurs either due to the sclerosant infiltrating skin that is already affected by the malformation and therefore thinned and fragile. In such cases, superficial injections should be avoided if possible. Soft tissue breakdown can also occur secondary to arterial reflux of sclerosant, which is carried to normal tissues adjacent to or distant from the lesion; the results of this are unpredictable and can be severe. Several mechanisms have been proposed to account for nerve damage. This complication has been documented with most agents. Possible mechanisms include direct effects of sclerosant on adjacent nerves, irritation of nerves by surrounding inflammation and compartment syndrome. In many cases, nerve injury resolves, but permanent loss of function can occur.

Outcomes of venous sclerotherapy are relatively poorly documented in the literature and vary significantly in such a heterogenous population [7-9].

Lymphatic malformations:

Sclerotherapy of LMs is usually more straightforward. The risks of complications are less, because the malformation does not communicate with the normal venous system and non-target sclerosant is therefore not a significant risk. Technique and outcomes depend to

some extent on the agent used and the morphology of the lesion. In general, macrocystic lesions respond better to sclerotherapy than microcystic lesions. Sclerosing agents for LMs include STS, doxycyclin, OK432 and bleomycin. Some agents, such as OK432, act by inducing sterile inflammation within the lesion over several days or weeks, leading to progressive scarring and shrinkage of the cysts [10]. Others, such as STS, act in a similar way to venous sclerotherapy, causing immediate endothelial damage. The former agents simply need to be instilled into the lesion as part of a very quick and simple procedure, while the latter agents often require techniques such as changes of posture during the procedure, extended dwell times and repeated instillation/drainage of sclerosant in order to maximise endothelial contact with the drug.

Most lesions are accessible percutaneously. When treating macrocystic malformations, a single needle is placed into the lesion under US guidance; usually a 21G needle will suffice, although some cysts may contain thick debris or haematoma from recent intralesional bleeds or infections, both of which are recognised sequaelae of LMs. The largest cysts should be drained to dryness, though care should be taken not to lose access to the lumen of a completely collapsed cyst. The sclerosing agent is then instilled, almost always in smaller quantities than the volume of fluid initially aspirated. The dose depends on the agent used. Operators vary as to whether they use fluoroscopic screening during injection; in my practice, this is not considered necessary, as instillation of sclerosant can be followed clearly on US and non-target sclerosant should not be an issue, as the lesion is not in communication with the venous or arterial system.

In general, sclerotherapy of microcystic lesions does not have as good outcome rates as macrocystic disease. The principle of sclerotherapy is to try to access the largest of the cysts with a small gauge needle and instil the agent slowly so that the drug percolates through the lesion, as most of the cysts communicate. In practice, it often involves bathing the whole area in the drug with inevitable extravasation of sclerosant. Therefore, potent agents such as STS and alcohol should be avoided.

Most agents cause some degree of post-treatment bruising and swelling. This can last 1-2 weeks. When treating peripheral lesions, this is not clinically significant but swelling of head and neck lesions can lead to airway compromise and these patients should be actively managed on an appropriate clinical ward.

Complications include post-treatment infection, which usually requires just a 5-day course of oral antibiotics, and intralesional haemorrhage, which causes sudden swelling and bruising and can be uncomfortable. Neither complication appears to have a negative effect on the outcome of sclerotherapy. Potent sclerosants such as STS and alcohol are at risk of causing localised skin breakdown.

Outcome rates of lymphatic sclerotherapy vary between agents [11-13]. In general, macrocysts respond better than microcysts. Outcomes appear, in some specific instances, to be site-dependent; orbital LMs appear to respond well to sclerotherapy, while tongue involvement does not usually respond adequately. Complex lesions often have a fibrous component and adjuvant surgery is often needed.

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3003.4

Vascular malformations in children

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Learning Objectives:

1. To review the clinical and anatomical features particular to paediatric vascular malformation
2. To review the indications and technique for embolization of paediatric vascular malformation
3. To review the results, complications and follow-up strategy post embolization of paediatric vascular malformation

LYMPHATIC MALFORMATIONS (LM):

Genetics

Multiple genes have been described in the process of lymphangiogenesis including, VEGFR3, VEGFC and Ang2, Lyve1, Nrp2, podoplanin.

CLINICAL FEATURES

Lymphatic malformations appear as soft non-pulsatile masses with normal overlying skin present at birth or in early childhood. Prenatal ultrasound can detect macrocystic lesions in the late first trimester. LMs not diagnosed prenatally are generally evident at birth or before the age of 2. LMs occur in the head and neck in 48%, trunk and extremities 42% and intra-thoracic or intra-abdominal viscera in 10%. They can be associated with overlying angiokeratomas which at intervals may bleed or become infected.

Macrocystic LMs are generally defined as lesions containing cyst spaces greater than 2 cm and microcystic as cysts less than 2 cm.

RADIOLOGICAL FEATURES

Ultrasound

Macrocystic LMs appear on gray scale as anechoic cavities with possible internal septa and debris. Microcystic lesions have small

cavities resulting in innumerable reflective interfaces and hyperechoic appearance giving the lesion a more solid appearance.

Computer tomography

LMs appear as fluid-filled low attenuation masses, occasionally with fluid-fluid levels that can represent acute or sub-acute bleeding. Peripheral contrast enhancement of the walls may occur. The internal septa are generally not well seen. The role of CT in these lesions should generally be reserved for acute lesion enlargement and secondary compression.

Magnetic resonance imaging

Lymphatic malformations appear as multi-cystic masses that insinuate between tissue planes. These lesions demonstrate predominantly fluid type characteristics on all MRI sequences (low signal on T1 and high signal on T2 sequences) with varying degrees of septation and fatty elements. Microcystic lesions demonstrate intermediate signal intensity on T1 and T2 spin echo sequences.

MRI is an excellent modality to assess lesion extent in terms of tissue planes, airway compression, mediastinal extension and potential solid organ and bone involvement. It is also the modality of choice for orbital lesions and optic nerve assessment.

Treatment

Despite the high rates of recurrence/residual disease (25 to 52%) and complication rates of 12.5-44% surgical excision has been historically considered the main treatment of choice for lymphatic malformations.

To date there have been no prospective randomized trials comparing the sclerotherapy agents currently in use. Different sclerosing agents have been used effectively including: doxycycline, ethibloc, absolute alcohol, sodium tetradecyl sulphate, OK 432 and bleomycin. Percutaneous sclerotherapy has proven to be an effective treatment using these agents with excellent response rates ranging between 20% and 64%.

In addition, overall complication rates are reported in a number of series to range from 2 to 22% and include skin ulceration requiring skin grafting, loss of vision resulting from an infected corneal ulcer, scarring, airway obstruction, and nerve damage.

In general, macrocystic lesions are more responsive to any sclerotherapy agent than microcystic or mixed lesions with reported response rates between 88 and 100% reported using agents such as ethanol, doxycycline, OK432 and sodium tetradecyl sulphate.

Microcystic lesions are a challenge to treat and generally require multiple therapies. Agents such as sodium tetradecyl foam, doxycycline (bland or foam) and bleomycin have been directly injected into these lesions with response rates reported between 55.7% and 100%. Response rates for OK432 in microcystic disease have also been reported as 68% as compared to 90-100% with single cyst and macrocystic disease.

Due to the high incidence of spontaneous infection together with an increased risk upon accessing the lesion, prophylactic antibiotics have been recommended immediately before sclerotherapy of lymphatic malformations.

Doxycycline

Doxycycline can be injected directly into the lesion or via a catheter and is generally instilled at a concentration of 10mg/ml for 1-3 treatments for consecutive days with an instillation time of 1-6 hours. Absolute ethanol has been used in the same mechanism. Doxycycline tends to have less neurotoxic effects and local skin risks such as blistering and skin necrosis than ethanol.

Sodium tetradecyl sulphate foam

Catheter-directed therapy using a combination of sodium tetradecyl sulphate foam succeeded by instillation of absolute ethanol has been reported by Shiels et al to have excellent response rates of up to 100% as determined by radiologic (US and MRI) and clinical resolution.

Alcoholic solution of zein

Alcoholic solution of zein (Ethibloc) a combination of zein (corn protein), sodium diatrizoate and oleum in ethanol is not currently approved in the USA. Dubois et al. reported >95% regression in 64% of lesions and >50% in the remainder of both macrocystic and microcystic lesions. The most frequent complication was soft tissue leakage of the sclerotherapy agent in 70% cases without sequelae.

OK432

OK432 (Picibanil) is a attenuated strain of Streptococcus pyogenes and has been used as a sclerotherapy agent since 1987. A review of the literature by Poldervaart et al demonstrated OK 432 to be most efficacious in macrocystic lesions with excellent response rates .>88%. In this series, microcystic lesions, however, demonstrated excellent response rates in only 27%, good in 33% and poor in 40%. Adverse effects were mild, such as fever, lethargy and local inflammation manifesting as local pain, redness and swelling and only occurred in 5-8%.

Bleomycin

Bleomycin is an anti-neoplastic drug that has been in use since at least 1972. The biggest concern in the use of bleomycin although rare is pulmonary toxicity with Blum et al reporting in 1973 an overall definite rate of 1.1% resulting in death in 0.84% patients. There was a strong correlation between the risk of death from pulmonary toxicity and total doses of >450mg with the most common dose regimen being 15mg/m^2 twice a week.

A review of the literature by Acevado et al in 2008 including case reports and cohort studies for sclerotherapy of lymphatic malformations described excellent response rates with bleomycin in 35.2%, good in 37.1%, fair/poor in 18.4% and no response in 11.6%.

Laser therapy

The role of laser therapy for lymphatic malformations is generally reserved for the associated superficial cutaneous/mucosal vesicles. In addition, microcystic lesions of the tongue and oral cavity have been treated with the carbon dioxide laser and the Nd/Yag with some success.

Radiofrequency ablation

Grimmer et al reported a response rate of up to 62% when radiofrequency ablation was used in 11 patients with microcystic lesions of the lips, tongue, floor of mouth or buccal mucosa. Improvement in bleeding, pain, infection and vesicle formation was noted

VENOUS MALFORMATIONS (VM):

Clinically venous malformations are present at birth, although not always apparent and tend to grow steadily in proportion to the somatic growth of the child, especially during puberty and pregnancy. Overall, these congenital lesions affect boys and girls equally with a reported incidence of 1- 2 in 10,000 births and a prevalence of 1%.

Genetics

Most venous malformations 95% are sporadic but a genetic TIE2 mutation has been described in some hereditary cutaneomucosal venous malformations the most common being the glomovenous malformation.

CLINICAL FEATURES

Venous malformations can occur anywhere in the body, but are most frequently seen in the head and neck (40%), extremities (40%) and trunk (20%). Most present as solitary lesions.

Venous malformations are usually isolated findings; however, they may be associated with syndromes such as:

· Klippel Trenaunay (KT) syndrome
· Blue Rubber Bleb Nevus syndrome (BRBN)
· Muco-cutaneous familial venous malformation
· Glomovenous malformation
· Maffucci's syndrome
· Proteus syndrome
· Bannayan – Riley –Ruvalcaba syndrome
· CLOVE/S syndrome

RADIOLOGICAL FEATURES

Ultrasound

On gray-scale imaging venous malformations can appear as hypoechoic or heterogenous lesions with anechoic structures

visible in less than 50% cases. In addition, the Doppler flow is generally monophasic low velocity flow and in some cases flow is only discernible with compression and release of the lesion.

Computer tomography

On non-enhanced CT venous malformations are hypoattenuating or heterogeneous depending on the degree of fatty infiltration. The presence of dystrophic calcifications within the lesion and involvement of adjacent bony structures can be well characterized.

After contrast administration gradual peripheral enhancement is noted.

Magnetic resonance imaging

Venous malformations appear typically as isointense or hypointense lesions, but could be hyperintense depending on the presence of intralesional fat. Punctuate areas of low signal voids are seen in the presence of phleboliths.

In T2-weighted or inversion recovery sequences VMs demonstrate high signal intensity and this sequence is the best sequence to determine the full extent of the lesion and its relationship to adjacent vital structures. T1 weighted post-contrast imaging demonstrates both homogenous or heterogeneous enhancement and dynamic contrast-enhanced MR imaging can has increased the specificity of venous malformation diagnosis.

Treatment

Sclerotherapy

In general, venous malformations are treated percutaneously with sclerosing agents. The most common agents described in the literature include ethanol, sodium tetradecyl sulphate foam, ethibloc, polidocanol and more recently bleomycin.

Sclerotherapy is generally performed using a percutaneous approach with the aid of US and fluoroscopic guidance.

Adjunctive techniques such as coil or tissue adhesive embolization or laser ablation may be helpful in selected cases such as in children in whom rapid venous outflow is demonstrated or in those individuals with large varices or persistent lateral veins such as in KT syndrome. In addition, anastomoses with the normal deep veins can also be occluded with coils or NBCA prior to the injection of the sclerotherapy agent.

The most common agents used appear to be ethanol and sodium tetradecyl sulphate foam. Response rates of between greater than 90% have been described with 3% STS foam sclerotherapy in a small series after a mean of four treatment sessions. Complications included pain, blistering and skin erosions in this series.[4] In another series lower rates of treatment success were noted with lower extremity VMs and, in particular, those with an intra-articular component.

Ethanol is probably the most common agent used for sclerotherapy for venous malformation but also the most toxic. Response rates of up to 98% and no recurrences at 18-month follow-up have been described but after multiple treatment sessions with a mean of four procedures.

When administering absolute ethanol the volume used is the most reliable predictor of serum ethanol level and Mason et al demonstrated that a level of >1ml/kg may put patients at increased risk of respiratory depression, cardiac arrhythmias, seizures and rhabdomyolysis. Mason et al also identified a positive relationship between the use of alcohol and sodium tetradecyl sulphate and abnormalities of the coagulation profile such as a decrease in platelets and fibrinogen, an increase in prothrombin time and a positive D-dimer profile.

Other agents such as alcoholic solution of zein have been shown to have excellent response rates in 74% cases, with complete cure in 50%, using sclerotherapy alone or in conjunction with surgery.

Bleomycin used via a percutaneous approach in a moderate series of VM patients demonstrated complete resolution in 32% patients and significant improvement in 52% patients with no serious side effects.

NBCA has a limited role in the treatment of venous anomalies as it forms a hard mass and is slowly absorbed. Burrows et al recommends its use for pre-operative intra-articular venous malformation treatment diluted to 1:6 with oily contrast medium to increase distribution in the lesion.

Endovenous diode laser therapy has been reported in a small series of venous malformations to have a good response with 14-month follow up. Success rates between 95 and 100% have been reported with endovenous laser ablation of the saphenous vein. This has been a useful alternative therapy for treatment of the large marginal vein in Klippel-Trenauney syndrome although there are no reports to date in the literature.

The most common complications observed post-sclerotherapy of venous malformations are: skin erythema, blistering, skin breakdown, bleeding, necrosis and hemoglobinuria. Less frequently thrombophlebitis, thromboembolism and cardiovascular complications can occur. Hemoglobinuria occurs secondary to hemolysis and can be conservatively treated with IV fluid replacement until urinary clearance. Adequate hydration is also advised pre-procedure.

Different rates of complications have been associated with each type of sclerosing agent. In most of the series the use of ethanol revealed a higher percentage of minor and major complications in about 12% of the sessions and 27.9% of the patients. The use of sodium tetradecyl sulphate has reported lower total complication rates ranging between 0 and 9.6%.

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Special Session
The role of IR in venous disease

3004.1

Indications for IR treatment in deep vein thrombosis

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Learning Objectives:
1. To review the indications for IR treatment in acute DVT
2. To review the indications for IR treatment in chronic DVT
3. To review the contra-indications for IR treatment in acute and chronic DVT

It should be obvious to anyone that deep venous thrombosis has the potential to cause pulmonary emboli and perhaps death. Every airline has a policy to help their passengers prevent deep venous thrombosis.

Anticoagulation remains the primary method of treatment of most deep venous thrombosis but a significant number of persons progress on anticoagulation to develop extending venous thrombosis. Many of these have an excellent indication for catheter directed or even systemic thrombolysis provided the duration of thrombosis is less than 10-14 days.

Although there is long standing evidence that thrombolytic therapy is associated with more rapid and more complete clearance of lower limb deep vein thrombosis (1,2) the ultilisation of thrombolysis in deep venous thrombosis is lower than optimal.

The major reasons for this reluctance to use thrombolysis are that the risk of major bleeding is over-stated by physicians and that the clinical relevance of rapid relief of venous obstruction requires more robust data. Since historically there is a risk of major bleeding with thrombolytic therapy many patients are unwilling to accept a perceived extra risk of death or disability.

The one indication that has gained wide acceptance is phlegmasia cerulea dolens (aka venous gangrene). Sadly in the author's experience it invariably presents itself on a basis of failed anticoagulation with heparin. These cases would have been better treated from the outset with catheter-directed thrombolysis.

Thrombolysis is indicated in any case of ilio-femoral or vena cava deep venous thrombosis which is less than 10-14 days of onset. The reason for this cut-off is that once fibrin has cross-linked, pharmacological thrombolysis is not effective. However, since not all of the thrombus is necessarily cross-linked at once, in some critical cases of more chronic thrombosis, it may be worthwhile attempting a pharmaco-mechanical thrombolysis with a readiness to angioplasty and stent any residual venous stenosis.

There are data that indicate that early and complete lysis with catheter-directed thrombolysis is effective in reducing the post-thrombotic syndrome in patients who have femoral or iliac deep venous thrombosis (3). A trial that randomly selected patients with iliofemoral deep venous thrombosis to either catheter-directed or systemic thrombolysis showed that venous valvular competence was preserved in more patients with catheter-directed therapy (4). A more recent study in children aged 11-19 years confirmed the safety of pharmaco-mechanical thrombolysis with a greater than 90% technical success and no major bleeding. In this group the cumulative incidence of postthrombotic syndrome was 13% at 1-2 years (5). A prior study by these authors showed an incidence of postthrombotic syndrome of 80% in children when thrombolysis was not used (6).

The risk of major bleeding is also significantly less with catheter-directed thrombolysis especially if pharmaco-mechanical systems or sequestered thrombolysis is used. With the widespread availability

of tissue plasminogen activators and urokinase, streptokinase use should be discontinued. Most of the "horror stories" of haemorrhage used by clinicians to frighten patients away from thrombolysis are from the streptokinase era.
Thrombolysis for pulmonary embolism is indicated when there is a major recent embolus with persistent systolic hypotension (7). Other indications including right ventricular dysfunction or visible large embolus on imaging are less accepted and a decision to use thrombolysis should be made on a case by case basis. Some pharmaco-mechanical devices may not be safe to use in the pulmonary circulation.
Currently there are no trials of thrombolytic therapy for infra-popliteal deep venous thrombosis. The preferred treatment is anticoagulation with the expectation that proximal extension of thrombosis will be halted. Unfortunately this is not always the case.
Summary of indications:
1. Acute deep venous thrombosis (<10- 14 days).
(a) Cerulea Phlegmasia Dolens.
(b) Failed anticoagulation with extension to femoral or iliac veins.
(c) Primary Presentation with ilio-femoral thrombosis.
(d) Inferior vena cava thrombosis.
(e) Acute pulmonary embolus with systolic hypotension.
(f) Acute pulmonary embolus with right heart dysfunction.
2. Chronic deep venous thrombosis (>2 weeks).
(a) In conjunction with angioplasty and stent.
(i) Persistent venous hypertension with repeated deep venous thrombosis.
(ii) Inferior vena cava thrombosis.

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3004.2

Thrombectomy vs. thrombolysis in deep vein thrombosis

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Learning Objectives:
1. To describe the techniques of thrombectomy and thrombolysis
2. To review the role of thrombectomy in acute DVT
3. To review the role of thrombolysis in acute DVT

Deep vein thrombosis is a serious health issue and causes short- and long-term effects.
The short-term local effects include leg swelling, pain, immobility, occasionally progressing to a severely swollen leg with markedly impaired venous return or even arterial inflow.
Central migration of a thrombus results in a pulmonary embolus, this is the 3rd largest killer in the cardiovascular arena after myocardial infarction and cerebrovascular accident- bigger (in developed countries) than breast cancer and AIDS combined.
Long-term effects are chiefly those of the post-thrombotic syndrome (PTS). Post-thrombotic syndrome is significantly underrecognised by those physicians who initially see patients presenting with DVT- namely those in the Emergency Room, General Practice, and Internal Medicine. PTS is also the single biggest determinant of quality of life at 2 years post-DVT.
Anticoagulation (AC) has been the mainstay of DVT "therapy" for over 50 years. Of course, therapy may be slightly too strong a word as AC merely reduces the risk of proximal propagation whilst relying on the body's won fibrinolytic (used in this context interchangeably with thrombolytic) mechanisms to attack the thrombus.
Methods of anticoagulation are also changing considerably with a whole host of new treatments coming on stream, but that is outside the scope of this review.
More aggressive methods of DVT therapy rely on administering thrombolysis preferably in as high a concentration as possible deep within the thrombus. The trick is to achieve as high an intra-thrombus dose (thereby dissolving as many of the fibrin strands holding the whole show together) while getting as little systemic release as possible (which gives rise to the bleeding etc.). Systemic thrombolysis essentially yields more of the side effects and less of the thrombus dissolution.
It should also be stated that the more central the DVT, the greater the effect, and therefore the majority of this review will concentrate on iliofemoral DVT rather than femoro-popliteal venous thrombosis.
It is also important to note that there is no randomised control trial showing these aggressive forms of DVT treatment to be beneficial compared to the current gold standard of anticoagulation. (That is in fact the purpose of the ATTRACT trial in the USA which is currently mid way through recruitment. It is designed to assess, statistically, whether catheter-directed thrombolysis/combined CDT plus mechanical methods is superior at 2-year follow-up compared with standard anticoagulation.)
Nonetheless there is now a considerable body of evidence demonstrating improved patency rates of venous segments, less reflux and most importantly improved clinical results in terms of reduction of PTS, following catheter-directed thrombolysis as well as a combination of mechanical methods and thrombolysis. There are several small but well worked trials comparing thrombolysis and its' variants plus anticoagulation vs. anticoagulation alone.
In addition, there is considerable evidence that pneumatic compression boots and compression hosiery add significantly to results and reduce the incidence of PTS.
In 2008 CHEST finally recommended CDT for acute iliofemoral DVT with a 2B rating, with mechanical combined with thrombolysis deemed worthy of a 2C.
The purpose of this 30 minutes is to present the attendee with virtually the whole armamentarium in the management of acute

DVT-anticoagulation, catheter-directed thrombolysis, mechanical thrombectomy, combined mechanical plus CDT, aspiration, isolated pharmaco-mechanical venous thrombectomy, pneumatic compression boots, and compression hosiery.

Although the traditional "treatments" do not involve interventional radiologists to any great extent, it is clear that we have more to offer patients than just saving seriously compromised limbs. In fact of all specialties, we are ideally placed to be intimately involved with all aspects of care - from initial presentation, diagnosis using US, CTV or MRV; onto different treatment options and lifelong longitudinal follow up. Who should be looking after patients with DVT; internal medicine physicians who prescribe anticoagulation; or interventional radiologists who can diagnose the problem, remove the thrombus, restore patency of venous segments by placing stents, and then follow-up patients long term?

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Disclosure

Paid medical consultant to Cook Medical Marvao Medtronic Boston Scientific Covidien UCSI Orthosensor

3004.3

Paget-Schroetter syndrome: what is it, should we treat it?

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Learning Objectives:

1. To describe the entity of Paget-Schroetter syndrome
2. To discuss the treatment strategy for Paget-Schroetter syndrome
3. To discuss results and outcome of treatment in Paget-Schroetter syndrome and how to optimise outcome

Paget Schroetter syndrome, or effort thrombosis of the axillo-subclavian venous system, is distinct from other forms of upper limb deep vein thrombosis. It occurs in younger patients and is often secondary to competitive sport, music or strenuous occupation. If untreated there is a higher incidence of disabling venous hypertension than was previously appreciated. Anticoagulation alone or in combination with thrombolysis leads to a high rate of re-thrombosis. We have established a multi-disciplinary protocol over 15 years, based on careful patient selection and a combination of lysis, decompressive surgery and post-operative percutaneous venoplasty. In the last 10 years a total of 232 decompression procedures have been performed. This lecture will review the literature and present the Exeter Protocol along with practical recommendations for management.

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3004.4

Nutcracker syndrome: what is it, should we treat it?

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Learning Objectives:

1. To describe the entity of Nutcracker syndrome
2. To discuss the indications for treatment of Nutcracker syndrome
3. To discuss the contra-indications for treatment of Nutcracker syndrome

The nutcracker phenomenon refers to compression of the left renal vein between the abdominal aorta and the superior mesenteric artery, although other variants exist. The nutcracker syndrome refers to symptoms secondary to the nutcracker phenomenon. The syndrome typically occurs in relatively young, previously healthy people. As with other venous disorders, there is a wide spectrum of clinical presentations (including no symptoms) and there are no diagnostic criteria. No consensus exists on what symptoms are severe

enough to warrant the designation of a clinical syndrome or to what extent various findings may simply reflect different evolutionary stages of the process. Because of the variability of symptoms and absence of consensus on diagnostic criteria, the exact prevalence of nutcracker syndrome is unknown but may be slightly higher in females. Some authors report that symptoms can be aggravated by physical activity and there can be orthostatic intolerance. Hematuria is the most commonly reported symptom and varies from microhematuria to macrohematuria, occasionally with resultant anemia that requires blood transfusion. Cystoscopy may identify a left ureteral origin. The presumed mechanism for hematuria is that compression leads to left renal vein hypertension, which may result in rupture of the thin walled vein into the renal calyceal fornix. Pain is the next most common symptom. It is sometimes characterized by abdominal or flank pain that occasionally radiates to the posteromedial thigh and buttock. The pain is typically exacerbated by sitting, standing, or walking. Some patients describe typical symptoms of pelvic congestion. Other manifestations include vulvar or lower extremity varices. Nausea and vomiting have been described due to splenic vein compression. The presumed mechanism for pelvic congestion or symptomatic varicocele is the formation of collateral venous circulation such as a prominent left ovarian vein or testicular vein with their associated symptoms, such as vulvar varices in females or varicocele in males. The diagnosis is typically made on clinical suspicion confirmed by duplex scanning, CT or MRI. Some will only base the diagnosis on demonstration of a hemodynamically significant pressure gradient across the point of compression during catheter venography. Management options range from observation to nephrectomy, depending on the severity of symptoms. Conservative treatment is recommended for mild hematuria. The correlation between imaging evidence of left renal vein compression and clinical symptoms remains challenging, and therefore most authors recommend that interventions should be considered only when symptoms are severe or persistent. Many authors recommend a conservative approach, with observation for at least 2 years because as many as 75% of patients will spontaneously have significant symptom resolution. Most treatments aim to decrease LRV hypertension, but others are directed against pelvic venous reflux. Treatment options include surgical procedures to achieve venous decompression, the most common being transposition of the left renal vein to the IVC, and endovascular procedures including stenting of the left renal vein and embolization of the left gonadal vein. Level I evidence does not exist for any given therapy, or even for existence of the syndrome. In the author's opinion, treatment should be reserved for those patients in whom other causes for their symptom complex have been exhaustively excluded, and where the severity of the symptoms justify the risks of the chosen therapy.

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Disclosure

Board observer, NDC Inc. Medical Advisory Board, Boston Scientific Corp Research Steering Committee, Cook, Inc

Special Session
Controversies in interventional oncology

3102.1

Surgery is the first choice for small renal cancer

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Introduction:

Due to elaborated imaging techniques the majority of renal tumors are small masses at diagnosis ("stage migration").

Nephron-sparing surgery (NSS) is widely accepted to treat renal cell carcinoma (RCC) not only in an imperative situation (solitary kidney) but also for elective indications (healthy contralateral kidney). Current guidelines of the eau (European Association of Urology) recommend NSS as the standard procedure for solitary RCC up to 7 cm in diameter, if possible.

Major arguments for NSS instead of radical tumor nephrectomy (RN) have to be debated in detail: 1. oncological outcome with respect to local recurrence and metachronous distant tumor progression (metastases), 2. prevention of chronic kidney disease (CKD), 3. risk for adverse effects on general health (especially cardiovascular events), 4. advantages and disadvantages of different operation techniques and 5. feasibility for the elderly.

In addition, it has to be clearly defined in which cases observation alone (active surveillance) of small renal masses is an alternative to excision (with respect to the estimated histology of the mass - i.e. risk for a benign versus malignant lesions - and to the natural biology/course of the "tumors").

Finally, the seldom indications for alternative nephron-sparing ablative procedures, such as cryotherapy, radio frequency ablation (RFA), high-focussed ultrasound (HIFU) and so forth must be much more precisely worked out.

Status quo ante:

1.There is increasing evidence that elective NSS of organ-confined RCC (T1a/b/2 N0 M0) provides better or at least similar excellent oncological results as RN [Thompson 2008; Becker 2006; Roos 2010; Becker] (highest level of evidence: EORTC 30904-GU phase-III non-inferiority trial) [van Poppel 2011]. Side-information: NSS - whenever possible to perform - is recommended even in case of metastatic disease (risk reduction to die! HR: 0,49 and 0,54 for CSS and OS) [Hellenthal 2010].

2. The onset of a decreasing glomerular filtration rate (GFR) and dramatical impairment of CKD is significantly reduced by NSS [Huang 2006] compared to RN. To predict the risk of CKD after RN recent nomograms can help decision making [Yokoyama 2011]. In general, the permanent renal damage is correlated to the loss of functional nephrons, that will be mechanically destroyed, and to the duration of ischemia during operation (limit: 20 minutes warm ischemia, 35 minutes cold ischemia). However, this argument became inferior, since ischemia is not necessary anymore for any open operation, if modern principles of NSS are respected.

3. There is a controversial discussion wether RN leads to an increased risk for the non-cancer related morbidity and mortality of the pts, especially cardiovascular diseases [Huang 2009], or not [Miller 2008].

4. Open NSS is the most utilized procedure to resect small tumor masses of the kidney. Simple enucleation of RCC seems to be nearly equivalent to traditional partial nephrectomy [Minervini 2011]. Notably, neither the thickness of the surgical margins nor the presence of a positive margin does correlate with the risk of local tumor recurrence. By conventional laparoscopic techniques comparable outcomes can be achieved to open surgery. Robotic surgery is fashion, but really overwhelming advantages for the use of robots ("must do" instead of "me too") have not been demonstrated yet.

5. Of interest, NSS is more feasible for octogenerians with RCC than RN [Hellenthal 2011].

Conclusion:

Surgery is the first choice for small renal cell carcinoma. Tumor ablation provides no real advantage in general practice, but leads to a worse oncological efficacy (RR for local progression rate: 7,45 for cryoablation; 18,23 for RFA [Kunkle 2008].

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3102.2

Ablation is the first choice for small renal cancer

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Why not? Minimally invasive thermal ablation has a long history in oncologic interventions. Especially in multimorbid patients, thermal ablation yields in good clinical results without deterioration of the clinical status. Literature reflects a broad clinical experience of curative and palliative ablation in patients with liver (1) as well as renal tumors (2).

Radiofrequency ablation (RFA) is the most frequently applied of all methods. First described by Zlotta and co-workers in1997 (3), RFA is a hyperthermal ablation technique, based on thermal induction by electrical energy. A high frequent alternating current (275-480 kHz) is brought into tissue by an electrical active probe and induces frictional heat due to ionic agitation. The heat extends by thermal conduction and is limited by the cooling effect of blood perfusion of the surrounding tissue. Heat distribution within target tissue is depending on several factors like fluid content, electrical conductivity and blood perfusion and decreases nearly linearly with distance to energy source. The shape of resulting coagulation necrosis is mainly depending on probe configuration, but also of the presence of heat sink effects by cooling vessels (segmental arteries) and collecting system. Modern probes allow ablation of lesions between 2 and 5 cm in diameter. In experimental work, increase of necrosis was achieved by temporary occlusion of the renal artery. A similar effect is obtained by superselective tumor embolization prior to ablation by particles or lipiodol, which is suggested in lesions exceeding 3 cm in size. A further increase in ablation volume requires reposition of the probe. In order to avoid thermal collateral damage in adjacent structures like bowel or liver, an additional injection of carbon dioxide or 5% glucose is suggested in cases of exophytic tumors with broad contact to neighbour organs. In opposition to cryotherapy, thermal effects cannot be imaged directly and requires a thorough monitoring by ultrasound or CT. Under sonographic control, hyperechoic signals due to gas bubbles are seen regularly at the end of coagulation. Unfortunately, they do not correlate to the extent of final necrosis. As coagulated and thus necrotic tissue is not perfused, the use of contrast agent (either US or CT) allows a clear delineation of viable tumor and is recommended to be used before the probe is being removed. Thus, residual tumor can be ablated within the same session. After successful ablation, track ablation avoids bleeding complications and tumor cell seeding successfully (4).

What do clinical results say? The effects of minimally invasive treatment of renal cell cancer with curative intent must be comparable or better than established resective techniques (5). Although studies with a follow-up period of more than 5 years are still rare, a couple of papers show quite convincingly results. Levinson and co-workers (6) reported on 31 patients with 34 RFA treatments with a mean diameter of 2 cm (1-4 cm). During a mean follow-up period of 61.6 months (41-80), 3 recurrences 7, 13 and 31 months after intervention were observed, resulting in a overall recurrence-free survival of 90.3% and a 100% metastasis-free and disease-specific survival rate. McDougal and co-workers (7) reported on a 93% recurrence-free survival in 16 patients during a follow-up of 55 months with tumors less than 5 cm in diameter. Stern and co-workers (8) achieved a 98% recurrence-free survival in 63 patients over a mean follow-up of 34 months (1-80 months) in renal tumors of 2.1 cm in mean diameter (1-4 cm). These promising results were confirmed by Ji and co-workers (9) who reported on a local tumor control rate of 98.1% in 106 patients suffering from RCCs (size range 0.9-5.5cm in diameter), resulting in a disease-free survival rate of 97.8% over a mean follow-up period of 32 months (range 12-48). Last but not least, Mylona and co-workers (10) reported of a recurrence rate of 11% in 18 patients with lesions ranging from 1 to 7 cm in diameter. Over a mean follow-up time of 31.2 months (12-72 months) no recurrences were observed in lesions smaller than 3 cm in diameter.

And what about renal function? It is known that thermal ablation is a nephron sparing technique, indicated by numerous papers about percutaneous ablations in patients with single kidneys or with reduced renal function. For example, in a patient subgroup with impaired renal function of the study by Stern and co-workers (8), the eGFR decreased from 76.3 and 74.3 mL/min/m(2) after radiofrequency ablation.

Further advantages? It is known that thermal ablation does not require general anesthesia necessarily and thus can be offered especially to poor surgical candidates with reduced cardial or pulmonal function. Further, the mean hospitalization time is shorter than after resective surgery (2). Finally, thermal ablation is more cost effective

as compared to nephron sparing surgery (11).
In summary, thermal ablation of small renal cancer is a relative simple intervention, has a high tolerance, fewer complications and shorter hospitalization duration than resective surgery. With respect to comparable intermediate data (long-term data are not yet available), it seems to be superior to surgery.

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3102.3

Drug eluting beads are all we need for TACE in HCC

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Hepatocellular carcinoma (HCC) is the fifth most common cancer and the third leading cause of cancer-related deaths in men (1). In HCC patients the tumour develops in cirrhotic livers in most individuals and thus, their outcome is related to both cancer and cirrhosis. The Barcelona Clinic Liver Cancer (BCLC) staging system (2,3) links tumour stage with treatment strategy and may be applied to the majority of HCC patients.
Transarterial chemoembolisation (TACE) is the standard of treatment for unresectable HCC in the intermediate stage. It has been shown that TACE achieves partial response in 15 – 55% of patients. (4-11). A systematic review and meta-analysis of randomised clinical trials for unresectable HCC has shown a survival benefit of TACE in comparison to control (12). Therefore, TACE is considered the standard of care (13).

Drug eluting Beads:

The DC Bead™ drug eluting beads hydrogel particles based on polyvinyl alcohol are capable of loading doxorubicin. It has been shown in animal studies and clinical phase I/II studies that TACE with DC Bead™ resulted in higher tumour concentrations and lower systemic concentrations of doxorubicin (14-20). The 4 single arm pilot studies with doxorubicin-loaded DC Bead™ showed very promising tumour response rates and low complication rates as well (19-22).
In a multicenter, single blind, prospective, randomised, controlled study designed to assess the clinical performance of doxorubicin TACE with DC Bead™ in the treatment of unresectable HCC in comparison with conventional doxorubicin TACE patients were randomised 1:1 to either doxorubicin TACE with the DC Bead™ (test arm) or the conventional doxorubicin TACE (control arm) (PRECISION V Trial)(24).
Included were patients with HCC not suitable for resection, liver transplantation or percutaneous ablation. Patients with multinodular or bilobar HCC were included, diffuse HCCs with >50% tumour involvement of the liver were excluded. Patients should have a performance status ECOG 0 (asymptomatic) and 1 (limited restriction of daily activities), and a well preserved liver function (Child-Pugh A and up to B7). Patients were excluded with vascular invasion and extra hepatic spread, with another primary tumour and if previously treated with radiotherapy or doxorubicin.
DC Bead™ TACE (test arm): Patients received DC Bead™ loaded with doxorubicin at a dose of 150mg in each procedure. The aim of each procedure was be to deliver 2 x 2ml vials of DC Bead™ (total 4ml) loaded at 37.5mg/ml of doxorubicin. It was recommended that chemoembolization should be performed with one vial DC Bead 300-500mm followed by one vial of 500-700mm in diameter. No adjustment was made for bilirubin concentration.
Conventional TACE (control arm): Patients received intra-arterial injection of an emulsion of doxorubicin in lipiodol followed by proximal embolization with particles. The goal was to deliver the entire dose of 150mg of doxorubicin together with up to 10 ml of lipiodol.
In both treatment arms, embolization was performed via an unilateral femoral artery approach, and superselective catheterization of the tumour feeding hepatic artery branches. Patients should receive three chemoembolization treatments within 6 months.
The tumour response was evaluated based on contrast-enhanced magnetic resonance imaging (MRI). It was reported according to the Response Evaluation Criteria in Solid Tumours (RECIST) criteria (23) and to the modifications of the European Association for the Study of the Liver (EASL). In accordance with the EASL criteria, responses were defined as follows: complete response (CR) - complete disappearance of all known viable tumour (assessed via uptake of contrast in the arterial phase of the MRI scan) and no new lesions; partial response (PR) - 50% reduction in viable tumour area of all measurable lesions; stable disease (SD) - all other cases; progressive disease (PD) - 25% increase in size of one or more measurable lesions or the appearance of new lesions. Objective response was defined by CR and PR, disease control by CR, PR and SD.
In the DC Bead™ arm 102 and in the cTACE arm 110 patients were allocated, respectively. The mean age of the patients was 67.2 years 185 (87 %) were male.
Complete tumour response was achieved in 25 (26.9%) versus 24 (22.2%) in the DC Bead™ versus cTACE arm, respectively. Partial response was achieved in 23 (24.7%) versus 23 (21.3%), and stable disease in 11 (11.8%) versus 9 (8.3%) patients. Therefore, the objective response rate was 51.6% versus 43.5% ($p = 0.11$) and the disease control rate was 63.4% versus 51.8% in the DC Bead™ versus cTACE arm at 6 months, respectively. In patients with more advanced disease and poorer prognosis (67%) due to Child-Pugh B cirrhosis, ECOG 1 performance status, bilobar disease and recurrent disease the objective response rate was significantly better in the DC Bead™ group ($P<0.05$). The overall time to progression was median 217 ± 7.84 days in the DC Bead™ arm and 196 ±14.92 days in the cTACE arm. The time to progression of the treated target lesions did not reach the median in the DC Bead™ arm after 270 days whereas the median time in the cTACE arm was 228 days. The rate of doxorubicin-related AEs was significantly higher (13% versus 37%; p=0.0001)

in the cTACE arm. Cancer-related death due to disease progression within 6 months was observed in 1/102 versus 3/110 patients in the DC Bead™ versus cTACE arm, respectively (24).
HCC is a highly chemotherapy-resistant tumour. However, doxorubicin has shown to have an efficacy when it is given intraarterially. The trend for higher rates in the objective response and disease control rate in all stratified groups, as it was shown in the PRECISION V RCT, offers the assumption that DC Bead™ TACE is superior to cTACE in the treatment of intermediate HCC. This assumption is supported by the experimental studies that could demonstrate a higher and prolonged retention of doxorubicin within the tumour after DC Bead™ TACE. The American Association for the Study of Liver Diseases considered patients with Child-Pugh B cirrhosis and tumour symptoms (ECOG 1) a contraindication for cTACE. In this RCT patients with Child-Pugh B and ECOG 1 had a significantly high objective response rate after DC Bead™ TACE. Therefore the treatment of advanced disease is safe and efficacious with DC Bead™ TACE and can be recommended for these patients.

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3102.4

Lipiodol TACE still has a role in HCC

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Particulate embolization of hypervascular tumors has been performed since the 1960s, based on earlier anatomical studies identifying the hepatic artery as the primary source of blood to hepatic malignancies. More sophisticated in-vivo videomicroscopy techniques elucidated that blood reaches hepatic tumors via a peribiliary capillary plexus with anastomoses from the hepatic artery to terminal portal venules. Penetration through this complex network requires a liquid agent. In the early 1970s, iodized ethyl esters of poppyseed oil (Lipiodol®) were found to be selectively taken up and

retained in liver tumors when injected intra-arterially as a contrast agent. Chemoembolization using iodized Lipiodol® as a drug carrier was developed in the 1980s and is the global standard for treatment of primary and secondary hepatic malignancies. Water-in-oil emulsions of Lipiodol with anti-cancer drugs deliver drug intra-tumorally with prolonged retention times. Its opacity allows for real-time monitoring of therapy during embolization. Uptake and retention of Lipiodol is a validated imaging biomarker for both pathological tumor response and patient survival. Lipiodol chemoembolization is the only technique demonstrated by randomized controlled trials to improve survival in HCC.

Newer polymeric embolic platforms have been developed that allow predictable drug loading, delivery, and elution with lower systemic drug exposure than oily emulsions. To date, all studies in HCC have failed to demonstrate improvement in tumor response or in patient survival compared to oily chemoembolization or to bland embolization. In the Precision V prospective randomized trial of dox-loaded PVA beads vs. oily chemoembolization, response by RECIST and necrosis criteria were the same in both arms. In a prospective randomized trial of dox-loaded PVA beads vs. unloaded beads for HCC, survival at 6, 9, and 12 months was identical. Major hepatobiliary complications occurred in 17% of patients receiving dox-loaded beads vs. 2% in those who had bland embolization. The learning curve with these new devices has been fraught with complications. Injuries to gut, gallbladder, pancreas, and cutaneous soft tissues have been reported due to non-target embolization of the non-opaque beads, whose delivery cannot be monitored in real-time like iodized oil. Hepatobiliary necrosis is an alarmingly frequent complication, reported in up to one-half of patients in some series. Since the beads are too large to penetrate the intratumoral vessels, they lodge outside the tumor and rely on passive diffusion for drug delivery to the tumor, resulting in excess drug deposition in normal hepatic parenchyma. Images of iron-labelled beads depict that they concentrate around tumor nodules with little penetration of the intratumoral vasculature, unlike Lipiodol which is selectively taken up and retained in HCC. Studies of tissue drug levels in animal models reveal highly toxic drug concentrations immediately surrounding dox-loaded beads, but sub-lethal drug concentrations in tumor. Even in experienced hands, the complication rate of DEBs exceeds QI guidelines for chemoembolization.

While it is unlikely that this platform will prove superior to oily emulsions for treatment of HCC, far more interesting is the potential application for delivery of newer drugs such as irinotecan and paclitaxol to tumor types that traditionally have not been well managed by oily chemoembolization.

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Disclosure

Consultant, Guerbet. consultant, Biosphere/MERIT Medical. consultant, Biocompatibles/BTG

3102.5

Transcatheter therapy in hepatic colorectal metastasis has value

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In patients with predominant hepatic disease, intra-arterial therapy has been used mostly as salvage therapies after failure of IV standard of care therapies for metastases, and because response rate remains interesting even when using the same drug that the one which was or became inefficient with IV administration. Due to the high response rate of IAHC, there are some recent reports and ongoing study using such therapies in first line. In addition, IAHC used in an adjuvant setting after liver resection has been demonstrated to increase survival [1].

IAHC has the main advantage of increasing drug concentrations in tumor deposits, thus resulting in a significant increase in response rates because many tumors display a steep dose-response curve. When compared to IV perfusion the estimated increase in liver exposure by IAHC is 100-300 fold for FUDR, about 20 fold for THP adryamicin, 5 to 10 fold for 5FU, 4 to 7-fold for cisplatin, 6 to 8 fold for mitomycine, 4 fold for oxaliplatinum, and only 2 fold for doxorubicin. All clinical trials using 5 FU or FUDR have demonstrated a better response rate for IAHC than for IV treatments. Adjunction of embolization, and namely used of drug eluting beads during arterial therapy further enhanced drug concentration as demonstrated for doxorubicin [2] and irinotecan in our pre-clinical experience.

In the past only few trials have demonstrated a benefit in survival [3,4]. Intra-arterial chemotherapy was more or less abandoned at the time IV irinotecan and oxaliplatinum proved to give equivalent response rate to intra-arterial 5-FU. Then, oxaliplatin was used IAH and combined with IV 5FU, it demonstrated an overall response rate of 62% among the 39 assessable patients including 17, 12, and 12 patients who had failed to respond to prior systemic chemotherapy with FOLFIRI, FOLFOX, or both, respectively [5]. In this report, further R0 surgical resection can be proposed in 18% of initially unresectable CRLM and radiofrequency ablation in 2%. A triple combination including IAHC with FUDR plus IV oxaliplatinum and irinotecan allowed as high as 90% of tumor response [6]. More recently 49 patients with unresectable CRLM (53% previously treated with chemotherapy) were enrolled onto a phase I protocol with HAI floxuridine and dexamethasone plus systemic chemotherapy with oxaliplatin and irinotecan [7].

In this study, more than five CRLM were present in 73% of patients, 98% had bilobar disease, and 86% had six segments or more involved. Ninety-two percent of the 49 patients had complete (8%) or partial (84%) response, and 47% (23/49) of the patients were able to undergo resection in a group of patients with extensive

disease. For chemotherapy naïve and previously treated patients, the median survival from the start of HAI therapy was 50.8 and 35 months, respectively. In our center we treated 36 patients with extensive non-resectable CRLM (≥4 LM in 86%; bilobar LM in 91%) 2 using IAHC with oxaliplatin (100 mg/m2 in 2 hrs) plus intravenous 5FU-leucovorin (LV, 400 mg/m2 in 2 hrs; FU, 400 mg/m2 bolus then 2,400 mg/m2 in 46 hrs), and cetuximab (400 mg/m2 then 250 mg/m2/week, or 500 mg/m2 every two weeks) as first-line treatment [8]. Overall response rate was 90% (95%CI, 70-99) and disease control rate was 100% (95%CI, 84-100). Forty-eight percent of patients were downstage enough to underwent R0 resection and/or radiofrequency ablation. After a median follow-up of 11 months, median PFS was 20 months (median OS, not reached; 12- and 18-month OS, 100%).

Intra-arterial therapy through delivery platform that allows at the same time embolization and progressive released of the drug have been recently introduced in the treatment of colorectal cancer metastases. A phase II study in 82 patients with CRLM not resectable and in progression after two lines of chemotherapy received 185 DEBIRI TACE with 100-200mgr of Irinotecan with 75 to100% reduction of metastatic contrast enhancement in all lesions treated. RECIST response rate was 78% with 90% of patients declaring a long lasting improvement of quality of life [9]. DEBIRI have been used to convert non operable patient to surgical candidates by Brower at al [10] with 9O TACE in 55 patients [10]. At 6 months, CR was 7%, PR was 35%, SD was 54% and PD was 4%, with 20% of patients downstaged to surgery or ablation. Pathological assessment of the resected specimens showed minimal nonspecific portal chronic inflammation without evidence of fibrosis, or chemotherapy-associated steatohepatitis. The overall pathological response rate in the resected specimens ranges from 30 to 90%.

ESMO 2010 reports 74 patients who failed at least two lines of chemotherapy randomized to DEBIRI 2courses at 1 month interval (n=36) versus 8 courses of IV FOLFIRI at 2 weeks interval (n=38) [11].

The response rates were 70% and 20%, the 2-year overall survival were 38% and 18%, the median overall survival were 690 days and 482 days and the progression-free survival were 225 and 94 days for DEBIRI and FOLFIRI respectively. Early toxicity ≥grade 3) was higher for DEBIRI (70%) versus FOLFIRI (25%), while late toxicity (≥grade 2) was higher for FOLFIRI (80%) than DEBIRI (20%). Improvement of quality of life was 60% for DEBIRI and 22% for FOLFIRI. Overall cost of treatment was lower for DEBIRI.

Around 30% of TACE sessions are associated with adverse events during or after the treatment. The factors predictive of adverse events and significantly greater hospital length of stay are lack of pretreatment with hepatic arterial lidocaine ($p = 0.005$), > or = 3 treatments ($p = 0.05$), achievement of complete stasis ($p = 0.04$), treatment with >100 mg DEBIRI in 1 treatment ($p = 0.03$), and bilirubin >2.0 microg/dl with >50% liver involvement ($p = 0.05$) [12,13].

Hong et al recently compare TACE with DEBIRI to radioembolization for salvage therapy for liver dominant CRLM in a series of 36 patients and reports similar survival for both treatment as a salvage therapy with median survival times of 7.7 months for the TACE group and 6.9 months for the radioembolization group (P = .27). The 1-, 2-, and 5-year survival rates were 43%, 10%, and 0%, in the TACE group and 34%, 18%, and 0% in the radioembolization group [14].

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3102.6

Systemic therapy is all we need for non-resectable disease

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Treatment of patients with advanced colorectal cancer and liver metastasis remains a significant challenge due to the limited number of treatment options and the poor outcome. A number of cytotoxic reagents (5-fluorouracil, irinotecan and oxaliplatin) and antibodies including bevacizumab, cetuximab and panitumumab have recently been approved for the treatment of colorectal cancer. All these compounds have proven their efficacy in randomized phase II and III studies in patients with advanced disease in the past. Use of this drug has improved patient overall survival from 6 months to beyond 24 months. Response rates of 12 to 14% were achieved using 5-fluorouracil, which has been in use since 1958. Based on the

data from the CRYSTAL study, response rate of 60% can be achieved in k-ras wild-type patients with an acceptable side-effect profile. While loco-regional therapies represent a potentially very active and potent treatment regimen, this type of treatment has not proven efficacy in large randomized trials. Treatment results largely depend on the experience of the individual interventional radiologist, which make it difficult to compare results. Furthermore, different types of interventional therapies are often combined, which make it impossible to relate the effects of a specific treatment to patients' outcome. Therefore, systemic chemotherapy has been defined to be the treatment of choice for non-resectable disease according to different national and international treatment guidelines, including the NCCN and ESMO guidelines.

These recommendations are based on a number of different observations and facts, which will be discussed during my presentation and are summarized here:

1. Data from large randomized trials demonstrate that in less than 20% of all cases metastasis are restricted to the liver. Therefore, more than 80% of the patients with non-resectable disease will not profit from a liver directed therapy, since extra-hepatic tumors will without doubt progress without a specific treatment.
2. While-liver directed therapies might be able to achieve high chemotherapy concentrations in the liver, systemic dose levels are very low.
3. No clinical trial has shown a superior outcome (overall survival) for loco-regional therapy of systemic therapy in patients with stage IV disease and liver metastasis.
4. While liver-directed therapies are potentially very effective they also cause significant hepatotoxicity. Therefore, they cannot be used in a neo-adjuvant setting with the aim to achieve a response rate, which would allow for a curative resection after treatment.
5. In contrast to systemic therapy, which can either be given orally or at least on an outpatient base, loco-regional therapy requires specialized physicians to deliver the therapy of choice.
6. A number of different loco-regional therapies have been evaluated in patients with non-resectable disease. However, no standard-type of treatment has been established yet, which could potentially be compared with a systemic chemotherapy regimen.

In summary, based on the results from large randomized clinical trials in patients with non-resectable colorectal cancer and liver metastasis, systemic chemotherapy remains the treatment of choice. However, loco-regional therapies remain a potentially very interesting treatment option considering the fact, that these type of treatments can be used to achieve high response rates. Furthermore, because patients with advanced colon cancer experience overall survival rates of more than two years, treatment-related side effects, which are known to increase in terms of frequency and severity over time, become an increasing problem in the management of patients with advanced disease. Under these circumstances, loco-regional therapies might become a potentially interesting treatment alternative.

Special Session
Preventive stroke management

3103.1

Detection of supra-aortic atherosclerotic disease and vulnerable plaques with contemporary non-invasive imaging

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Learning Objectives:

1. To understand where the non-invasive angiography (CTA, MRA) stands in early detecting the supra-aortic stenosis to prevent the incoming stroke
2. To understand basic pros and cons of CTA and MRA
3. To learn if and how the imaging would detect an atherosclerotic plaque which is more prone to create a stroke

Stroke is a leading cause of death and long-term morbidity. There are approximately one million stroke-related events per year in the US alone. Often atherothromboembolism from a focal atherosclerotic plaque at the carotid bifurcation cause stroke and carotid stenosis and is often present in these patients. Commonly used imaging techniques for diagnosis of significant carotid artery stenosis include Doppler ultrasonography (DUS), digital subtraction angiography (DSA), MR angiography (MRA), and multislice CT angiography (CTA). DSA is still considered the standard of reference for evaluation of carotid artery stenosis. However, it comes with a risk of neurological complications, which is estimated to be in the range of 0.05 to 0.5%. DUS is not capable of imaging all vessels that are relevant for the brain's blood supply. Therefore, in clinical routine practice non-invasive imaging techniques such as MRA or CTA are widely used for establishing the diagnosis and subsequent treatment planning.

Traditionally, the degree of luminal stenosis has been used as marker for the stage of disease. However, prospective clinical trials have shown that the majority of patients with a history of recent transient ischemic events or stroke suffer only mild-to moderate carotid stenosis. Using conventional stenosis criteria, in many of these symptomatic individuals the severity of disease would be underestimated. These patients would falsely be considered to have early-stage carotid artery disease. Consequently, improved criteria for identifying the high-risk carotid plaques independent of the extent of stenosis are needed. Histological studies from different vascular territories have led to the hypothesis that plaques with large lipid-rich necrotic cores, thin fibrous cap, extensive plaque neovasculature, intraplaque hemorrhage and vessel wall inflammation pose an increased risk for plaque rupture and ischemic events. These plaques are considered "vulnerable". Despite the widespread consensus on the importance of the characteristics of the "vulnerable plaque", there is a lack of reliable imaging tools for in-vivo plaque characterization. Over the last decade MRA and more recently CTA have been identified as promising tools for assessing plaque morphology and composition in the search for the "vulnerable plaque".

MRA and CTA may roughly be considered equal for assessing the degree of carotid stenosis [1]. However, MRA has been shown to accurately identify key carotid plaque features, such as a lipid-rich necrotic core, intraplaque hemorrhage, neovasculature and vessel wall inflammation [2]. In contrast, CTA proved perfect for identifying calcified lesions, but due to a relevant overlap in the attenuation values associated with lipid-rich necrotic core, connective tissue, and hemorrhage, its reliability for identifying these components is limited [3]. Almost a decade ago high-resolution MR imaging proved its ability to accurately classify human carotid atherosclerotic plaques according to the American Heart Association classification [4]. MRA therefore permits distinguishing advanced lesions from early and intermediate atherosclerotic plaques.

It has been shown that "vulnerable plaques" are more prone to the slow flow phenomenon during carotid artery stenting (CAS) and intraplaque hemorrhage which is thought to be associated to embolization during carotid endarterectomy (CEA) [5]. These results, however, are (1) not yet confirmed by randomized studies and (2) unlikely to affect the need for treatment in case of a significant carotid artery stenosis. Nevertheless, reliable plaque analysis is likely to alter treatment decisions, particularly in patients with a limited degree of stenosis but high risk types of plaques. Due to the current complexity of MR plaque imaging, it is not yet widely used in clinical routine practice. Moreover, imaging is only one piece of the puzzle. A careful clinical workup with a thorough neurological assessment remains a mainstay in the diagnosis of carotid artery disease and the gatekeeper for imaging tests.

So far MRA is the only candidate for an in-vivo assessment of the "vulnerable plaque". For several reasons there is no consensus of the use of such a test in clinical routine and several tasks lie ahead. Most importantly, a validated and generally accepted comprehensive plaque score is needed as foundation for future clinical trials. While, the available data on the prognostic impact of plaque imaging is promising, it is limited with respect to the number of patients and ischemic events. Thus, larger studies are needed to prove that specific baseline plaque features are associated with an increased risk for future ischemic events.

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3103.2

Extracranial stenting

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Learning Objectives:

1. To learn defining treatment objectives and indications based on imaging
2. To learn different endovascular treatment approaches according to supra-aortic lesions
3. To learn about stent selection in different settings

Introduction and Objective: Recent epidemiological studies show that stroke might actually be the second cause of mortality in the world. According to the Italian Longitudinal Study on Aging (ILSA) and other Italian national population studies, 80% of all yearly strokes would be first-ever strokes and 20% recurrent strokes. Two thirds of these strokes are ischemic and more prevalent in the elderly patients. 20% of these patients die within the first month and another 30% within the first year. About half of all ischemic strokes are due to stenotic atherosclerotic plaques in the extracranial vessels. The North American Symptomatic Carotid Endarterectomy Trial (NASCET) showed that patients with symptomatic carotid artery stenosis of 70 to 99% had a two-year stroke risk of 26% if treated with medical treatment alone. Patients undergoing carotid endarterectomy (CEA), on the other hand, had a two-year stroke risk of 9%. Thus, the absolute risk of stroke reduced by 17% at two years in symptomatic patients treated surgically. Similarly, the Asymptomatic Carotid Artery Study (ACAS) showed that in patients with asymptomatic carotid stenosis (60-99%), the annual incidence of stroke on medical therapy alone was 2.3% and that CEA reduced it to an annual risk of 1%. However, periprocedural risk of cranial nerve damage (5.6%), and other medical complications (8.1%) and myocardial infarction (1.2%) associated with CEA prompted the development of safer percutaneous methods as an alternative treatment in patients excluded from these trials. Major Carotid End Arterectomy (CEA) trials have confirmed the role of CEA in mitigating the risk of stroke. Carotid artery angioplasty and stent placement (CAS) is rapidly being affirmed in several centres as a valid alternative to CEA in selected patient subsets. The aim of our investigation was to evaluate the benefit of carotid angioplasty and stenting in preventing cerebrovascular disease in different groups of patients and to assess the feasibility and the safety of this technique.

Materials and methods: We treated 1450 patients always using a protection device. We treated both symptomatic (60%) and asymptomatic patients (40%); each candidate was previously clinically evaluated by Neurologist and Angiologists. 60% stenosis was the cut off to select symptomatic patients and 80% was the cut off for asymptomatic patients.

Results: Outcomes were evaluated on a mean follow-up of 47.4 months (range 6-118). In the periprocedural period (up to 30 days), 2.4% of patients of the symptomatic group had a minor stroke and 1.2% had a major stroke (one fatal stroke). 1.4% of the asymptomatic group had a minor stroke and 1.5% had a major stroke. 0.4% of patients died for cardiac reasons. The restenosis rate was 3% using a cut off of 50% of stenosis.

Conclusion: Global stroke (symptomatic + asymptomatic) and death rate was 3.4%. In the symptomatic group we had 3.6% of all types of cerebral stroke and 2.9% in the asymptomatic group. Our findings demonstrate that carotid angioplasty is a safe procedure with a complication rate similar to surgical literature but with a lower incidence of cardiac complications. Our results are in line with those of recent randomised studies.

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3103.3

Intracranial stenting

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Learning Objectives:
1. To learn how to define treatment indication based on imaging and clinical setting
2. To learn basic endovascular treatment approaches
3. To learn how to select stent according to the lesion

No abstract available.

Special Session Imaging after EVAR

3104.1

Update on CTA protocols and results: single, double or triple phase scan?

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Learning Objectives:
1. To learn how to perform a proper CTA study after EVAR
2. To learn how to optimize the scanning protocol for best possible results
3. To discuss pros and cons of single or multiple phase scans

Reasons for follow up after EVAR

In contrary to patients after surgical repair, patients after endovascular treatment of their aortic aneurysms require life time follow up imaging. There are different reasons for this need for follow-up: the life expectancy of the materials used for endovascular treatment might be limited – the first generation of stentgrafts has shown severe fractures of the used material. Additionally the chronic and progressive character of atherosclerosis can cause progression of aortic dilatation leading to movement of the prosthesis or insufficient aneurysm exclusion with time. Furthermore, endoleaks can generate further grow of the aneurismal sac even after stentgraft placement. Such endoleaks might appear even years after stentgraft placement. Finally, additional, unexpected findings like tumors should be detected during follow up.

Reasons for using CTA for follow up after EVAR

CT angiographies of the aorta using state of the art Multislice scanners represent very robust and easy to perform imaging studies. Once a routine imaging protocol has been established, this protocol can be performed with excellent results in every patient allowing for exact and reliable intra-patient comparisons during follow-up time as well as compared to the baseline examination, which is usually performed by using CTA. CTA's of large imaging volumes (for example the entire aorta) can be acquired with high spatial resolution in a very short acquisition time of less than20 seconds. The advantages of CTA compared to other imaging modalities include the high reliability, the good comparability to previous CTA studies and the high spatial resolution. However, disadvantageous for the use of CTA is the radiation exposure and the use of iodinated contrast agents, combined with the risk for causing contrast induced nephropathy (CIN) in patients at risk, and most of the patients after stentgraft placement due to aneurysmatic disease are at risk for or suffer from impaired renal function.

Within this presentation optimized imaging protocols for CTA's after stentgraft placement should be demonstrated including the implementation of state-of-the-art dose saving techniques. Additionally, optimized contrast-injection protocols should be discussed

providing satisfactory diagnostic image quality with low contrast volumes.

CTA after EVAR

Due to the above mentioned need for life-time follow-up after endovascular stentgraft implantation, radiation exposure due to diagnostic imaging is an important issue to avoid relevant cumulative radiation doses to the patients. On the other hand maximal diagnostic information should be provided by any follow up examination. The main task for imaging after EVAR is the detection of treatment associated complications, disease progression and/or other relevant diseases. Treatment related complications are mainly described by growth of the aneurismal sac, the presence of endoleaks and stent fractures or occlusions of stentgraft legs, whereas disease progression might be described by the occurrence of new aneurysm in previously untreated parts of the arterial vasculature (iliac arteries, thoraco-abdominal aorta, visceral arteries) or by the occurrence of stenotic arterial lesions. Finally, unexpected, additional findings like tumors or stones should be detected. Imaging protocol for CTA after EVAR should therefore provide a sufficient compromise between diagnostic accuracy and reasonable low radiation dose exposition.

Different protocols have been published in the scientific literature so far advocating the standardized acquisition of single, double or even triple phase imaging for follow up after stentgraft. The acquisition of a native scan might be advantageous to differentiate between calcifications and endoleaks as well as to allow for density measurements within the aneurismal sac in case of obscured endoleaks [1-3]. However, the substitution of the real native phase by a virtual non-contrast scan obtained using a Dual-Energy technique has been recommended recently [4-5]. Additionally, even about the necessity of acquiring arterial and venous or arterial or venous phase imaging no clear guidelines do already exist within the literature [1-3]. In this presentation, an overview about the current literature on this question should be provided. Furthermore, the pro's and con's of single, double or triple phase scans should be discussed.

By attending this presentation, the audience will receive information's about the state of the art CTA technique after EVAR including the incorporation of modern dose saving strategies and will learn about the advantages and disadvantages of acquiring multiphase scans in patients after EVAR.

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3104.2

MRI, MRA protocols and results

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Learning Objectives:

1. To learn how to perform a proper MRA study after EVAR
2. To learn how to optimize the MR scanning protocol for best possible results
3. To discuss pros and cons of different protocols and techniques in the EVAR patient

No abstract available.

3104.3

Can CEUS replace current modalities?

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Learning Objectives:

1. To discuss the role of CEUS in diagnostics of EVAR patients
2. To discuss the different techniques and its results
3. To discuss pros and cons of CEUS vs. established modalities

Endovascular repair (EVAR) is playing an increasing role in the treatment of abdominal aortic aneurysm. A successful procedure depends on the complete sealing of the aneurysm sac from blood flow to achieve general pressure relief and avoid aneurysm rupture, with shrinkage of the aneurysm sac. However, many patients treated with EVAR require re-intervention in the middle and late follow-up. For this reason, a strictly surveillance of these patients is mandatory to early detect an endoleaks as well as other procedure-related complications. The standard of reference in the post-EVAR follow-up is represented by CT-angiography. However, CTA has limitations, principally represented by the radiation exposure. Therefore, it would be useful to have another reliable diagnostic examination during follow-up. CEUS seems to be a fast, non-invasive, less expensive, reliable and valid alternative to MSCT angiography for endoleak detection in endovascular aortic stent graft patients.

It will be reviewed ultrasound contrast agents and contrast-specific imaging characteristics, in order to learn the contrast-enhanced ultrasound (CE-US) scanning technique and to illustrate its feasibility to obtain an early detection and treatment of eventual post-EVAR complications.

On CE-US images, the endoleak appears as a high attenuation area beyond the graft but within the aneurysm sac, absent on the baseline unenhanced phase images, due to the presence of contrast enhancement. The evaluation is based on visual assessment, without attenuation measurements, with particular attention to the endoleaks wash-in (defined as the time between beginning of contrast material injection and contrast visualization within the aneurysm sac), endoleaks wash-out (defined as the time between beginning of contrast material injection and disappearance of all contrast from the sac), the origin of the endoleaks as well as the identification of inflow and outflow collateral vessels. The enhancement morphology of endoleaks should be either as "cavity filling" (defined as contrast concentration into a pseudocavity within the sac) or a simple diffuse spreading of contrast agent into the thrombus. Recent literature demonstrated that, due to the longer duration of enhancement, lack of metallic artifacts and angio-dynamic evaluation of the leak during the dynamic phase, CEUS seems similar to MRA but more specific than CTA in detection of small low-flow endoleaks. In endoleaks classification, CEUS seems more specific than CTA and MRA thanks to longer duration of enhancement, lack of

metallic artifacts and angio-dynamic evaluation of the leak during the dynamic phase.
CE-US is also similar to MRA and CTA in the evaluation of patency of stent-graft and distal iliac-femoral districts as well as in the assessment of sac aneurysm changes.
However, CEUS also has some limitations: patient habitus (obesity) and bowel gas can interfere with imaging and the patient must cooperate. Moreover, sonographic examination results are operator-dependent and obtaining quality images requires training and specific skills.
Furthermore, in the post-EVAR follow-up, CEUS cannot replace CT-angiography in providing information related to graft anchoring and integrity, aneurysm morphologic changes or visceral vessels patency (renal arteries).
Our suggested post-EVAR follow up is based on CTA or MRA at 1 and 12 months after EVAR with CEUS performed at 6 months and annually thereafter, if no complications are detected.

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3104.4

How to manage patients with renal insufficiency?

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Learning Objectives:

1. To define the problem of renal patient management
2. To discuss if and how MRA, CTA and DSA can be applied
3. To discuss how to medically and clinically support the patient before, during and after imaging/intervention

Contrast-enhanced computed tomography (CTA) has long been considered the gold standard to assess patients following endovascular aneurysm repair (EVAR).
CTA is used because it gives a comprehensive overview of the AAA sac, of the stent graft, and can readily detect complications. Most follow-up protocols involve assessing if the sac is shrinking, stable in size or increasing in size. Complications are then excluded by looking for evidence of endoleak, and if present attempting to classify it to assess risk of rupture. The shape, position and integrity of the stent graft can also be easily assessed. This allows identification of limb kinking that may lead to limb occlusion or dislocation. Migration can be assessed, prior to development of endoleak, and if the stent graft is fractured the impact can be monitored more closely.
Unfortunately to carry out a detailed CTA examination requires the use of potentially nephrotoxic iodinated contrast, and this is problematic in those with renal insufficiency, especially as the repeated insult of multiple follow up studies can have an incremental deleterious effect on renal function.
This presentation will examine how to mitigate the risks of using CTA in these patients.
Various nephroprotective approaches can be tried. Adequate hydration is vital, and some have suggested that fluids and forced diuresis is useful. Antioxidants such as N-acetylcysteine are widely used but the trial data are mixed. Other medical approaches include use of drugs that act upon the renal circulation, but the results are again uncertain. Statins also have theoretical benefits, but their effect is probably best felt in terms of secondary prevention of cardiac events.
Alternatively do away with CTA altogether. Many now feel that use of CTA is not necessary for all cases following EVAR, and certainly not as frequently as cases were imaged in the past. Alternative approaches have been proposed with various simplified follow up imaging protocols mostly centred around the use of ultrasound as the primary imaging modality. Other approaches can use other imaging techniques, with MRI/MRA showing some promise. Non-contrast CT can also be considered, though as this will simply measure sac size, its advantage over Ultrasound assessment of sac size is questionable. All these approaches have the advantage of not requiring the nephrotoxic contrast used in CTA. Some protocols call for the use of CTA, especially early in the follow up following EVAR, but with the aim that use of other imaging modalities will reduce the proportion of cases and the frequency with which CTA is required.
Some patients with renal insufficiency will inevitably require further assessment and treatment because of problems identified at follow up imaging, whatever follow up imaging method is used. If possible most will be treated using endovascular techniques, and conventionally this would require the use of iodinated contrast. If using digital subtraction angiography alternative contrast agents are available, and in the context of EVAR follow up carbon dioxide angiography is probably the most useful. This can often be used to help evaluate endoleak, as well as guide appropriate intervention.

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CIRSE 2011

PART 2

Free Papers

**Abstracts of
free paper presentations
(oral communications)
sorted by presentation numbers**

Cardiovascular and Interventional Radiological Society of Europe

CIRSE

Free Paper Session
Abdominal non-vascular interventions

1301.1

Percutaneous endobiliary RFA and ductoplasty for biliary patency restoration: an early experience

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Purpose: This abstract reports the early experience of a new technique of percutaneous biliary recanalization using endobiliary radiofrequency ablation (RFA).
Material and Methods: Percutaneous RFA and ductoplasty was performed in 5 patients (age range: 31 to 72 years; head of pancreas (n=2); common bile duct tumour (n=1); tumour blocked metal stent (n=1), hepatic duct stricture (n=1)). The procedure was performed one to two weeks after biliary decompression with percutaneous transhepatic cholangiostomy (PTC). RFA ablation was performed under general anaesthetic using 10 Watts of power for 2 minutes using a new 8Fr bipolar RF catheter (Habib™ EndoHPB, EMcision Ltd., London, UK) placed in the biliary stricture area using a guidewire technique. RFA application was immediately followed by balloon ductoplasty. The balloon was kept inflated for 2 minutes. Subsequently, the PTC catheters were kept in a closed position proximal to the biliary stricture in order to maintain access to biliary tree in case of drainage failure.
Results: Percutaneous endobiliary RFA with subsequent ductoplasty restored bile duct patency in all cases as assessed by contrast injection and follow-up CT scan. No procedural complications were observed. The longest follow-up period was 2 months.
Conclusion: Percutaneous endobiliary RFA and ductoplasty may offer an effective option to restore biliary patency. It may also offer additional palliative potential. However, longer follow up and randomized studies are warranted.

1301.2

Percutaneous transhepatic management of non-anastomotic biliary stricture with plastic endoprostheses in the liver transplantation: evaluation of efficacy and feasibility

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Purpose: To evaluate the feasibility and efficacy of plastic endoprostheses as a stenting device for non-anastomotic biliary stricture in liver transplantation.
Material and Methods: From 2005 to 2009, 84 patients (male 68, female 16; mean age 55.3 ± 9.8; cadaveric donor transplantation 40, living donor transplantation 44) with biliary stricture underwent transhepatic biliary intervention using plastic endoprostheses (diameter 7Fr or 10Fr; length 5cm, 7cm, or 10cm), and 48 patients (male 41, female 7; mean age 57.2 ± 7.9; cadaveric donor transplantation 38, living donor transplantation 10) were treated for non-anastomotic biliary stricture (unilateral focal 1, confluence 13, bilateral multifocal 18, diffuse necrosis 16). Prostheses were inserted in the biliary tract pushed by an introducer sheath (8Fr) for the 7Fr prostheses or a fragmented OASIS stent introduction system for the 10Fr prostheses coaxially over the guidewire, and were removed using a wire basket or a biopsy forceps.
Results: Of 48 patients, 34 patients including one patient with total occlusion of hepatic artery are in good condition, one patient is still under treatment using plastic endoprostheses, one patient is scheduled for retransplantation due to deteriorated hepatic function, one patient passed away due to rupture of MCA aneurysm, four patients passed away due to multiorgan failure, and seven patients were lost to follow-up.
Conclusion: Percutaneous transhepatic insertion and removal of plastic endoprostheses is a useful and feasible method for the management and treatment of non-anastomotic biliary stricture, and can improve the function of the graft and prolong the survival of the graft and the patient.

1301.3

A randomised controlled study on the effectiveness of 'anti-reflux' stent versus 'standard open' for inoperable tumours of gastro oesophageal junction and in the prevention of symptomatic gastro-oesophageal reflux

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Purpose: To compare the efficacy of 'stent with antireflux valve' (ARS) with 'standard open stent' (SOS) in the prevention of symptomatic gastro-oesophageal reflux in patients with gastro-oesophageal junction (GOJ) tumours.
Material and Methods: Ethics Committee approval was granted. 50 consecutive patients with inoperable GOJ tumours were randomised to receive either ARS or SOS at a single UK centre between August 2006 and August 2010. Technical and clinical success rates, complications, quality of life and survival data were collected. Efficacy was determined from dysphagia and reflux scores obtained before and 48 hrs post-procedure.
Results: 27 patients received ARS and 23 SOS. Technical success rate was 94%. Post-procedure dysphagia and reflux scores were better in ARS group; 1.7 (SD 0.9) and 0.8 (SD 0.8), respectively, as opposed to 2.4 (SD 0.7) and 1.2 (SD 1.1) in the SOS group. However, there was no statistical significance between the two groups, either in reflux (p=0.61) or dysphagia (p=0.29) when change from pre-procedure score was evaluated. Immediate complications were similar between the two groups. Late complications (stent migration, tumour ingrowth and stent fracture) were more common in the ARS group but this did not reach statistical significance (P=0.23).
Conclusion: The use of ARS confers no measurable advantage with regard to reflux symptoms, dysphagia or complication rate for patients with inoperable GOJ tumours compared with SOS.

1301.4

Our successful experience of 59 transcutaneous stenting procedures on main pancreatic duct in cases of complicated chronic obstructive pancreatitis

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Purpose: To determine the safety and efficacy of antegrade transcutaneous pancreatoduodenal stenting procedures in the treatment of complicated chronic obstructive pancreatitis.
Material and Methods: Between 2006 and 2011, 59 patients affected by obstructed pancreatitis with pancreatic destruction and round pancreas fluid collections were primarily undergone an transcutaneous external drainage of main pancreatic duct and fluid collection areas. We used two techniques – antegrade direct transcutaneous approach into main pancreatic duct with subsequent balloon pancreatic duct distension (23 patients) and temporary

external-internal pancreatoduodenal drainage (9 patients) and stents implantation (14 patients). Three times balloon and self-expended stents were used, eleven times – plastic one was used. In cases of extensional severe stricture of proximal part of main pancreatic duct (26 patients) we used transcutaneous trans duodenal or trans stomach punctural approach into the duct with subsequent pancreatoduodenal bypass, displace external part of drain tube into duodenal lumen. Additionally in 3 patients, it was realized transcutaneous removal of main pancreatic duct stones.
Results: Success was achieved in all 59 cases. There was 1 bleeding, 3 drain tubes displaced.
Conclusion: Our experience confirms that transcutaneous approach to the main pancreatic duct above stricture area even using trans stomach and trans duodenal mode can be free from complications due to strict execution of technique procedure. Transcutaneous pancreatic duct stenting procedures resolve effective pancreatic hypertension and inflammation.

1301.5

Powdered collagen for transhepatic track embolisation after percutaneous biliary intervention

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Purpose: To assess whether Avitene flour (Bard UK), a haemostatic collagen powder can be used for track occlusion after percutaneous biliary procedures.
Material and Methods: A two-centre retrospective review was performed for cases of Avitene embolisation of the hepatic track. 0.5g collagen was mixed with 6-8ml of non-ionic contrast to a radiopaque paste and injected under fluoroscopic control at the end of the procedure while withdrawing the catheter. The off-label use was approved by the drugs and therapeutics committee at The Christie.
Results: 58 stent placements with embolisation were performed in 59 cancer patients, 11 were high risk for haemorrhage. 35 were done as a single, 24 as a staged procedure. The radiopaque paste could be administered accurately avoiding intraductal injection in all patients. There were no adverse events to the collagen and no procedural complications. Suspected post-PTC haemorrhage occurred in 3.4% (2/59) treated with transfusion only, compared to a national average of 6.1%. No biliary peritonitis or biloma occurred. No adverse effects from the collagen were seen, specifically no hypersensitivity or abscess formation. 30-day mortality was 20% (12/58), in line with national average as published through the Biliary Drainage and Stent Registry of the British Society of Interventional Radiology.
Conclusion: Avitene flour is a cheap (approx. € 55.-) and easy method of embolising the transhepatic track. It is a physiological approach with a bioabsorbable product leaving no residual material. Initial results indeed suggest that it has the potential for reducing post-procedure haemorrhage and bile leak and may allow more single-staged procedures and reduce hospital stay.

1301.6

Colorectal stenting in large bowel obstruction: our experience

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Purpose: To review our technical and clinical success outcomes following colonic stenting for large bowel obstruction (LBO) performed at our institution.
Material and Methods: A retrospective study of all patients where colonic stenting was attempted from February 2006 to December 2010. Data on patient demographics/presentation, stenting procedure, outcomes/complications, location/length of stricture were obtained from a secure PACS database, electronic medical records and interventional radiology database.
Results: A total of 182 procedures with a mean age of 71.9 years. 20/162 patients had two procedures. Technical success rate was 81.9% and clinical success rate was 78.6% (121/154). Stent-related perforations occurred in 5.2%, stent migration in 9.7% and in-stent tumour growth in 5.2%. The 30-day mortality for successfully stented patients was 10.5%. Clinical success and technical success were significantly reduced in patients with lesion lengths ≥5cm (p=0.0016,0.039) and if lesions were based on flexures (p=0.009,0.0202). Technical success was also significantly reduced if symptoms to stenting were >1 week (p=0.011). Patients in whom perforations occurred were significantly older (p=0.0378); however, age was not a factor in perforation at the stent site itself. There was no significance between the type of stent and complications.
Conclusion: Adverse outcome was associated with increasing time from presentation of symptoms to stenting, stents placed at flexures, longer length of strictures or increasing age of the patient. Colonic stenting for LBO remains a useful tool as a bridge to surgery or palliation, but there are still significant complications related to colonic stent placement. Appropriate patient selection is paramount when considering patients to stent.

Free Paper Session
Bone, spine and soft tissue intervention 1

1302.1

Cryoablation/vertebroplasty versus radiofrequency/vertebroplasty in neoplastic vertebral localisation

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Purpose: The aim of our study was to emphasize the state of the art in vertebral neoplastic percutaneous palliative treatment by comparing the visual analogue scale (VAS) scores in cryoablation plus vertebroplasty versus radiofrequency plus vertebroplasty, and their feasibility, reliability and efficacy in short-term series.
Material and Methods: Combined procedure of radiofrequency (RF) thermal ablation plus vertebroplasty or cryoablation plus vertebroplasty were performed in osteolytic neoplastic localizations in 45 consecutive patients suffering from pain refractory to conservative therapies. We evaluated pain with a "visual analogue scale" (VAS) performed in the preoperative period and at 4 hours, 24 hours, 1 week, 1 month, 3 months and 6 months from the procedure.
Results: There were no statistical significant differences in the VAS score between patients treated with cryoablation and

vertebroplasty and those treated with RF ablation and vertebroplasty at 1 week (p=0.34), 1 month (p=1), 3 months (p=0.68) and 6 months (p=0.65). Patients treated with cryoablation and vertebroplasty have less pain at 4 hours (p<0.001) and at 24 hours (p<0.001) than patients treated with RF ablation and vertebroplasty.
Conclusion: Both RF-ablation and cryoablation are optimal techniques in the treatment of painful vertebral neoplastic lesions. Cryoablation achieves reduced treatment-related pain in the early follow-up time and a better volume control by real-time depiction of ablation margins.

1302.2

Has the percutaneous vertebroplasty a role in preventing local tumor progression/recurrence in spinal breast cancer metastases?

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Purpose: To evaluate the efficacy of percutaneous vertebroplasty (PV) in prevention of progression and/or local recurrence in patients who have spinal metastases from breast cancer.
Material and Methods: Retrospective study involving 52 patients referred from one institution (Institut Curie) between 28 and 85 years of age (mean age = 57y) treated for spinal bone metastases from breast cancer by acrylic transpedicular vertebroplasty (number of treated vertebrae = 117), from January 2000 to December 2009. Each patient had a spinal MRI at imaging follow-up, with a mean delay of 36 months. Statistical correlation between the local tumor progression/recurrence, the degree of cement filling the original vertebral metastases (<50%, ≥ 50% but incomplete, complete/almost complete), and the presence of an epidural or a paravertebral metastatic extension at diagnosis was evaluated using Fisher exact test.
Results: The rate of local tumor progression/recurrence after treatment by PV was 9%. No statistically significant correlation between the degree of cement filling, the presence of an epidural or paravertebral metastatic extension, and the progression or local recurrence after PV was found by the statistical analysis.
Conclusion: Local recurrences/progressions after PV in bone metastases from breast cancer are rare. Cement filling of the lesion as well as the absence of epidural or paravertebral extension at the moment of the diagnosis is not recorrelated with the absence of recurrence.

1302.3

Comparative prospective study upon load distribution variation among patients with vertebral fractures treated with percutaneous vertebroplasty and a control group of healthy volunteers

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Purpose: Through a comparison of patients with vertebral fractures and normal population, we illustrate effect of percutaneous vertebroplasty (PV) upon load distribution changes (among two feet - among rear and front of the same foot) during standing and walking.
Material and Methods: Last year, we prospectively compared 2 groups. Group A (36 patients, 75±15 years) with vertebral fractures were evaluated on an electronic baropodometer. Load distribution between right and left foot during standing and walking was recorded and compared prior (Group A1) and the day after (Group A2) PV. Group B (30 patients, 42±13 years) with no back pain or surgery record (normal population) were evaluated on the same electronic baropodometer. The two groups were compared by means of related samples Wilkoxon Signed Rank test.
Results: Mean value of load distribution between rear and front of the same foot for the normal population was 9.45±6.79% upon standing and 14.76±7.09% upon walking. Mean value of load distribution between rear and front of the same foot prior to percutaneous vertebroplasty was 16.52±11.23% upon standing and 30.91±19.26% upon walking. Load distribution post-vertebroplasty was 10.08±6.26% upon standing and 14.25±7.68% upon walking. Comparison of load distribution among Group A1 and Group A2 or Group A1 and Group B is statistically significant (p=0.001 and p=0.011, respectively). Comparison of load distribution among Group A2 and Group B is not statistically significant (p=0.486).
Conclusion: Comparative groups enable us to consider that PV apart from the already known pain reduction effect is efficient on equilibrium and load distribution improvement as well.

1302.4

Analysis of risk factors for pathological fracture after cementoplasty of metastasis of the proximal femur

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Purpose: Percutaneous cementoplasty is an effective treatment for painful bone metastases. It has been used for patients with metastases of the proximal femur. However, several reports in the literature have concluded that cementoplasty does not provide adequate mechanical stability because of the body weight and should be contraindicated. We have evaluated risk factors for pathological fracture after cementoplasty of metastasis of the proximal femur.
Material and Methods: We have retrospectively analyzed all consecutive patients who underwent percutaneous cementoplasty for painful metastasis of the proximal femur from June 2003 to October 2010. Patients were not candidates for surgical stabilization because of poor performance status or refusal. The risk factors studied were the size of the lesion (axial plan, coronal plan and volume), the cortical involvement (length in coronal plan and circumference) and the fracture of the lesser trochanter prior to the cementoplasty.
Results: 17 patients underwent cementoplasty for painful metastasis of the proximal femur. A pathological fracture occurs in 41% (n=7/17). The sizes of the lesions were not predictive of fracture. However, the cortical involvement ≥30 mm in coronal plan (p=0.004) or >50mm in circumference (p=0.0008) were predictive of fracture. The fracture of the lesser trochanter was predictive as well (p=0.02).
Conclusion: Cementoplasty can be performed for proximal metastasis of the femur in case of cortical involvement <30 mm in coronal plan, <50% in circumference and no fracture of the lesser trochanter. Otherwise, surgery is highly required to improve mechanical stability.

1302.5

One-year survey of two different ultrasound (US)-guided percutaneous treatments of lateral epicondylitis: results of a randomised controlled trial

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Purpose: Lateral epicondylitis is a common cause of elbow pain in general population. We show the efficacy of a percutaneous treatment under US guidance in treating this condition.
Material and Methods: 32 patients (18 males, 14 females, mean age

45±8.6) suffering from lateral epicondylitis underwent an US-guided percutaneous treatment. They were randomly subdivided into two groups. In the first group (16 patients), under local anaesthesia and US guidance, a needle was advanced into the enthesis of the common extensor tendon. There, we performed multiple punctures to obtain a scarification of the enthesis and of the preinsertional portion of the tendon. In a second group (16 patients), an US-guided steroid injection was performed. A visual analogue scale was used to evaluate the degree of pain pre- and post-treatment at 2, 12, 24 and 48 weeks.
Results: In the first group, no significant improvement compared with baseline was found at 2 weeks but was present at 12, 24 and 48 weeks ($p < .001$ for all). In the second group, significant improvement compared with baseline was found at 2 weeks ($p < .001$) but not at 12, 24 and 48 weeks. Comparison between the groups showed significantly different outcome in favour of the second group at two weeks ($p < .001$) and in favour of the first group at 12, 24 and 48 weeks ($p < .001$).
Conclusion: US-guided percutaneous dry needling alone is more effective than steroid injection. The efficacy of this treatment seems to be long-lasting. It can be considered as an effective and minimally invasive treatment for lateral epicondylitis.

1302.6

Percutaneous vertebroplasty with CT-rotational fluoroscopy imaging technique

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Purpose: The development of a C-arm cone-beam CT unit coupled with flat detectors has markedly increased anatomic visualization capabilities for interventional radiology procedures. Our aim was to evaluate the reliability of a rotational angiographic unit (RA) with flat-panel detector as a single technique to guide percutaneous vertebroplasty (PVP) and for post-procedure imaging processing by 2D and 3D reformatted images.
Material and Methods: Twenty-five consecutive patients (35 vertebral bodies, 20 lumbar and 15 thoracic) were treated under RA fluoroscopy. Using a ceiling-mounted angiographer (Artis zee, Siemens, Erlangen, Germany) rotational acquisitions with 2D and 3D (Software 3D Dyna CT) reconstructions were obtained in all patients for immediate post-procedure assessment with a dedicated workstation (Syngo Workstation, Siemens, Erlangen, Germany). Rotational CT acquisitions were used to evaluate the position of the needle during the procedure. Fluoroscopy time, patient exposure radiation dose, technical success of the procedures, mean procedure time, mean number of rotational acquisitions and complications were recorded.
Results: In all cases, a safe trans-pedicular access and an accurate control of the bone-cement injection were successfully performed. No cement leakages were encountered. The mean (+/-SD) procedure time was 35,2+/-20,3 minutes, and the median fluoroscopy time was 4 minutes 58 seconds. Median number of rotational acquisitions was 3 and mean patient dose was approximately 6+/-1,3 mSv. There were minor complications (pain, small hematoma) in two patients (4.3%).
Conclusion: PVP with 3D fluoroscopy with rotational CT acquisitions is a reliable and feasible technique reducing time of the procedure and allowing fast and cost-effective procedures with high rate of success.

Free Paper Session
Embolotherapy

1303.1

Peripheral and visceral embolotherapy with ethylene vinyl alcohol copolymer (Onyx): incidence of non-target vessel embolization and ischemic complications

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Purpose: To determine the risk of non-target vessel embolization and ischemic complications following embolotherapy with the liquid embolic agent ethylene vinyl alcohol copolymer (Onyx).
Material and Methods: Between January 2004 and January 2011, one hundred ninety-nine patients underwent peripheral or visceral embolotherapy using the liquid embolic agent Onyx. All angiograms were retrospectively evaluated with respect to migration of Onyx into non-target vessels. In addition, all medical charts were reviewed to identify all patients who presented ischemic complications that required surgical or endoscopic intervention or prolonged hospital stay. Follow-up was performed until death or discharge from hospital.
Results: Embolotherapy with Onyx was performed for treatment of acute arterial hemorrhage (83 patients), embolization of esophageal and gastral varices after TIPS creation (61 patients), preoperative tumor-embolization (10 patients), embolization of arteries prior to SIRT (10 patients), embolization of endoleaks (9 patients), embolization of AV-shunts (7 patients), embolization of aneurysms and pseudoaneurysms (6 patients) and miscellaneous indications (13 patients). Migration of Onyx into non-target vessels occurred in five patients (2.5%). In these five patients no ischemic complications emerged. In four patients (2.0%) embolization with Onyx caused ischemic complications requiring surgical intervention (two times splenectomy, two bowel resections).
Conclusion: Peripheral and visceral vessel embolization using the liquid embolic agent Onyx is safe and effective. To avoid complications specific material properties of Onyx have to be considered.

1303.2

Contrast-enhanced magnetic resonance angiography as a screening procedure for the initial detection of pulmonary arterio-venous malformations and for follow-up after embolization therapy in patients with HHT

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Purpose: To evaluate contrast-enhanced magnetic resonance angiography (CE-MRA) as a screening procedure for the detection of pulmonary arterio-venous malformations (PAVM) in hereditary hemorrhagic telangiectasia (HHT) and for follow-up after embolization-therapy.
Material and Methods: 259 patients (mean age 46.3, male 106, female 153) with confirmed HHT according to Curacao criteria or their first degree relatives underwent screening pulmonary CE-MRA (Gadolinium-BOPTA 0.1 mmol/kg bodyweight) for the presence of PAVM. Patients with at least one PAVM ≥5 mm or a feeding pulmonary artery diameter >3 mm were referred for conventional pulmonary angiography (DSA) for embolization-therapy.
Results: Overall, CE-MRA detected 265 PAVM in 87 of 259 patients

(33.6%) (120 in 39 men, 145 in 48 women, 87 in 30 women of child-bearing age <=50 years). One PAVM was detected in 38 patients, two PAVMs in 16 patients, three in 8 patients and >=4 in 25 patients. Most PAVMs detected on CE-MRA were small (<10 mm). 67 of 87 patients with 218 evaluable PAVMs detected on CE-MRA underwent global or selective DSA. Significantly (p<0.001) fewer PAVMs (163/218 [74.8%]) were demonstrated on global DSA of which 152 were embolized. Follow-up CE-MRA showed 57 new PAVM in 14 patients (interval 1-6years), and 22 reperfused PAVM (due to recanalization, opening of collaterals, insufficient packing) in 19 patients (female 11) (interval 3 months-7 years).
Conclusion: CE-MRA is a suitable screening procedure permitting accurate detection and appropriate differentiation of PAVM in HHT requiring embolization. Tight packing is a prerequisite in coil-embolization for permanent occlusion. Despite initial successful embolization, reperfusion may occur. Consequently, regular follow-up is mandatory.

1303.3

The safety and outcome of prostatic artery embolization to treat benign prostatic hyperplasia

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Purpose: To evaluate the safety, short and medium term results of prostatic artery embolization (PAE) for symptomatic benign prostatic hyperplasia (BPH).
Material and Methods: PAE performed in 79 patients with symptomatic BPH. Age 52 – 82; mean 67.6 years. Prostate volume, PSA, uroflowmetry, International Prostate Symptom Score, and International Index Erectile Function were evaluated before and at 1, 3, 6, 12 and 18 months after PAE. Mean prostate volume before PAE was 78cc. The procedure was performed by femoral approach with a C2F5 and a micro catheter. Nonspherical PVA particles 200 mm were used in the first 14 patients and 100 mm in the last 64 patients. Control follow-up performed between 1 and 18 months (mean 7.8 months).
Results: Technical success achieved in 78 of the 79 patients (98.7%). Clinical success achieved in 74 patients (94.9%) with significant improvement in 62 patients (79.5%) and slight improvement in 12 (15.4%). After the procedure none of the patients needed continuation of prostatic medication. Four patients did not improve (5.1%) due to unilateral embolization (3 patients) and incomplete embolization (1 patient). There was one major complication (1.5 cm2 sized bladder wall ischaemia treated surgically). In 21 (26.9%) patients the sexual function improved and there were no cases of sexual dysfunction related to the procedure. Most patients did not feel any pain during the procedure and were discharged as outpatients.
Conclusion: PAE in patients with symptomatic PBH is safe, with low morbidity, no sexual dysfunction, good short and medium term results allowing removal of all prostatic medication.

1303.4

Haemophilic chronic sinovitis: therapy of haemarthrosis using endovascular embolization in knee and elbow

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Purpose: To show the effect of embolization therapy in patients with haemophilic sinovitis and haemarthrosis.
Material and Methods: 23 patients, 2 with inhibitors, ranging from 12 to 56 y-o, presenting at least a minimum of 3 haemarthrosis events in 6 months, and sinovitis. We performed 26 procedures. Angiography of genicular arteries in the knee (18) and ulnar and radial arteries in the elbow (6) was followed by selective gelfoam or PVA particles embolization in blush or hypervascular lakes using standard endovascular technique. MR image was performed before and in 2 and 6 months control. Follow-up between 6 and 42 months, evaluating number of haemathrosis events, amount of coagulation, substitutive factors used and QOL.
Results: All patients have QOL improvement and gaining effectiveness in physiotherapy. In the knee group the average of days without clinical events was 112±76.8. These patients reduced the number of events and the severity of them and consumption of coagulation substitutive factors decreased (p<0.01) at 6 months in the whole study and (p<0.01) at 18 months in patients bleeding more than 3 events in 3 months. One patient had to be re-embolized at 6 months. Technical success was 96,15% without major complications and adverse effects. In the elbow group 1 patient had bad results and coincided with an insufficient technical embolization.
Conclusion: In haemophilic patients with chronic knee/elbow sinovitis, endovascular embolization seems to offer a safe therapeutic option to treat haemarthrosis and reduce sinovitis.

1303.5

Treatment of peripheral vascular malformation: a new concept of low pressure sclerotherapy

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Purpose: Intra-lesion injection and compression of venous out flow are responsible for an elevation intra-lesion pressure that can induce peripheral diffusion of the sclerosis agent. We developed a concept of LPS by placing multiple needles in the lesion that allow free circulation of the sclerosing agent; these needles work as multiple valves that allow an out flow of the sclerosing agent.
Material and Methods: Between Sept. 2006 and Oct. 2010, 81 patients were treated with this concept. 57 patients with VM, 14 patients with LM: 2 micro- 12 macro-cystic and 10 patients for superficial AVM. Foam was used in all cases of VM and in two cases of micro-cystic lymphatic malformation. Absolute ethanol (AE) was used in 44 patients: 22 VM complementary to foam and 12 LM and 10 cases of peripheral AVM. Glue was used in 2 cases of AVM complementary to AE.
Results: Technical success was reached in all cases. Loss of volume at MR was 25-80%. Except two patients, large size VM patients were cosmetically improved and relieved of pain. Swelling of the lesion occurred in all patients and it was well tolerated and controlled with NSAID with resolution in few days. No significant complication occurred in all patients.
Conclusion: LPS concept using foam and AE in our experience over four years has proven the technique to be effective with dramatic decreasing of complication. AE is used to treat macro-cystic lymphatic malformation and superficial AVM and complementary

to foam STS in some VM with extreme care concerning the volume injected.

1303.6

MR-guided percutaneous embolization of low-flow vascular malformations: initial experience using a hybrid MR/X-ray fluoroscopy system

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Purpose: Low-flow vascular malformations (VM's) are typically treated using ultrasound/X-ray-guided percutaneous sclerotherapy. Many lesions cannot be seen with ultrasound and require multiple treatments and exposure to ionizing radiation. VMs can be easily identified and targeted using MR. MR can also be used to assess immediate post-procedural changes. We present our initial experience treating low-flow VMs using a 1.5T MRI/X-ray "Miyabi" suite.
Material and Methods: Between 9/7/2010 and 2/3/2011 patients with VMs were enrolled due to an inability to find their lesion(s) using ultrasound. All MR-guided-interventions were performed on a 1.5T MRI (MAGNETOM Espree/Siemens)/X-ray angiography (Axiom Artis dFA/Siemens) "Miyabi" suite. After planning MR, all lesions were accessed under real-time MR using 20-22G MR-compatible needles (Cook/InVivo). Patients with lymphatic malformations were treated in the scanner with doxycyclene (10mg/cc) through the access needle. Venous malformations were injected with diluted Gadopentate Dimeglumine and imaged to assess for venous drainage, then transferred to the angiography unit where an injection of i-oxilan 350 was used to confirm MR findings, followed by treatment with anhydrous ethanol. Follow-up MR was then acquired.
Results: Eight patients were enrolled (8-56 y.o.) with a total of 11 targeted malformations (6 venous/5 lymphatic). Of the 8 patients, 5 were treated, all with therapeutic response.
Conclusion: Low-flow VMs can be safely and effectively treated using a 1.5 T MR system. Our goal is to improve the MR-imaging protocol and to eliminate the use of X-ray altogether. Our next steps will involve the further development of rt-HASTE sequence as well as of a FLASH sequences for assessment of lesion flow/outflow.

Free Paper Session
EVAR and TEVAR 1

1304.1

Endovascular renal chimney stent-graft technique in patient with hostile proximal neck: technique and acute/mid-term results

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Purpose: To evaluate the feasibility, safety and efficacy of chimney-EVAR (Ch-EVAR) technique in patient with hostile proximal neck for standard EVAR.
Material and Methods: 18 patients considered at high surgical risk underwent Ch-EVAR. 14 balloon-expandable stent-graft and 7 bare stents were implanted in the renal arteries, 5 patients had bilateral renal chimney-graft. In all 18 patients, 6-10 ml of fibrin glue was injected into the sac by a 5Fcath to obtain a complete thrombosis and avoid late type-2 leak. The results of the Ch-EVAR procedure were evaluated at 1, 6 and 12 months by a MSCT and serum creatinine at 24h, 6 and 12 months.
Results: The sac was excluded in all cases and no endoleaks were found in the CT follow up at 1, 6 and 12 months. Average serum creatinine before the procedure was 1.4 mg/dl: at 24h, 6 and 12 months it was 1.9, 1.5 and 1.3 ml/dl, respectively. 2 patients had a worsening of serum creatinine at 24 hours for renal stent thrombosis. Only 1 patient was treated while in the second the stent-graft was embedded into a thrombus of the aortic wall and no attempt to repair was made.
Conclusion: Ch-EVAR seems to be a safe, feasible and effective technique to treat patients with hostile proximal neck AAA, with no endoleaks and only an acute loss of one out of 20 renal arteries stented.

1304.2

A mid- to long-term experience of clinical efficacy and cost per quality-adjusted–life years with pararenal endovascular aortic repair (PEVAR) without fenestration for pararenal AAA compared with open surgical repair

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Purpose: EVAR affords more propitious peri-operative and long-term survival than open surgical repair (OSR). However, up to 70% of AAAs are anatomically incompatible with EVAR. We aim to gauge the feasibility of applying commercially available endografts to pararenal aneurysms compared with OSR. Primary endpoints were aneurysm-related survival and cost per quality-adjusted-life-years (QALY).
Material and Methods: From 2002 to 2009, 1868 patients with pararenal AAA were investigated. 118 had intervention and were described by consultant radiologists as 'unsuitable for EVAR'. 66 had OSR and 52 had pararenal EVAR (PEVAR). PEVAR patients were older (74.3 yrs vs. 70.8 yrs, p=0.014) with higher mean SVS co-morbidity severity scores (p=0.0001). All procedures were within 14 days of diagnosis. Mean aneurysm diameter was larger in OSR (OSR 6.6cm vs. PEVAR 5.9cm, p=0.010). For PEVAR 83% of endografts were 34mm/36mm.
Results: 3-year aneurysm-related survival was significantly higher with PEVAR (100% vs. OSR (92.4%+/-4.37%), p=0.045). PEVAR provided an incremental cost-effectiveness ratio of €129,586 saved per QALY gained. 3-year freedom from secondary intervention (PEVAR 83.4% vs OSR 95.5%, P=0.301) and all-cause survival (PEVAR 57.1% vs. OSR 84.8%, p=0.195) were similar. 30-day morbidity halved with PEVAR (15% vs. 30%, p=0.059). Length of hospital stay (p=0.0007) was lower and number of patients fit for discharge to their home (p=0.006) higher with PEVAR.
Conclusion: PEVAR granted our patients longer Q-TWiST and Superior Freedom from MACE up to three years. Despite 3-year survival rate of 57%, PEVAR is cost-effective and offered as endo-bailing for patients living on borrowed time, abolishes the socio-economic catastrophe of managing a rupture PAAA.

1304.3

Aneurysmal extension to the iliac bifurcation: comparison of bell-bottom technique versus hypogastric exclusion

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Purpose: Thirty percent of patients undergoing endovascular aneurysm repair (EVAR) have iliac artery aneurysms. Aneurysmal involvement at the iliac bifurcation potentially undermines long-term durability of the repair. Treatment and outcome in patients undergoing EVAR with unfavorable iliac anatomy is rarely reported.
Material and Methods: Patients who underwent EVAR with aneurysmal involvement at the iliac bifurcation were identified in two university teaching hospitals. Bell-bottom technique (iliac limb≥20mm) (BBT) or hypogastric artery embolization and iliac limb extension (ILE) were used. Outcomes of these two approaches are compared using Pearson Chi-square test.
Results: One-hundred-eighty-nine patients were identified from 2004 to 2009. Ninety-three percent were male, average age was 73 years (range 53-91). Indication for EVAR included asymptomatic AAA (n=157), symptomatic or ruptured aneurysm (n=23), and common iliac artery aneurysm (n=9). Average AAA diameter was 62 mm. A total of 237 unfavorable iliac bifurcations were treated. One-hundred-fifty-eight iliacs were treated with BBT, 79 underwent ILE. Hypogastric embolization was achieved by coiling (n=54) or vascular plug (n=36). Total reintervention rates were similar for BBT and ILE (7.2% vs 6.8%, p=0.1) including 3% of BBT and ILE needing reintervention for type 1b or 3 endoleak. There was no significant difference in limb patency rates. Median follow-up was 22 months. 30-day mortality was 1.5%.
Conclusion: Careful pre-operative planning enables patients with unfavorable iliac anatomy to be successfully treated with BBT or ILE. BBT with preservation of the hypogastrics is not associated with significantly higher rates of reintervention on mid-term follow-up. Therefore, when feasible, BBT is desirable.
Disclosure: Dr. Eskandari serves as a paid consultant for Harvard Clinical Research, Medtronic, and Abbott Vascular. Dr. Morasch receives honoraria for serving as training course director for W. L. Gore & Associates, Inc. and as consultant for King Pharmaceuticals.

1304.4

Frequency and significance of type II endoleaks after endovascular repair of abdominal aortic aneurysms during long-term follow-up

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Purpose: To evaluate frequency and aneurysm sack changes in type II endoleaks during long-term follow-up.
Material and Methods: 433 patients (mean age 72.9, range, 51 - 87 years) were retrospectively reviewed for type II endoleak. Data of 54 patients with type II endoleak and at least three-year follow-up were analysed. Two groups were defined according to their involved side-branches, with perfusion of the sac by lumbar arteries solely (group 1) and by lumbar arteries and the inferior mesenteric artery (group 2).
Results: Overall mean follow-up was 53.8 ± 29.3 months. 38.9% (n=21) of patients belong to group 1 and 61.1% (n=33) to group 2. By means of groups, diameter of the aneurysm sac decreased, was stable, or increased in 23.8%, 33.3%, 42.9% in group 1, and in 6.1%, 45.5%, 48.5% in group 2 (p=0.155) . During follow-up, 33.3% (n=18) reinterventions were performed, resulting in freedom from reintervention at 1, 3 and 5 years of 88.9%, 74.2% and 60.4%, respectively. Survival at 1, 3 and 5 years was 98.1%, 98.1% and 92.2% without type II related rupture.
Conclusion: Patients with type II endoleaks by lumbar artery solely had a higher rate of aneurysm sack shrinkage compared to a combined type II endoleak. Increase of the aneurysm sack did not cause rupture in long-term follow-up.

1304.5

A conformable stentgraft for the arch: results on the the first 94 patients

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Purpose: All thoracic stentgrafts are straight tubes and rarely arrange in a good way to the 3-dimensional curve of the aortic arch. Therefore, we tested a new conformable stentgraft (CTAG) over a period of one year. The primary outcomes were mortality, morbidity and conformability to the arch.
Material and Methods: From October 2009 through October 2010, 94 patients from five European centres were treated with this new device. In addition to demographic data, specific data with respect to the arch was collected and the CT scans were judged especially with respect to the apposition (defined as < 2mm distance from the inner wall) 55% were acute cases. The mean age was 68.5 years among the 64 males and 30 females. The mean ASA classification was 3.5. Fifty patients had a thoracic aneurysm, 22 an acute symptomatic B-dissection, 15 an intramural haematoma/penetrating ulcer and the last seven patients had a traumatic transection. 83% had hypertension and 26% coronary heart disease and 215 had a concomitant or operated AAA.
Results: The CTAG was introduced through the retrograde route in all cases. The landing zone was in the arch (zone 0-3) in 86 cases. The device was correctly (as intended) placed in 99%. Conformability was achieved in 95% of the cases. Three patients had an endoleak type 1. 30-day mortality was 11% and the stroke rate was 11%.
Conclusion: The CTAG shows a good apposition in the arch. The mortality was acceptable with respect to the cohort nature. The stroke rate was comparable to other series of arch surgery.
Disclosure: The CTAG registry is sponsored by the Gore company. I am consultant to the WL Gore.

1304.6

Zonal variations in the size of the atherosclerotic aortic arch during cardiac cycle and their implications on endovascular stenting

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Purpose: Atherosclerosis is the commonest cause of aortic aneurysm formation which is often treated by endovascular stenting. We aim to assess the expansile differences between the Ishimarus zones of the aortic arch throughout the cardiac cycle. This study further focuses on the implications of this variation in diameters, in negating the need for gated examination for sizing endovascular stents.

Material and Methods: Cardiac-gated CT examination of atherosclerotic ascending arch and descending aorta was evaluated retrospectively. Patients with acute aortic syndromes, connective tissue syndromes and aortitis were excluded. The best systolic and diastolic images were interrogated and true transverse slices were obtained using a 3D workstation for measuring the short and long axis diameters. Differences between the systolic and diastolic images for the short axis, long axis and an average of the two were calculated.
Results: A total of 135 zones were evaluated in 27 patients. The average variation between diastole and systole diameters was as follows. a) Zone 0 - 0.17 mm (max 1.9mm and min 0.15mm). b) Zone 1 - 0.0 mm (max 2.9mm and min 0.05mm). c) Zone 2 - 0.38 mm (max 2.5mm and min 0mm). d) Zone 3 - 0.24 mm (max 2.1mm and min 0mm). e) Zone 4 - 0.58 mm (max 2.2mm and min 0.1mm).
Conclusion: While the average variations were well under 1mm for all zones the maximum was noted in zone 4 (0.58) and the least in zone 1 (0.0). The study shows limited variations in atherosclerotic aortas supporting the theory of reduced expansibility in them secondary to the disease process. This would in turn suggest that we do not need to undertake gated examinations of the aorta prior to endovascular procedures.

Free Paper Session
TIPS

1305.1

Transjugular intrahepatic portosystemic shunt (TIPS) creation as treatment for refractory chylous ascites and chylothorax in patients with cirrhosis

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Purpose: The etiology of chylothorax is usually attributed to: tumors, trauma, and idiopathic conditions. Chylothorax appears to be a rare and underreported manifestation of cirrhosis as a result of transdiaphragmatic passage of chylous ascites. This condition can be very debilitating as a result of respiratory compromise from voluminous pleural collections, as well as metabolic derangements, malnutrition, and immunologic impairment form loss of vital lymphatic constituents.
Material and Methods: In the past 7 years we have encountered two patients with hepatitis C-induced cirrhosis who have developed complicated high-volume chylous ascites and chylothorax who were successfully treated with creation of a TIPS. The first patient was 46 years old being worked up for liver transplantation who developed increased abdominal girth and oliguria. His admission MELD score was 26. Admission chest radiograph showed a large right pleural effusion which was tapped and revealed chylous fluid. He required frequent thoracenteses and had a chest drain placed, which drained up to 5 liters per day. The second patient also being worked up for liver transplant from hepatitis C-induced cirrhosis had a MELD score of 15 and developed diuretic-resistant chylous ascites and pleural effusion and required paracenteses every 2 weeks to control his dypsnea.
Results: Both patients underwent TIPS procedures with resolution of effusions and ascites and improvement in renal function in the first patient so that hemodialysis was no longer necessary.
Conclusion: TIPS should be considered for therapy in cirrhotic patients with intractable chylous ascites/pleural effusions.

1305.2

De novo TIPS (transjugular intrahepatic portosystemic shunt) creation with an ePTFE stentgraft in patients with intractable ascites: long-term follow-up

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Purpose: To evaluate the long-term outcome of TIPS creation with the GORE VIATORR® endoprostheses for the treatment of intractable ascites.
Material and Methods: 57 consecutive patients (14 female, 43 male patients; mean age 57, range, 41-80 years), with Child-Pugh stages A/B/C 7%/ 70%/ 23%, were treated with de novo TIPS creation. Patient survival, clinical, sonographic, and venographic follow-up data were collected.
Results: Technical success was achieved in all patients. The portosystemic pressure gradient was reduced from 22 to 10mmHg. Cumulative survival rates were 77/72/63/40% after 6/12/24/48 months, respectively. Overall primary and secondary patency rates after 6/12/24/48 months were 73/61/56/56% and 97/97/88/88%, respectively. TIPS dysfunction led to reintervention in 20 of 57 (35%) patients. TIPS reduction was necessary in 9 of 57 patients (16%).
Conclusion: TIPS creation with the VIATORR® endoprosthesis is safe and effective. Long-term primary success rates are not as promising as compared to early and mid-term patency rates.

1305.3

Percutaneous staged intervention for congenital porto-systemic shunts (CPSS) with portal venous hypoplasia (PVH)

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Purpose: CPSS with PVH causes hyperammonemia and acute closure of the shunt results in portal hypertension. A transcatheter method of staged shunt reduction to afford gradual growth of portal vessels followed by shunt closure is reported.
Material and Methods: Patients underwent angiography in the CPSS or in the SMA to identify the gut venous drainage. Pressure measurements and angiography during temporary occlusion of the CPSS were performed to assess portal pressure and identify portal vessels. If the mean pressure was below 18mmHg and portal vessels were identified, the shunt was closed. If vessels were diminutive and the pressure above 18mmHg, a staged approach was performed.
Staging included the implantation of a tailored reducing stent made by tying a limiting suture around a balloon-expandable stent appropriate to the CPSS dimensions. Recatheterization was performed approximately 3 months later. If the portal pressure was below 18mmHg and vessels had developed the CPSS was closed with a device. If not, a second reducing stent was implanted.
Results: 6 patients [5M,1F] median age 3.3yrs [0.5-13] had CPSS, PVH and hyperammonemia. One patient tolerated acute closure. Portal pressure rose above 18mmHg in 5 during occlusion. At median follow-up of 3.6yrs, after 18 procedures, all patients have growth of portal vessels, normal ammonia levels and no complications. In 5/6

patients the shunt is closed. One patient required surgical banding of the shunt since a reducing stent could not be positioned.
Conclusion: Staged closure of CPSS is safe, effective, causes growth of portal vessels and treats hyperammonemia.

1305.4

Correlative analysis between pre-TIPS MELD, pre- and post-TIPS portosystemic gradients and quantitative digitally subtracted portography parameters: a potential for predicting post-TIPS outcomes

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Purpose: To evaluate quantitative digitally subtracted angiography (Q-DSA) parameters that reflect portal venous hemodynamic changes pre- and post-TIPS creation and to correlate these parameters with changes in the portosystemic gradient (PSG) and MELD.
Material and Methods: Q-DSA was performed on a dedicated prototype workstation (iFlow, Siemens). Regions of interest (ROIs) corresponding to liver parenchyma (right lobe: RLP and left lobe: LLP) and portal veins (left: LPV and right: RPV) were drawn on pre- and post-TIPS portograms. Density measurements over time were recorded and 1-slope, 2-peak density (PCD) and 3-time-density product (AUC: area under curve) were calculated for each ROI. Pre-TIPS MELD and PSGs were compared to Q-DSA parameters.
Results: 22 patients undergoing TIPS were included. Pre-TIPS MELD positively correlated with pre-TIPS slope of the LLP (r: +0.503, p=0.017), and pre- to post-TIPS delta AUC of the LPV (r: +0.472, p=0.031). Pre-TIPS PSG negatively correlated with both pre- to post-TIPS delta PCD of the RLP (r: -0.533, p=0.011) and the delta AUC of the LLP (r: -0.767, p=0.0001). Post-TIPS PSG negatively correlated to pre- to post-TIPS delta AUC of the LLP (r: -0.455, p=0.033). Pre- to post-TIPS delta PSG negatively correlated with delta AUC of the LLP (r: -0.690, p=0.0001).
Conclusion: Patients with more advanced hepatic disease may have altered left portal flow/perfusion. Left hepatic lobe Q-DSA parameters correlate better with pre-TIPS MELD, and PSG changes than right hepatic lobe Q-DSA parameters. There is a potential to objectively evaluate TIPS-related portography utilizing Q-DSA and correlate it with post-TIPS clinical outcomes.
Disclosure: Dr. Kowarschik is employed by Siemens AG and is directly responsible for the design and implimentation of the iFlow software used in data analysis. Dr. Matsumoto acts as a consultant for Siemens AG.

1305.5

Technical and clinical outcome of transjugular intrahepatic portosystemic stent: shunt bare metal stents versus polytetrafluoroethylene-covered stent grafts

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Purpose: To retrospectively compare bare metal stents (BMS) with polytetrafluoroethylene (PTFE)-covered stent grafts in patients undergoing transjugular intrahepatic portosystemic stent shunt (TIPS).
Material and Methods: From February 2001 to January 2010, 174 patients were included. Group 1 (I) consisted of 116 patients (mean age 57.0±11.1 years) with BMS stents (Palmaz, Cordis, USA). Group 2 (II) consisted of 58 patients with stent-grafts (Viatorr, Gore, USA) (mean age 53.5±16.1 years). Angiographic and clinical follow-ups were performed. Primary study goals included technical success, shunt patency as well as time to and number of revisions required to maintain TIPS patency. Secondary study goals included clinical success.
Results: Hemodynamic success was 92.2% in I and 91.4% in II (n.s.). Primary patency was significantly higher in II compared to I (53.8% after 440.4±474.5 days versus 45.8% after 340.1±413.8 days; p<0.05). In the first angiographic control, a portosystemic pressure gradient ≥15mmHg was present in 73.9% after 156.2±283.1 days and in 39.4% after 201.1±301.8 days in II (p<0.05). Clinical success was 73.7-86.2% after 466.3±670.1 days in I and 85.7-90.5% after 617.5±642.7 days in II (n.s.). Thereby, hepatic encephalopathy was 37.5% in I and 36.5% in II (n.s.). The first TIPS revision was performed significantly later in II compared to I (288.3±334.7 days versus 180.1±307.0 days; p<0.05).
Conclusion: Viatorr stent grafts significantly increased primary shunt patency as well as decreased time to and number of TIPS revisions. There was a trend of higher clinical success after Viatorr stent grafts without increased hepatic encephalopathy compared with TIPS using BMS stents.

1305.6

Transjugular intrahepatic portosystemic stent-shunt placement in liver-transplant recipients

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Purpose: To determine the feasibility, efficacy and safety of transjugular intrahepatic portosystemic stent-shunt (TIPSS) in liver transplant (LT) recipients.
Material and Methods: Between July 1995 and June 2010, 30 transplanted patients (mean age 53) with recurrent hepatitis B or C infection (n=15), secondary biliary cirrhosis (chronic rejection n=2), portal vein thrombosis (n=4), Budd-Chiari disease (n=2), small-for-size syndrome (n=3) or other uncommon causes of portal hypertension on the graft (n=4) underwent TIPSS implantation. Indications include refractory ascites (n=18), hydrothorax (n=3), recurrent variceal bleeding (n=3), early portal vein occlusion (n=3), liver insufficiency after LDLT (n=2) and portal pressure reduction before surgical biliary repair (n=1). The median time interval from LT to TIPSS was 21 months (2-61). Bare and covered stents were implanted in 13 and 17 patients, respectively.
Results: TIPSS procedure succeeded in all patients. The mean portosystemic pressure gradient was reduced from 16.9 to 7.1 mmHg. (Near)-complete ascites remission was achieved in 72% of patients with ascites. All patients with hydrothorax or variceal bleeding did respond dramatically to TIPSS. One among the two patients with small-for-size syndrome improved significantly. 18 patients (60%) developed new onset or worsening encephalopathy at a median of 21 days. 17 of the 30 patients (57%) died during the study period, mainly from liver failure or sepsis. Four of five patients who underwent retransplantation survived. The median survival after TIPSS was 6.2 months (1.5-72).
Conclusion: TIPSS indications may be extended to liver transplant recipients. Control of ascites or bleeding could be achieved in most cases. A poor survival rate due to liver failure or immunosuppression-related sepsis is observed. Early redo transplantation after TIPSS placement could improve survival.

Free Paper Session
Oncologic IR 1

1306.1

Percutaneous cryoablation of renal tumors: initial experience in 95 tumors

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Purpose: To evaluate the feasibility, the safety and the efficacy of renal percutaneous cryoablation.
Material and Methods: From May 2007 to December 2010, 92 renal tumors in 83 non-surgical patients (mean age 72) were treated with cryoablation. Mean tumor size was 29 mm (8-70). 65% tumors were central or mixed and 45% were anterior in close contact with the bowel. Procedures were performed percutaneously under CT or MR guidance, with biopsy performed during the same session. For bowel or ureter insulation, thermal protection technique with CO2 dissection was used. Minimum follow-up with MRI and creatinin was 4 months.
Results: Complications included 6 perirenal hematomas (7%), with one requiring surgical hemostasis, and one fatal Mendelson syndrome. Three patients required an additional session for complete ablation. All others were treated in a single session with no evidence of residual tumor on follow-up. CT and MR control allowed precise monitoring of the ice ball. Creatinin remained unchanged after 4 months. No urinary fistula occurred.
Conclusion: Percutaneous cryoablation is a promising alternative technique for the management of renal tumors in poor-surgical patients. The intent is curative in a single session for tumors less than 4 cm. When comparing with RF ablation, the major advantages of cryoablation are the optimal visualization of the iceball with CT- and MR-guidance, the better protection of the collecting system for central tumors and the ability to activate simultaneously multiple cryoprobes when treating large tumors. However, large and central tumors are associated with a higher risk of complications or incomplete treatment.
Disclosure: X.Buy and A.Gangi are consultant for Galil Medical

1306.2

Repeated liver percutaneous isolated localized perfusion (Liver-PILP) with occlusion balloons and a catheter-based stent-graft-like perfusion device: first two human interventions

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Purpose: To evaluate the feasibility, repeatability and safety of a novel liver percutaneous isolated localized perfusion (Liver-PILP) system for the first time in man.
Material and Methods: The PILP catheter set was tested for the first time in a patient suffering from colorectal cancer with unresectable liver metastasis refractory to chemotherapy. An hourglass-shaped device was placed in the inferior vena cava, creating a chamber with access to the hepatic veins without interruption of the vena cava flow. A perfusion circuit between the hepatic veins and the proximal portal vein was then created while the portal vein and the hepatic artery were occluded by balloon catheters, thus isolating the liver. Retrograde isolated perfusion was then performed with 40 mg/m2 eloxatin. Two consecutive procedures were performed in the same patient within 6 weeks.
Results: In both procedures, it was possible to insert, accurately position and retrieve all components of the PILP catheter set without angiographic evidence of leakage, vessel occlusion or dissection. Perfusion of eloxatin was performed without any sign of systemic side effects. After the intervention, transaminases and lactate dehydrogenase levels were transiently elevated during less than 14 days after the intervention. Pre- and post-operative CT scans did not disclose any sign of healthy liver tissue damage.
Conclusion: For the first time in a human patient, repeated percutaneous isolated perfusion of the liver was achieved using the Liver-PILP system. Devices could be safely and accurately positioned, and successful vascular isolation of the liver was achieved.
Disclosure: Consultancy agreement

1306.3

Trans-arterial chemoembolization of liver metastases from colorectal cancer adopting drug-eluting beads loaded with irinotecan compared with FOLFIRI: results at two years of a phase III clinical trial

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Purpose: Liver metastases from colorectal cancer in most of cases are unresectable. Systemic chemotherapy actually can prolong survival not more than 24 months. FOLFIRI represents an active chemotherapy regimen against advanced CRC. Aim of this phase III study is to assess survival as primary endpoint comparing TACE with drug-eluting beads loaded with irinotecan and FOLFIRI in pts with unresectable LM from CRC.
Material and Methods: Between December 2006 and December 2009, we randomized 76 pts with LM from CRC, 38 pts to DEBIRI treatment and 38 pts to FOLFIRI. Two pts had early progression and four FOLFIRI pts refused. We performed 72 cycles of DEBIRI in 35 pts with a relative dose intensity of 99%, and 292 FOLFIRI cycles were administered in 35 pts with a relative dose intensity of 90%.
Results: We reported these results at a median follow-up of 24 months (18-36): median survival: 48% for DEBIRI vs 28% for FOLFIRI; response rate: 70% for DEBIRI vs 20% for FOLFIRI; acute toxicity: 70% for DEBIRI vs 20% for FOLFIRI; late toxicity: 20% for DEBIRI and 80% for FOLFIRI; QoL improvement: 65% for DEBIRI vs 25% for FOLFIRI.
Conclusion: DEBIRI increased 2-y median survival difference of 20% compared to FOLFIRI, improving response rate and performance status and reducing costs. DEBIRI-induced acute post-embolization syndrome, generally resolved in few days and FOLFIRI caused more late. DEBIRI showed better results in term of survival and QoL than FOLFIRI.

1306.4

Single center prospective phase II trial of Yttrium-90 radioembolization for treatment of colorectal liver metastases that have failed first line chemotherapy and prior to initiation of second line chemotherapy: study design and early results

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Purpose: After colorectal cancer, liver metastases (mCRC) have progressed on first line chemotherapy, tumor response rates to second line chemotherapy are poor. We hypothesized that addition of a course of Yttrium 90 (^{90}Y) radioembolization (RE) before second line chemotherapy may improve tumor response rates, possibly by a mechanism of radiation-induced chemosensitization.
Material and Methods: Eligible patients had unresectable liver only or liver predominant mCRC who have failed first line Oxaliplatin-based chemotherapy (FOLFOX or CAPOX +/- Bevacizumab). ^{90}Y RE using resin microspheres was performed in 1 session for unilobar disease and 2 sessions for bilobar disease. Patients were then placed on second line Irinotecan-based chemotherapy (FOLFIRI). Tumor response has been assessed primarily with PET CT using RECIST criteria, and secondarily with PET scan SUV values, contrast-enhanced ultrasound, and serologic markers.
Results: To date, 7 patients have been enrolled, and 4 have follow up of at least 4 months. One has had a complete response to 9.5 months and 3 have had stable disease to 4.1, 7.1, and 7.4 months. No major toxicity has occurred.
Conclusion: Progression-free survival (PFS) of 4.1-9.5 months appears favorable compared to comparable historical controls with FOLFIRI second line chemotherapy of 2.5 months mean PFS (Tourmigand, et al). Potentially ^{90}Y RE sandwiched between first and second line chemotherapy improves tumor chemosensitivity. Total enrollment goal is at least 30 patients.
Disclosure: S. Rose is a proctor for SIRTEX Medical. T. Reid receives research support from SIRTEX Medical for this IRB approved trial with an IDE.

1306.5

Radiofrequency-assisted intact specimen biopsy of breast tumors: an evaluation according to the IDEAL guidelines

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Purpose: Radiofrequency-assisted intact specimen biopsy (RFIB) has been introduced for percutaneous biopsy or removal of breast tumors. Using radiofrequency cutting, the system enables the interventional radiologist to obtain an intact sample of the target lesion. According to IDEAL guidelines, we performed a critical evaluation of our initial experience with RFIB.
Material and Methods: Between June and November of 2010, X-ray-guided RFIB was performed in 19 female patients. All patients presented with suspicious microcalcifications (BI-RADS III-V) on mammography. Biopsy specimen integrity, thermal damage and histological diagnosis were assessed by an expert breast pathologist. Data on technical success, diagnostic and therapeutic accuracy and peri-procedural complications were collected and analyzed according to the IDEAL guidelines.
Results: Median age was 59 years. Median lesion diameter on mammography was 8 mm (range 2-76 mm). The procedure was successful in 17/19 (89%) patients and unsuccessful in 2/19 (11%) patients (1 nonrepresentative sample, 1 sample with extensive thermal damage). Histological analysis of the RFIB specimen revealed 12/19 (63%) benign lesions and 7/19 (37%) malignancies (4 DCIS lesions and 3 invasive ductal carcinomas). In 1 patient a DCIS lesion was completely removed with RFIB. Overall, 3 peri-procedural complications occurred (1 wound leakage, 1 arterial hemorrhage and 1 infection requiring oral antibiotics).
Conclusion: Tissue sampling of suspicious breast lesions can be performed successfully with RFIB. In 1 patient DCIS was radically excised with RFIB, which illustrates its potential as a minimally invasive therapeutic procedure for removal of small breast tumors. This is an interesting focus for further research when larger probe sizes become available.

1306.6

The size of drug-loaded microspheres influences the local drug delivery and toxicity

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Purpose: The size of drug-loaded particles used for HCC embolization varies considerably between reports, ranging from 100 to 700 µm, with no clear rationale for choosing a specific size. The present study evaluates the effect of microsphere size on the local delivery of drug and associated histologic effects in a model of pig liver embolization.
Material and Methods: Two hepatic artery branches were embolized with a fixed volume (0.5mL) of 100-300 µm or 300-500 µm doxorubicin-loaded microspheres (DOXMS, 25 mg/mL). Euthanasia was performed 7 days after the procedure. Liver was explanted, fixed in formalin and sampled in embolized areas. Histologic analysis was performed on HES stained tissue section. DOX tissue concentration was measured radially around MS with fluorescence microspectroscopy.
Results: The diameter of vessels occluded by 100-300µm DOXMS was significantly smaller than vessels occluded by 300-500µm (202±90µm vs 397±134µm P<0.001). Concentric areas of coagulative necrosis were observed around both sizes of DOXMS. The rate and the extent of necrosis were significantly higher around 300-500µm than 100-300µm DOXMS (hepatic artery: 76% vs 37%, liver parenchyma: 64% vs 25%, biliary duct: 64% vs 25%, portal vein: 53% vs 12%; P<0.002). Drug tissue concentration was significantly higher in 300-500µm than 100-300µm group over the first 420 µm surrounding the microspheres and not different further.
Conclusion: 300-500µm DOXMS are associated with higher tissue damage than 100-300µm because of a different location in hepatic arteries and/or to a higher delivery of drug.

Free Paper Session
Venous Interventions 1

1307.1

IVC filter placement: a comparison of CIRSE and BCSH guidelines

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Purpose: Venous thrombo-embolism (VTE) accounts for significant morbidity and mortality. Although the preferred method of treatment and prevention of VTE is anticoagulation, inferior vena cava filters are an important adjunct in prevention of pulmonary embolism. However, filter placement carries significant risk, making careful patient selection essential. The aim is to highlight the discrepancies between interventional radiology and haematology practice guidelines that emerged from our audit of local practice.
Material and Methods: Using a local database, we analysed caval filter placements in the Lothian Health Board, March 2007 to May 2010. 118 cases were recovered. Records were submitted to the British IVC filter registry and local and national data compared. The indications considered were compared against those recommended by the British Committee for Standards in Haematology (BCSH) and the Cardiovascular and Interventional Radiology Society of Europe (CIRSE) and those listed in the British filter registry.
Results: All filters were potentially retrievable. Retrieval was successful in 88% although only attempted in 50%. Immediate procedure-related complications were <1%. Locally, 29% and 5% of placements were not consistent with (or contraindicated by) BCSH and CIRSE guidelines, respectively. Nationally, 29% and 2% of indications cited were not in accordance with BCSH and CIRSE guidelines, respectively.
Conclusion: We investigate discrepancies and highlight the significant differences in accepted indications by the two institutions. Awareness of these discrepancies is important in optimising patient care. We suggest review and correlation of current guidelines.

1307.2

Fracture and distal migration of the Bard recovery filter: a retrospective study with follow-up of 363 patients over 7 years

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Purpose: To report the incidence of limb fracture and migration of the Bard recovery filter.
Material and Methods: From 2003 to 2006, 363 recovery filters were placed at a single institution. All available images were evaluated for fracture and distal migration.
Results: Among the 363 patients, 97 patients had filter retrieved at a mean interval of 3.9 months. 135 patients died with the filter in situ at a mean interval of 16.7 months. 131 live patients had the filter in situ with mean follow-up of 46.5 months. There were 130 patients had at least 1 CT chest, 153 patients had CT of abdomen, 256 patients had chest X-ray, 164 patients had plain film of abdomen/pelvis and 106 patients had cavagram. The average imaging follow-up interval was 18.4 months. There was no distal en-bloc migration. There were 26 limb fractures in 20 patients, all were the short limbs, with an average interval of 33.9 months. 8 limbs were found in pulmonary arteries, 7 limbs in iliac/femoral veins, 7 limbs near the filter, 1 limb in each following sites: right ventricle, right renal vein, outside cava near the filter and 1 could not be located. Of the 20 limb fracture patients, 3 died of an unrelated cause and 17 were asymptomatic at the last clinic visit.
Conclusion: Recovery filter fractures occurred only at the short limb in this study. Majority of the fracture fragments migrated to distant sites, with the lung and pelvic vein being the most common embolic organs. No life-threatening events were identified.

1307.3

Paclitaxel-eluting balloon angioplasty versus plain balloon dilatation for the treatment of failing dialysis access: a prospective randomized controlled trial (NCT01174472)

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Purpose: To report the interim results of a prospective randomized trial investigating angioplasty with paclitaxel-eluting balloons (PEB) versus plain balloon PTA for the treatment of failing arteriovenous fistulae (AVF) or prosthetic arteriovenous grafts (AVG).
Material and Methods: This was a non-inferiority hypothesis trial registered in clinicaltrials.gov (NCT01174472). Enrollment criteria included an angiographic and clinical diagnosis of dysfunctional dialysis access due to at least one stenotic lesion in patients with AVF or AVG circuits. From March to December 2010, 40 patients were randomized to undergo either PEB dilatation (n=20) or standard PTA (n=20) of a stenosed venous outflow lesion. Regular angiographic follow-up was scheduled every 2 months. Study primary outcome measures included technical success (defined as residual stenosis of the treated lesion >30% without any significant dissection) and primary patency of the treated site (defined as angiographic visualization of a patent lesion with <50% restenosis and no need for any additional repeat procedure within the previously treated lesion due to failing access).
Results: Procedural variables were comparably distributed between both groups. Technical success was 100% for both groups. To date, 6-month angiographic follow-up is available in 13 cases of both groups. Interim calculation of the primary endpoint outcome by life table methods demonstrated a trend towards significantly higher primary patency (in days) of group PEB (228±22[CI:186-271]) versus group PTA (157±23[CI:112-202]); p=0.09 by log rank test.
Conclusion: Interim study outcomes show that PEB angioplasty might have a role in the treatment of stenotic venous outflow lesions of failing dialysis access. Long-term final data are awaited.

1307.4

A prospective double-blind randomised controlled trial of radiofrequency versus laser treatment of great saphenous varicose veins

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Purpose: Endovenous ablation of varicose veins using radiofrequency (RFA) and laser fibres (EVLT) has reported advantages over traditional open surgical treatment. There is little evidence comparing the efficacy and patient-reported outcomes between the two endovenous solutions. This study compares the RFA and EVLT strategies in a prospective double-blind clinical trial.
Material and Methods: Consecutive patients with primary

unilateral great saphenous vein (GSV) reflux undergoing endovenous treatment were randomised to RFA or EVLT. The primary outcome measure was GSV occlusion at 3 months following treatment. Secondary outcome measures were occlusion at 7 days, post-operative pain, analgesic requirement and bruising, assessed at day 7 following surgery. Quality of life (QoL) was assessed pre-operatively and 3 months following surgery using the Aberdeen Varicose Vein Questionnaire (AVVQ) and EQ-5D.
Results: 159 patients were randomised to RFA (79 patients) or EVLT (80 patients). Groups were well matched for demographics, disease extent, severity and pre-operative QoL. Duplex scanning confirmed 100% vein occlusion at 1 week in both groups. At 3 months occlusion was 97% for RFA and 96% for EVLT; P=0.67. Median (IQR) percentage above-knee bruise area was greater following EVLT 3.85% (6.1) compared to RFA 0.6% (2); P=0.0001. Post-operative pain assessed at each of the first seven post-operative days was less after RFA (P=0.001). Changes in the AVVQ (P=0.12) and EQ-5D (P=0.66) at 3 months were similar in both groups.
Conclusion: RFA and EVLT offer equivalent venous occlusion rates at 3 months following treatment of primary GSV varices. RFA is associated with less peri-procedural pain, analgesic requirement and bruising.

1307.5

Comparative rates of stenosis progression in treated symptomatic and untreated asymptomatic central vein stenoses in dialysis fistulas

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Purpose: The Kidney Dialysis Outcomes Quality Initiative and Vascular Access Society discourage treatment of central vein stenoses (CVS) in asymptomatic patients without handicapping arm edema. It is known that withholding treatment in grafts with asymptomatic CVS leads to slower stenosis progression than in treated cases. It is, however, not clear if the same outcomes apply in the case of fistulas and symptomatic CVS.
Material and Methods: We retrospectively evaluated stenosis progression in severely symptomatic high grade CVS (HG-CVS) treated by PTA and/or stenting and untreated asymptomatic cases left untreated. HG-CVS was defined as >50% stenosis of brachiocephalic/subclavian vein with mandatory collaterals. We measured stenosis progression rate by dividing the degree of stenosis by the time interval between venograms performed in asymptomatic cases and venograms performed serially after treatment in symptomatic cases.
Results: Fifty symptomatic HG-CVS were treated and 53 asymptomatic cases were assessed. The mean age, previous dialysis catheter use and location of stenoses at the brachiocephalic vein were 75±10 vs. 69±14 years, 48 vs. 26% and 46 vs. 74%, respectively ($p<0.05$). More than 85% of the cases had autogenous fistulas. Thirty-three percent of asymptomatic HG-CVS developed severe symptoms and 80% of treated symptomatic cases restenosed after 36 months ($p<0.05$). Stenoses improved and worsened in 12% and 48% of asymptomatic CVS, respectively, whilst 41% remained stable. Stenosis progression rate was 0.03%/day compared to 0.49%/day in treated symptomatic CVS ($p<0.05$).
Conclusion: HG-CVS in asymptomatic patients should not be treated given they have a slow stenosis progression. Treatment, conversely, leads to rapid stenosis progression.

1307.6

Stenting as an effective treatment of superior vena cava syndrome: review of 217 cases - a single centre experience

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Purpose: VCSS constitutes a severe clinical manifestation of central venous outflow obstruction mostly due to external compression by malignancies or intraluminal thrombus formation due to indwelling medical devices. This potentially fatal clinical entity with increasing prevalence requires prompt management to restore upper body venous outflow thus relieving symptoms and enabling diagnostic and therapeutical procedures ameliorating and prolonging patients' life. VCS stenting represents an effective, low-morbidity/mortality alternative to insufficient medical treatment, irradiation, chemotherapy or high-risk open surgery. We evaluate its technical success, clinical effectiveness, primary and secondary patency, asymptomatic period following the procedure and overall survival period in a large group of patients.
Material and Methods: 217 patients (age range 23-87 years) underwent endovascular treatment for SVCS in our center between November 2002 and December 2011 (malignant etiology in 203 cases, benign in 14). SVC was primarily stented in 205, balloon dilated in 1, interventional attempt was unsuccessful in 11 cases. Patients were invited back upon recurrence of symptoms.
Results: All successful interventions lead to immediate relief of symptoms. No peri-procedural mortality occurred. 1 SVC rupture, 1 stent fracture, 2 hemopericardium, 1 pericardial puncture were solved percutaneously. Reocclusion occurred in 12 cases (including 5 and 3 times in a single patient), 2 days-2.5 months after the procedure, thrombolysis reintervention. Restenosis was reported in 10 cases (including 5, 3 and 2 times in a single patient), 2 weeks-9 months following the procedure, re-PTA).
Conclusion: Stenting has in our center proved to be a highly technically successful, clinically effective, low-morbidity, low-mortality, low-complication, low-restenosis rate treatment option for VCSS.

Free Paper Session
PVD 1

1308.1

The pacifier trial. A randomized multicenter trial evaluating prevention of restenosis with paclitaxel-coated PTA balloon catheters in stenosis or occlusion of femoropopliteal arteries: first report

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Purpose: Evaluation of efficacy and safety of a novel paclitaxel-coated balloon catheter for reduction of restenosis after PTA of femoropopliteal arteries.
Material and Methods: Design: Two treatment arms, randomized enrollment of 91 patients. Inclusion criteria: Clinical Rutherford stage 1-5, occlusion or hemodynamic relevant stenosis (≥70 % diameter) of femoropopliteal arteries, successful guide wire passage. Treatment of 1-3 lesions/patient each with 1-5 uncoated (Pacific Xtreme™) or paclitaxel-coated (In.Pact Pacific™) balloon catheters strictly controlled in respect of paclitaxel content before and after use. Primary

endpoint: Late lumen loss after 6 months of follow-up evaluated by an independent blinded core lab. Clinical follow-up at 6, 12, and 24 months, respectively.
Results: Inclusion period ended in February 2011. Overall 91 patients were included; mean age, 70 years; maximum lesion length up to 30 cm; 20% occlusions; 25% restenosis or in stent restenosis. All patients have been successfully treated. Twenty percent of lesions were stented. Up to now no coating-related adverse events were observed. Moreover, early promising results have been seen in a proportion of patients upon first follow-up visits.
Conclusion: This is one of few controlled randomized trials with drug-coated balloons in peripheral arteries. So far, paclitaxel-coated balloon catheter angioplasty in femoropopliteal lesions has been shown to be a safe procedure. Exact numbers and first efficacy results at 6 months of angiography follow-up will be available in September 2011.

1308.2

Transfemoral and transtibial combined approach in subintimal recanalization of SFA obstructions extending on popliteal and distal vessel origin

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Purpose: Transfemoral and transtibial combined approach in subintimal recanalization of SFA obstructions extending on popliteal and distal vessel origin.
Material and Methods: On 664 diabetic patients treated for limb salvage, in 75 with SFA long occlusions involving the leg vessel tree were performed subintimal antegrade and retrograde (posterior tibial artery in 43 and anterior tibial artery in 32 cases) approach. The patent portion of the runoff vessel was previously assessed by magnetic resonance angiography and directly punctured under ultrasound Doppler guidance. A subintimal channel rendezvous was performed to allow snaring of the guidewires. Subsequent balloon dilatation was performed.
Results: We achieved 98.2% technical success. At Doppler-US mean follow up of 24.5 months, the patent vessels were 71.2%, but we had a 92.3% in limb salvage with complete healing of limb lesions and rest pain resolution. The oximetry value showed an increase from mean original value of 17.8 mmHg to 45.1 mmHg at 6 months follow-up.
Conclusion: In patients with SFA occlusion involving the popliteal trifurcation, secure candidate in amputation, combined antegrade and retrograde subintimal recanalization approach, is probably the most suitable and efficacy endovascular option to obtain a direct flow to the foot and so, an high percentage of limb salvage.

1308.3

The ACHILLES study, a prospective, randomized, multicenter comparison of balloon angioplasty and CYPHER SELECT® plus stent implantation in the treatment of patients with ischemic infrapopliteal arterial disease

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Purpose: To assess the safety and efficacy of the CYPHER SELECT™ Plus stent compared to percutaneous balloon angioplasty (PTA) in de novo and restenotic native infrapopliteal arterial lesions.
Material and Methods: We randomised 200 patients with infrapopliteal artery disease and ≤2 lesions with >70% stenosis, and a maximum lesion length of 120 mm to stenting or PTA at 16 institutions in Europe. The total number of stents was limited to a maximum of 4. The primary endpoint was angiographic in-segment binary restenosis at 1 year. Secondary endpoints included device-, lesion- and procedure success, mean %DS, MLD and late-loss at 12 months, assessment for stent fractures by X-ray at 12 months, and TLR, TVR, and amputations at 6 weeks, 6 and 12 months.
Results: The study randomised 99 pts (113 lesions) to stenting and 101 pts (115 lesions) to PTA. Baseline lesion characteristics were similar. Total lesion length was 26.9 and 27.5 mm for stenting and PTA, respectively. Crossover from the PTA group to stenting occurred in 8 pts. All 99 pts randomised to the stent group received a stent. The primary endpoint was reached by 19.4% in the stent group, and 41.9% in the PTA group (P=0.006) analyzed per "intention-to-treat", and by 18.7% in the stent group versus 45.5% (P<0.001) analysed "as treated". Secondary endpoints will be available at the time of presentation.
Conclusion: The Achilles study reached its primary endpoint, angiographic binary restenosis and demonstrated the superiority of the CYPHER stent over PTA in native infrapopliteal artery lesions.

1308.4

Risk factors using the Angio-Seal vascular closure device after antegrade puncture

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Purpose: To investigate the efficacy and to evaluate possible risk factors of the Angio-Seal vascular closure device after antegrade puncture.
Material and Methods: 105 consecutive patients with antegrade access to the common femoral artery (CFA) for lower limb vascular intervention were included into this prospective study. After intervention, 6F (n=76) and 8F (n=29) Angio-Seal vascular closure devices (St. Jude Medical Inc., USA) were used to achieve hemostasis. The platelets, INR, partial thromboplastin time (PTT), calcifications and prior surgical interventions of the CFA as well as the body-mass-index (BMI) were documented and the influence on technical success was analyzed.
Results: Immediate hemostasis was reached in 85 patients. In six patients a kink of the sheath obviated the passage of the collagen sponge towards the vessel; in another 14 patients persistent bleeding of the puncture site required manual compression. There was no significant difference between the groups of successful and unsuccessful sealing regarding the mean platelets (242 vs. 216 $*10^9$/l), INR (1.06 vs 1.02), prothrombin time (89 vs. 89%) and PTT (29 vs. 31 s). Also, no significant difference was found regarding the anticoagulation therapy, calcifications or prior surgical interventions of the CFA in both groups. However, significant difference was found with respect to the BMI (26.3 vs. 29.4 kg/m^2; p = 0.01).
Conclusion: Obesity seems to be an independent risk factor for failure of vascular closure using the Angio-Seal after antegrade puncture of the CFA. In 6% of our patients, hemostasis could not be achieved due to kink of the flexible sheath.

1308.5

Reversal of a retrograde to an antegrade access for bilateral femorocrural intervention in one session

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Purpose: Evaluation of the feasibility as well as the success and complication rates of the change of access direction in patients with PAOD for the bilateral intervention in a prospective study.
Material and Methods: During one year 239 patients referred to our department for intervention of the iliac and femorocrural vessels were evaluated prospectively for the change of access direction. In 38 (16%) the symptoms indicated a bilateral intervention distal to the CFA. 3 (8%) patients had to be excluded due to elevated creatinin level, in all other 35 patients it was attempted to change the initial cross-over access to an antegrade in the same session. The procedure was accomplished by drawing a sidewinder catheter in the ipsilateral CIA, pushing a hydrophilic guidewire in the SFA and repositioning the sheath. Sonographic and clinical controls followed the next day.
Results: In 32 patients (91%), the procedure was successful, in 3 cases (9%), it failed. One major hematoma (3%) was detected, which could be treated conservatively, in 2 cases (6%) pseudoaneurysms developed, which were treated by compression or thrombin injection. Three minor hematomas were documented (9%). In one patient (3%) a brain stem infarction occurred during the intervention after a posterior stroke some weeks before, which could not be related to the intervention.
Conclusion: The bilateral intervention of femorocrural vessels in one session by changing the access direction is feasible and associated with acceptable complication rates. In the hands of experienced interventionalists, this is a good possibility to optimize endovascular therapy economically.

1308.6

Endovascular revascularization for limb salvage in diabetic patients: procedural and clinical results

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Purpose: To evaluate short- and long-term results in diabetic patients who underwent endovascular revascularization for limb salvage.
Material and Methods: From June 2003 to June 2010, 2464 patients (average age of 69.5 years), all diabetics, were treated with different endovascular techniques to obtain a direct flow to the foot and to avoid major amputation. All the lesions were staged with Texas classification: 255 patients (10.3%) stage IIB, 340 (13.7%) IIC, 404 (16.4%) IID, 54 (2.2%) IIIA, 459 (18.6%) IIIB, 472 (19.1%) IIIC and 480 (19.4%) IIID. All patients were previously assessed with clinical evaluation, TcPO2/TcPCO2 measurement and angiographic study (magnetic resonance or CT).
Results: Post-intervention evaluation included measurement of TcPO2/TcPCO2, clinical evaluation and Color-Duplex ultrasound. Technical success rate was 95.6% with only 4.4% of failure. The 1.9% of patients despite technical success underwent amputation for the presence of severe osteomyelitis and altered microcirculation. The 13% of patients underwent re-intervention, because of wounds not healed or decrease of TcPO2, and the success rate was 11%. The mean follow-up time was of 24 months. The rate of limb salvage and major amputation were 92 and 8.66%, respectively.
Conclusion: Endovascular revascularization shows a high technical success rate with an elevated success rate of re-intervention and should be considered as the primary preferred therapeutic option in lower limb salvage for diabetic patients.

Free Paper Session Oncologic IR 2

1309.1

Multimodality HCC treatment with TACE and RFA for unresectable HCC

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Purpose: To evaluate multimodality treatment consisting of transcatheter arterial chemoembolization (TACE) and radiofrequency ablation (RFA) in patients with non-resectable hepatocellular carcinoma (HCC) regarding efficacy and survival outcomes..
Material and Methods: Eighty-five consecutive patients with non-resectable HCC received TACE followed by RFA. Efficacy of combined treatment was evaluated by contrast-enhanced CT/MRI regarding

response rates using the modified RECIST criteria. Survival was calculated depending on BCLC stage, Child-Pugh score, CLIP score and presence of solitary or multifocal HCC.
Results: Of 120 treated HCCs 99 (82.5%) showed complete response (CR) on imaging studies at first follow up, while in 21 HCCs (17.5%) residual contrast enhancement but no increase in size was noted, indicating partial response (PR). Patients with solitary HCC revealed CR in 91% of cases; in patients with multifocal HCC (n = 29) CR was achieved in 75% (48/64 HCCs), with the remainder showing PR. Median survival for all patients was 25.5 months. 1-, 2-, 3- and 5-year survival rates were 84.6%, 58.7%, 37.6% and 14.6%, respectively. Statistical analysis revealed a significant difference in survival between BCLC A and B patients.
Conclusion: The combined use of TACE and RFA in HCC patients provides an effective treatment approach with high local tumor control rates and promising survival data especially for BCLC A patients. Randomized trials are needed to compare this minimal invasive approach with surgical resection.

1309.2

Treatment of HCC with an ultrasound-activated microbubble drug carrier in a rat model

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Purpose: To determine if a doxorubicin-loaded microbubble contrast agent triggered by ultrasound is more effective than nanoparticles or free intravenous doxorubicin in treating hepatoma in a rat model.
Material and Methods: Microbubbles (1.2µm) and 200nm nanoparticles were prepared containing 14-C doxorubicin. Microbubbles, nanoparticles, a combination of the two, or free doxorubicin were administered intravenously in rats with hepatomas while tumors were insonated for 20 minutes. Plasma doxorubicin levels were measured over 30 minutes, and in various organs and the hepatomas at 4 hours, 7 and 14 days. Explanted tumors were measured and evaluated by autoradiography and histology.
Results: Animals treated with microbubbles had significantly lower peak plasma concentrations (0.4661 ± 0.0684%/ml) compared to nanoparticles (1.6495 ± 0.2936%/ml, p=0.0052) and free doxorubicin (3.0328 ± 0.6120%/ml, p=0.0019). After 14 days, levels in the heart were significantly lower in animals treated with microbubbles compared to free doxorubicin (0.1676%/g tissue vs. 0.3198%/g, p=0.0088). Tumors treated with microbubbles showed significantly higher drug levels than tumors treated with free doxorubicin after 4 hours (4.1739 ± 0.8397 ng/mg tissue vs. 0.4162 ± 0.0969 ng/mg tissue, p=0.0472). Tumor concentration of dox in the micobubble group exceeded the lethal IC50 for HCC. These tumors showed no significant increase in size over 14 days, and significantly less growth than tumors treated with free doxorubicin (p=0.0390). Autoradiography showed dense doxorubicin deposition in the microbubble group at 14 days, and none in the nanoparticle and free dox groups.
Conclusion: Doxorubicin-loaded microbubbles triggered with ultrasound provided enhanced, sustained drug delivery to hepatomas, reduced plasma and organ doxorubicin levels, and arrested tumor growth.

1309.3

Extrahepatic arterial embolization to treat hepatoma: what are they and how to do it

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Purpose: To evaluate the incidence of each extrahepatic collateral pathway to hepatocellular carcinoma (HCC), to investigate its formation axiom and to aim at boosting therapeutic effect of hepatic embolization for HCC.
Material and Methods: Extrahepatic collaterals to HCC were retrospectively assessed in 516 patients who received conventional celiac and superior mesenteric arteriography prior to embolization. If the mass nearby diaphragm, additional selective phrenic, right adrenal, right intercostal or internal mammary artery angiography was performed in 121 patients. All data were analyzed to study the extrahepatic collateral features of HCC.
Results: 196 cases of all patients had extrahepatic collateral feeders to HCC. The sources were 34.7% from right inferior phrenic artery, 26.0% from gastro-duodenal and omental, 21.4% from left gastric, 12.2% from pancreatic-duodenal arc, 1.0% right colic, 2.6% right internal mammary, 1.5% intercostal artery and 0.5% from dorsal pancreatic artery. Extrahepatic collateral feeders were very close to the primary location, mass size and surgical interventions. These results denoted that parasitic blood feeding of the masses in segments VII and VIII was usually from right inferior phrenic or adrenal artery, that in segments IV, V, VI was from the gastro-duodenal and omental artery, and that in segments II, III, IV from the left phrenic or gastric artery. The technical success rates of those collateral arterial embolizations were 97.2% in 182 cases.
Conclusion: Being familiar with the characteristics of extrahepatic collaterals and mastering their rules is paramount to successful arterial embolisation in the treatment of HCC. Only in that way we can raise up the survival rate of the patients with HCC.

1309.4

Transarterial chemoembolization with doxorubicin-eluting microspheres for inoperable hepatocellular carcinoma

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Purpose: To assess the safety and efficacy of chemoembolization with doxorubicin-eluting microspheres (DEB-TACE) for inoperable hepatocellular carcinoma (HCC).
Material and Methods: In this IRB-approved retrospective study, 98 patients (79M; median 59y) with inoperable HCC were treated with DEB-TACE. Patients with Child-Pugh A, B, C cirrhosis were 63, 33 and 2, respectively. Tumor was multifocal in 62. Ten patients had branch portal vein thrombosis. DEB-TACE was performed using 100-300-500µ LC beads mixed with 100mg of doxorubicin. 62 patients had one, 32 had 2, 7 had 3 and 1 had four DEB-TACE procedures. Response rate (RR) was assessed using RECIST and EASL criteria on CT/MRI at 1 month. Overall median survival from the diagnosis and from DEB-TACE and the survival rate at 6, 12 and 24 months were calculated.
Results: DEB-TACE was technically successful in all. 30-day mortality was 1%. 11.2% had transient mild renal dysfunction post-procedure. At 1 month, CR+PR were 33.2%, SD 54.7% and PD 11.9%. 74.3% had >50% necrosis. Overall median survival from the diagnosis and

from the DEB-TACE was 28 (CI 23-34m) and 15 months (CI 11-21m), respectively. Post-diagnosis, Child A patients had better survival than the Child B (31 months vs. 21 months); however, such difference in survival was not observed following DEB-TACE (15 months vs. 15 months). The survival rates at 6, 12 and 24 months were 81.5%, 50% and 17.5%, respectively.
Conclusion: Chemoembolization with doxorubicin-eluting microspheres was safe and well tolerated in patients with inoperable HCC. Its efficacy is comparable to the historical controls.

1309.5

Hepatocellular carcinoma: computed-tomography-guided high-dose-rate brachytherapy (CT-HDRBT) ablation of large (5-7 cm) and very large (>7 cm) tumors

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Purpose: To evaluate the clinical outcome of CT-guided high-dose-rate-brachytherapy (CT-HDRBT) of hepatocellular carcinomas (HCC) exceeding 5 cm in diameter.
Material and Methods: Thirty-five patients with 35 unresectable HCC ranging from 5 to 12 cm (mean: 6.8) were treated with CT-HDRBT. Tumors were classified into two groups according to diameter: "large lesions" (5-7 cm) and "very large lesions" (>7 cm). To evaluate tumor response, a Gd-EOB-DTPA-enhanced liver MRI was performed before, six weeks after and every third month after treatment. Endpoints comprised local tumor control (LTC), progression-free survival (PFS), and overall survival (OS). Intergroup differences were analyzed by the Fisher´s exact test.
Results: Nineteen tumors were graded as "large" and 16 as "very large". Complete tumor-ablation was achieved in all patients after the first CT-HDRBT session. The mean minimal-tumor-enclosing dose was 15.76 Gy, mean clinical target volume (CTV) was 185.5 ml. Five patients were lost at follow-up; the remaining patients were available for MRI-follow-up. At mean follow-up of 10.2 months, two patients developed a local progression (6.7%), one in the "large" and one in the "very large" group. Eight patients (26%) experienced a distant progression four (21%) in the "large" and four (25%) in the "very large" group. No patients died during the follow-up period. The mean OS was 12 months. No major complications were recorded.
Conclusion: CT-HDRBT is an alternative to thermal ablation of HCC and warrants an outstanding local tumor control rate also for big HCC lesions that would have been untreatable by thermal ablation.

1309.6

Liver and biliary injuries following transarterial chemoembolization of endocrine tumors and hepatocellular carcinoma: lipiodol versus drug-eluting beads

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Purpose: The aim of this study was to describe and compare the liver/biliary injuries encountered with DEB-TACE and lipiodol-TACE in a tumor model with (HCC) and without (NETs) underlying cirrhosis.
Material and Methods: 208 consecutive patients treated for a well-differentiated metastatic NET (n=120) or a HCC (n=88) were included in this retrospective study. A total of 684 CT and MR scans (baseline and follow-up imaging) were compared at consensus by two experienced radiologists. Liver and biliary injuries were classified as follows: dilated bile duct, portal vein narrowing, portal venous thrombosis and biloma/parenchymal infarct. Univariate and multivariate logistic regressions were used. A generalized estimating equation (GEE) logistic regression model was used to take into account repeated TACE sessions for each patient. Internal validation using bootstrapping (200 replications) was performed.
Results: There was no difference in the two subgroups (lipiodol- and DEB-TACE) for the main characteristics. The occurrence of a liver/biliary injury was strongly associated with DEB-TACE (OR:6.62; p<.001) irrespective of the type of tumor. Biloma/parenchymal infarct was strongly associated with both DEB-TACE (OR:9.78; p=.002) and NETs (OR:8.12; p=0.04). Biloma/parenchymal infarct was significantly associated with the variation of serum level of liver enzymes.
Conclusion: The use of DEB-TACE is independently associated with liver/biliary injuries. Biloma/liver infarct is independently associated with both DEB-TACE and NETs. The absence of such association in TACE of HCC may be explained by the hypertrophied peribiliary plexus observed in cirrhosis, acting as a protection against ischemic/chemical insult of bile ducts. We suggest caution when using doxorubicin-loaded beads in TACE for NETs.

Free Paper Session
Bone, spine and soft tissue intervention 2

2101.1

Does saline solution temperature influence patient short-term outcome of a double-needle ultrasound-guided treatment of calcifying tendinitis of the rotator cuff (CTRC)? The discovery of hot water

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Purpose: We determined whether the temperature of saline influences procedure performance and patient short-term outcome of an ultrasound-guided lavage technique for treating CTRC.
Material and Methods: 88 patients (49 females, mean age 47 ± 11.1 years) with painful shoulder and ultrasound diagnosis of CTRC were prospectively randomised. Group A (n = 44) underwent ultrasound-guided percutaneous treatment of CTRC (local anaesthesia, double-needle saline lavage and calcium aspiration, intrabursal steroid injection) using saline at room temperature, group B (n = 44) underwent the same treatment with saline at about 42 °C. Duration of procedure was recorded and ease of calcium dissolution was subjectively scored 1 (easy), 2 (intermediate), or 3 (difficult). Ultrasound appearance of the calcium deposit was judged as hard, soft, fluid. Visual analogue scale (VAS) was used for patients' discomfort.
Results: Procedure duration was significantly lower (P=.030) in group B (544±241s) compared to group A (791±311s). Calcium dissolution was significantly improved (P=.034) in group B (median score 1) compared to group A (median score 2); in the subgroup with hard deposits (group A, n=14; group B=16), ease of calcium dissolution was larger and more significant (P<.001). VAS was significantly lower after treatments in both groups compared to baseline (group A, VAS before=9.0±0.6; VAS 1 month=4.7±0.5; VAS 3 months=3.4±0.4; group B, 9.1±0.4, 4.5±0.4, 3.3±0.5, respectively, P<.001 for all). While four post-procedural bursitis were observed in group A, none of them was observed in group B.

Conclusion: When treating CTRC, using warm saline solution could reduce procedure duration, improve calcium deposit dissolution, and reduce the occurrence of post-procedural bursitis.

2101.2

Augmented reality visualization using image-overlay for MR-guided interventions: assessment of accuracy for lumbar spinal procedures with a 1.5-Tesla MRI scanner

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Purpose: To prospectively test the hypothesis that an augmented reality (AR) image overlay system can provide accurate MRI guidance for spinal injection procedures.
Material and Methods: An AR prototype was used in conjunction with a 1.5-Tesla magnetic resonance imaging (MRI) system (Magnetom Espree, Siemens Healthcare, Erlangen, Germany). A human lumbar spine phantom was used. 62 virtual targets were punctured in order to assess the system's accuracy. Subsequently, 60 anatomic targets (facet joint, disc space and spinal canal) were punctured to assess how the system's accuracy translates into practice. Assessments were made by comparison of planned needle paths and final needle location on co-registered DynaCT images (reference standard), using 3D Slicer software. Outcome variables included entry error, angle error, depth error, target error, successful access of anatomic targets, number of needle corrections, and time requirements.
Results: Accuracy assessments demonstrated an entry error of 1.6±0.8 mm, angle error of 1.6±1.0°, depth error of 0.7±0.5 mm, and a target error of 1.9±0.9 mm. All anatomical targets (100%, 60/60 insertions) were successfully punctured, including 20/20 facet joints, 20/20 discs, and 20/20 spinal canals. Four needle corrections (4/60, 6.7%) were required. Planning of a needle path required an average of 55 seconds. Needle insertion required an average of 1 minute and 27 seconds.
Conclusion: The presented AR image overlay system provides accurate MRI guidance for successful spinal procedures in a lumbar spine model. It has the potential to change the current practice of MR-guided lumbar spinal injection procedures.

2101.3

Imaging evolution of Aperius® percutaneous interspinous spacer correlated to clinical outcome in a 1-year/5 time points single arm multicentric prospective study on 157 patients

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Purpose: To correlate x-ray evolution to clinical outcome after placement of a percutaneous interspinous spacer in symptomatic degenerative lumbar stenosis (DLSS).
Material and Methods: From November 2006 to May 2009, 157 patients (mean age 65 years (19-84); M:F=50:50) were treated for symptomatic DLSS with 250 percutaneous interspinous spacers in 12 hospitals. A screening MRI and 5 time points clinical assessment (Zurich Claudication Questionnaire (ZCQ), EuroQol-5 dimension (EQ-5D) and VAS) with lumbar spine x-rays (screening, 48 hours, 6 weeks, 6 months and 12 months) were performed. X-ray analysis included device location and complications (spinous process fracture, device slipping, bending or fracture, subsidence), correlated to clinical outcome.
Results: 77% of the patients had a significant decrease in symptom severity (ZCQ, EQ-5D and VAS) at 6 weeks maintaining to 12 months.
AP x-rays showed:
- 100% of central location
- Bending of device wings in 68% at 48h, without clinical implication
- One broken device wing at 6 months but not removed

Lateral x-rays showed:
- Correct device location (anterior, central) in 96%
- Posterior location of 10 devices without clinical improvement in 6/10 patients
- Slipping of device from central to anterior/posterior location, respectively, in 4% and 0% without clinical impact
- Spinous process fracture in 9 with increased back pain in 2 patients
- Subsidence of more than 5mm in 9 patients without clinical impact.

Conclusion: Anterior slipping, bending of device wings and subsidence of more than 5mm do not impair clinical outcome at 12 months. Spinous process fracture or posterior location of device might compromise clinical outcome.
Disclosure: Consultant for Medtronic

2101.4

Cervical infiltrations under CT guidance: potential risks (a 10-year experience)

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Purpose: To demonstrate through a rigorous technique, the total safety of foraminal cervical infiltrations, for the patient in the case of a cervicobrachial neuralgia, due to a disk fragment.
Material and Methods: To underline a 10-year experience (January 2000-June 2010) in 450 patients treated by in situ corticoids infiltration under CT guidance, in the medial part of the foramen, just behind the ganglion. Systematic analysis was performed with contrast (0.5 ml) of the presumed diffusion space under CT control, before corticoids injection, and identification of an eventual vascular leak, either within the subarachnoid spaces or within the synovial articular capsule.
Results: The venous vascular contamination represents the most important risk: contrast passage within the foraminal, intracanalar epidural vein, or also through the muscular deep veins, distant from the cervical canal (14%, 64/450): CT depiction of abnormal contrast stagnation in a homo- or contra-lateral side. The total absence of any visible contrast during CT control must evoke a radiculo-medullary artery contamination, a very rare condition (1.3%, 6/450). In all cases, the needle must absolutely be repositioned, with a new contrast control. The contrast injection of the articular capsule is very frequent, without any danger (18-20%, 81-90/450). The reach of a radicular meningeal sheath is exceptional. No neurological complications were observed in this 10-year series.
Conclusion: The good knowledge of the presumed diffusion space (contrast) is absolutely necessary, routinely, in case of cervical infiltration with corticoids. The vascular contamination risks are the most dangerous and have to be immediately recognized before the corticoids injection.

2101.5

Physiological saline as "contrast fluid" for test injections in MR-guided drug delivery?

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Purpose: In MR-guided drug delivery procedures diluted Gd-DTPA contrast agents are utilized for test injections to predict the distribution of consecutive injected drugs. In the treatment of 138 patients, the feasibility of contrast-agent-free drug deliveries was evaluated. Pure physiological saline solution was used instead of diluted Gd-DTPA for test injections in epidural and intraarticular treatments.
Material and Methods: 161 treatments were performed at 1.5 Tesla. In 23 pain therapies (15 epidural, 8 intraarticular) test injections were conducted with diluted contrast agent (0.0025 mmol/ml Gd-DTPA). A T1-weighted FLASH sequence imaged the injected contrast agent. In 138 therapies (99 epidural and 39 intraarticular) pure physiological saline (0.9 % NaCl) was utilized for test injections. T2-weighted sequences were optimized for a contrasted high-quality proof of injected saline solution. Additional parameters were assessed: sequences for planning and needle guidance, procedure time, technical success and complications.
Results: T2w-BLADE produces suitable planning images with minimal motion artifacts. A PDw-TSE protocol excellently represented puncture needles in contrasted images. Good demarcation of injected Gd-DTPA was achieved by a T1w-FLASH sequence. Physiological saline solution test injections were accurately visualized by a T2w-HASTE sequence (TA=29sec). First 10 treatments took 49 ± 21 minutes and last 10 interventions 20.8 ± 6.2 minutes. All treatments were technically successful. No side effects occurred.
Conclusion: In 138 treatments the feasibility of contrast-agent-free epidural periradicular therapies and intraarticular drug deliveries could be demonstrated. With an optimized HASTE sequence pure saline is applicable for test injections in MR-guided drug deliveries. Patients and therapists benefit from a secure and inexpensive "contrast fluid" without side effects.

2101.6

Efficacy of Discogel®-radiopaque gelified ethanol and ethylcellulose in the treatment of contained disc herniations: a preliminary experience

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Purpose: The aim of this study is to provide the efficacy of Discogel®-radiopaque gelified ethanol & ethylcellulose (Gelscom®, France) in the treatment of disc protrusions by means of pain relief and maintaining the height of the intervertebral disc.
Material and Methods: Thirty-three patients (18 males, 15 females, av. age 49.4) with lumbosciatic pain due to contained disc herniations were selected for treatment with injection of Discogel. Diagnosis was confirmed by MRI in all patients. All procedures were performed under fluoroscopic guidance and with local anesthesia. Twenty-two gauge needles were used and 8 ml of ethanol gel + ethylcellulose were injected for each intervertebral disc. Clinical evaluation, assessment of pain by means of a 11-point visual analogue scale (VAS, 0-10) and of function by means of the Oswestry disability scale (ODI 0-50) was performed at baseline and at one month after the procedure. CTms checks have been performed immediately after the procedure and at one month. The volume was calculated with Advantage viewer system (GE, UK).
Results: A total of 37 intervertebral discs were treated. Baseline pain was 8.2 ± 1.7, baseline ODI was 36.1 ± 10.4. At one month, pain was 2.8 ± 2.2 ($p<0.01$), while ODI was 16.5 ± 2.8 ($p<0.01$). We reported an increase of 41.9% in the volume of the intervertebral disc (av. volume before: 8.07, after: 11.4cm3). We reported one asymptomatic canal leakage.
Conclusion: From our preliminary study, the injection of Discogel® is an optimal therapy for symptomatic patients with contained disc herniations. Furthermore, the ethylcellulose, through the formation of a soft prosthesis, ensures the maintenance of disc height.

Free Paper Session Oncologic IR 3

2102.1

Transcatheter intra-arterial infusion of supradose cisplatinum with sodium thiosulfate rescue using bronchial or chest wall arteries to treat pulmonary or pleural malignancies: description of technique and preliminary results of a phase I study

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Purpose: We hypothesized improved tumor control with intra-arterial delivery of supradose cisplatinum, and that toxicity could be minimized with simultaneous systemic administration of thiosulfate to bind free cisplatinum. The purpose of this presentation is description of the technique and preliminary results of this phase I study.
Material and Methods: Eligible patients had locally advanced non-resectable primary or metastatic malignancies of the lungs or pleura that were refractory to conventional chemotherapy. Thoracic CT angiography was performed to identify feeding arteries. 1 or 2 feeding arteries were catheterized, angiography performed including cone beam CT, flow rate of the feeding artery determined, and cisplatinum infused at 150 mg/m^2. Simultaneously, intravenous sodium thiosulfate was administered at 9 gm/m^2. A second dose was similarly administered two weeks later. Tumor response was assessed one week after the second treatment using CT RECIST criteria.
Results: 5 patients have been treated to date (metastases [3], non-small cell lung cancer [1], and mesothelioma [1]). Arteries infused: bronchial [8], intercostal [2], internal mammary [2], and lateral thoracic [1]. 4 of 5 patients tolerated both chemoinfusion sessions; 1 developed grade 2 nausea and declined further study participation. 1 patient was hospitalized with a grade 3 cough. Tumor responses were 2/5 partial response, 2/5 stable disease, 1/5 CT pending. 1 patient with mesothelioma had reduction of chest wall pain.
Conclusion: Intra-arterial supradose cisplatinum infusion appears to be feasible to treat locally advanced primary and metastatic pulmonary and pleural cancers. Toxicity appears to be tolerable. Safety and efficacy will be assessed with further patient accrual.

2102.2

Percutaneous cryoablation for the treatment of lung tumors

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Purpose: Percutaneous ablation of primary and metastatic lung tumors is most often performed using radiofrequency ablation. Percutaneous cryoablation is a modality which is increasing in popularity. We report the efficacy and complications of cryoablation at our institution.
Material and Methods: A retrospective IRB approved study was performed looking at 33 patients from 2007 to 2011 with both primary and metastatic lung tumors were treated with cryoablation. The mean age was 72.6yrs (±10.7). There were 15 females and 18 males. Of the lesions treated, 19 (59.4%) were primary lung cancers and 14 (40.6%) were metastatic lesions. Tumors ranged from 0.8 to 6.5cm in maximum dimension (mean 2.2cm). Disease progression was defined as local tumor progression only. Time to progression and complications were endpoints. Complications were defined using existing criteria.
Results: Technical success was 100%. All lesions were able to be ablated. Mean time to progression (TTP) for the entire cohort was 272.9 days. For primary lung cancers TTP was 309 days and for metastatic lung tumors, it was 227.3 days. For those that did not progress through their last follow-up imaging, mean progression free survival was 359 days. Patient follow-up ranged from 138 days to 617 days (median 378.5). Overall mortality was 21% including non-procedure-related deaths. There were 12 (36.4%) major complications and 4 (12%) minor complications.
Conclusion: Percutaneous cryoablation is a technically feasible and effective modality for the treatment of both primary and metastatic lung tumors. Its effectiveness compared to other modalities such as radiofrequency ablation must be studied in the future.

2102.3

A semi-automatic guide system for interventional radiology procedures of the lung

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Purpose: To assess the clinical benefit of a robotic system while performing bioptical procedures on the lung (SIRIO). The SIRIO system in an infrared supporting technology that let us to advance the needle in the lung with real time monitoring of the needle path in reconstructed images from CT in the different planes.
Material and Methods: Between August 2009 and December 2010, 198 consecutive patients were enrolled. Including criteria were lesions >1cm, distant from vital anatomical structures (cardiovascular and respiratory), needing a histological assessment in patients with good performance status. Patients were randomly assigned to group A (129, SIRIO technique) and group B (69, STANDARD technique). Technical success, number of CT scans, dose absorption by the patients and time procedure length were evaluated in both groups. The t Student test was performed. A p value less than 0.05 was interpreted as statistically significant.
Results: Technical success was always obtained. Scans number was 3.4+/-1.5 for SIRIO vs 6+/-4 for STANDARD technique. The mean dose of ionizing radiation administered to the patient was 34mGy for SIRIO vs 61mGy for the STANDARD technique. Time procedure length was 14+/-7 minutes for SIRIO vs 25+/-12 minutes for traditional biopsies. For these data the p value was less than 0.05.
Conclusion: SIRIO resulted in a reduced number of CT scans to reach the target lesion, thus minimizing procedure length time and ionizing radiation absorption. Comparing the accuracy of the biopsies in both groups, no differences were noted.

2102.4

Histopathologic and immunohistochemical features of tissue adherent to multitined RF electrodes after ablation of lung malignancies: preliminary findings

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Purpose: To assess whether histopathologic and immunohistochemical analysis of tissue adherent to radiofrequency (RF) ablation electrodes after ablation of lung malignancies is feasible and indicative of local tumor progression (LTP).
Material and Methods: Institutional Review Board approval and patient consent were obtained. Using proliferation (Ki-67) and apoptosis (caspase-3) markers, histologic and immunohistochemical analysis of tissue adherent to RF electrodes post-ablation was performed. Medical records and imaging were examined to determine LTP. Progression-free survival (PFS) and overall survival (OS) were assessed using Kaplan Meier Method. Multivariate analysis of factors related to LTP was performed.
Results: Forty-nine lung malignancies from 44 patients treated with RF ablation were identified. Thirty-two specimens were classified as coagulation necrosis (CN) and seventeen as tumor cells, positive for Ki-67 (viable). Mean tumor size was similar between groups. For viable and CN groups, LTP was seen in 9/17 (53%) and 10/32 (31%) specimens, respectively. The median PFS for large tumors (> 2 cm) is 9 and 56 months for viable tumor and CN groups, respectively (p=0.033). The median PFS for small tumors (≤ 2 cm) is 18 months for viable tumor group and is never reached in the CN group (p=0.024). Total median PFS was 27 months and median OS was 57 months.
Conclusion: Immunohistochemical analysis of tissue adherent to ablation electrode after pulmonary RF ablation can help predict clinical outcome. Evidence of Ki-67-positive tumor cells on the electrode is a strong predictor of LTP with a shorter PFS.

2102.5

18F-FDG PET/CT for therapy assessment in lung metastases treated by radiofrequency ablation: a multicenter prospective study (NCT 003382252)

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Purpose: Evaluation of 18F-FDG PET/CT performed 3 months after radiofrequency ablation (RFA) of lung metastases to detect and predict local recurrence.
Material and Methods: A baseline PET/CT was performed a

maximum of 2 months before RFA. After RFA, PET/CT was performed at 1 and 3 months, and lung CT scan at 2, 4, 6, 9 and 12 months irrespective of the result of PET/CT at 3 months (P3). Maximum standardized uptake values (SUVmax) were recorded. The gold standard was biopsy at 3 months or follow-up at 12 months. For qualitative analysis, P3 was considered positive if the lesion uptake was greater than mediastinal background. ROC curve analysis for SUVmax was also done. Primary endpoint is accuracy of P3. Overall survival (OS) and time to local relapse was computed from RFA date using Kaplan-Meier method.
Results: Between 2005 and 2009, 88 patients (mean age 65y) underwent RFA for 115 lung metastases (mean size 16.3 mm (5-38)). The median SUVmax before RFA was 5.6 (1.1-35.8). P3 and gold standard were available for 77 patients and 101 lesions. With a P3 SUVmax cut-off of 2.4, sensibility is 87.5 %, specificity 54.1% and accuracy 59.4%. Area under ROC curve is 0.74. OS is 93% at 1y, 78.1% at 2y. Local relapse was observed for 16 patients (2 after 12 months). Local control is 83.4% at 1y, 79.3% at 2y.
Conclusion: Specificity of P3 SUVmax is low because of persistent inflammation, especially when the lesion is close to the pleura and uptake pattern has to be also considered for better prediction of relapse.

2102.6

Radiofrequency of lung metastases, midterm results

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Purpose: To evaluate midterm efficacy and survival after radiofrequency ablation of lung metastases.
Material and Methods: From 2002 to 2010, in 2 centers, 519 patients received radiofrequency ablation (RFA) of lung metastases from colon (n=182-35%), rectum (n=85-16%), kidney (n=61,12%), soft tissue sarcoma (n=46,9%), or miscellaneous cancer (n=145-28%). Patients has 1 tumor (n=276, 53%), 2 tumors (n=128,25%), 3 tumors (n=68 -13%), 4 tumors (n=27-5%), 5 tumors (n=16-3%) or 6 to 8 tumors (n=4-1%). Disease was unilateral in 75%. Median tumor diameter was 15 mm [4-70]. 8% of patients had at least a tumor larger than 3 cm.
Results: 449 patients had a single RF, 70 had 2 RF sessions and 46 patients had bilateral RF in the same session. 1 patient died during the 30 post-RF days. After a median follow-up of 23 months, 278 patients had evolutive pulmonary disease including 70 patients who demonstrated incomplete ablation. Failure rate of the treatment per patient was 10.0%, 16.5% and 19.3% at 1, 2 and 3 years, respectively. At 3 years, failure rate was 17.3% and 41.7% when largest tumor was equal to or smaller than 3cm or over 3 cm, respectively. At 3 years, failure rate was 14.6% and 30.3% when largest tumor was equal to or smaller than 2cm or over 2 cm, respectively. Survival was 93.5%, 80.3%, and 69.7%, at 1, 2 and 3 years, respectively. 3-year survival was 75%, 65%, and 72% for colon, rectum and renal cancer, respectively.
Conclusion: RFA of lung metastases provides interesting 3-year survival, irrespective of the origin of the disease.

Free Paper Session
Portal and Hepatic Vein Interventions

2103.1

Combined treatment in early portal vein thrombosis after a pediatric liver transplantation

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Purpose: Early portal vein thrombosis is one of the most frequent surgical complications after pediatric liver transplantation. It can be potentially devastating and lead to graft failure. We describe a combined treatment in the early portal vein thrombosis after liver transplantation without rebuilding the portal anastomosis.
Material and Methods: From November 2006 to October 2009, five children weighing less than 10 kg with biliary atresia and portal vein hypoplasia were transplanted developing early complications of the portal vein within the first 72 hours posttransplantation. Four patients developed thrombosis and one portal flow absence secondary to collaterals steal flow. In the Surgery theater, through the previous laparotomy a vascular sheath was placed in the ileocolic vein (n=2), inferior mesenteric vein (n=1) or graft umbilical vein (n=1). The sheath was exteriorized through the wound (n=2) or a different transabdominal wall puncture (n =3). The angio-suite, the portal clots were mechanically fragmented with an angioplasty balloon. In three patients competitive collaterals were embolized with coils and in one a stent was placed. Thereafter, a transcatheter continuous drip of heparin was infused.
Results: One patient developed recurrent thrombosis 24 hour later and it was solved with the same technique. The sheaths were removed surgically at a mean of 10.6 days. All patients had portal vein patency at the end of follow-up.
Conclusion: Treatment of the early portal vein complications after pediatric liver transplantation with a combined treatment is feasible and effective.

2103.2

10-year single centre experience of endovascular management of Budd–Chiari syndrome

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Purpose: Retrospective analysis of technical success, complication, primary patency and re-intervention in endovascular management of Budd–Chiari syndrome (BCS).
Material and Methods: This study was done over 10 yrs (January 2001 to Dec 2010) in the department of Radio-Diagnosis in association with the department of pediatric gastroenterology, gastroenterology and gastro-surgery at Sanjay Gandhi Postgraduate Institute of Medical science Lucknow, India. Inclusion criteria were patients with features of primary and secondary BCS. Exclusion criteria were patients unwilling for follow up. Patient refused to give consent. Total number of patients was160: males 72%; females 28%. Follow-up was for 36 months. The mean age of patients was 35 years, ranging from 4 yrs to 80 yrs. Diagnosis was based on Doppler USG showing obstruction of supra/retro hepatic IVC and/or HV. Intervention was selected on the basis of extent and type of HV/IVC

block. Clinical, biochemical and sonographic follow up was done prior to procedure.

Results:

- Procedure: Angioplasty-10, Stent-131, TIPS-18 HVcannulation failed-1.
- Complication: Hemoperitoneum-5, hepatic artery pseudoaneurysm-1, hemothorax-1, thirty days mortality in 3pt.
- Outcome in 30 days: normal-149, Stent blocked/reduced flow-5, lost to follow-up-3, death-3 pt.
- Technical success of IVC-100%, HV-97.36%.
- Mean follow-up was 36 months.
- Stents patency of IVC-57%, HV-75%, IVC+HV-66.7% and angioplasty-75%.

Conclusion: Radiological intervention is an effective and safe treatment in BCS. Technical success, outcome, and stent patency of present study were almost near to other published data.

2103.3

Graft overperfusion: diagnosis and management in pediatric living donor liver transplants

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Purpose: To describe the signs and symptoms of graft overperfusion syndrome, and therapeutic interventions used successfully to treat this condition in a major metropolitan children's hospital and transplant center.

Material and Methods: Since 2000, 78 living donor liver transplants have been performed at our children's hospital. Of these, 2 (1M:1F) have subsequently developed high output ascites within one week of transplantation. Both were 7 yr of age. One had hepatic fibrosis secondary to polycystic kidney disease, the other had cirrhosis secondary to primary sclerosing cholangitis. Ascites output was 3-13 liters/d, accompanied by splenomegaly, coagulopathy, hyperbilirubinemia and hepatocyte ballooning. Both patients underwent perfusion-reduction procedures: interventional partial splenic embolization followed by TIPS in patient 1, and surgical splenectomy in patient 2.

Results: After 20 mo (patient 1) and 15 months (patient 2), both patients are stable at home. Ascites, coagulopathy, and hyperbilirubinemia have resolved completely. The 6-mm TIPS shunt remains patent with flow in the expected direction. Neither patient has required retransplantation.

Conclusion: Correct diagnosis of graft overperfusion syndrome and perfusion reduction interventions can successfully resolve life-threatening intractable ascites and coagulopathy. Because graft overperfusion syndrome has not been previously recognized as a reason for graft failure in small children, its recognition and appropriate treatment can be both life-saving and graft-preserving.

2103.4

The efficacy of digital subtraction angiography using carbon dioxide gas during balloon-occluded retrograde transvenous obliteration using foam sclerosants for gastric varices

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Purpose: Prior to balloon-occluded retrograde transvenous obliteration (BRTO), balloon-occluded retrograde transvenous venography (BRTV) using liquid iodine contrast media is usually used to identiy the gastric varices (GV). On the other hand, foam sclerosants have been applied for BRTO to reduce the sclerosants' dose and related hemolysis. However, physiological property of foam is completely different from liquid iodine contrast media; the latter is heavier while the foam is lighter than blood and ascends into the more ventral GV. The visualization of foam sclerosants is also difficult on fluoroscopy. Thus, we introduced digital subtraction angiography using carbon dioxide gas (CO_2) to estimate the distribution of foam sclerosants before BRTO.

Material and Methods: For nine patients with GV, BRTO using foam sclerosants was attempted. After temporary balloon occlusion at gastro-renal shunt, BRTV was performed using conventional liquid iodine contrast first and then CO_2 second. These BRTV were repeated after downgradings or changing the catheter positions. Each grade on Hirota's classification (grade 1; GV only, 2; GV>collaterals, 3; GV<collaterals, 4; collaterals only) was compared. When GV were opacified on CO_2-BRTV, foam sclerosants were injected.

Results: Fourteen BRTV were performed for nine patients. The grades on CO_2-BRTV (1.6±0.8) were significantly ($p<0.01$) smaller than the grades on iodine-BRTV (3.6±0.6). In all patients complete thrombosis of GV was obtained without any complication.

Conclusion: CO_2-BRTV provides good simulation of BRTO using foam sclerosants.

2103.5

Portal vein embolization before right liver resection using a histoacryl/lipiodol mixture

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Purpose: We evaluate the efficacy and safety of transhepatic portal vein embolization (PVE) of the right liver lobe using a histoacryl/lipiodol mixture in inducing contralateral liver hypertrophy before (extended) hepatectomy in patients with primarily unresectable liver tumors.

Material and Methods: 21 patients, 17 with liver metastases and 4 with biliary cancers with insufficient future liver remnant underwent portal vein embolization. Liver volumetry, complication rates, relevant laboratory values and duration of hospitalization were documented.

Results: In 21/21 patients (100%) PVE could be performed with histoacryl/lipiodol mixture alone (n=20) or histoacryl/lipiodol mixture with microcoils in addition (n=1) to a mean volume of histoacryl/lipiodol of 6.6± 4.1 ml (range 2-15 ml). No procedure-related complications occurred. No acute liver failure after embolization was observed. The volume of the left liver lobe increased significantly ($p<0.0001$) by 28% from a mean of 549 ml (296-1029 ml) to 709 ml

(380-1517 ml). 18/21 patients (85.7%) underwent surgery and in 13/18 (72.3%) patients the intended resection could be performed.
Conclusion: Preoperative portal vein embolization using a histoacryl/lipiodol combination is safe and effective in achieving hypertrophy of nonembolized parts of the liver.

2103.6

US-guided transhepatic puncture of hepatic veins for TIPS placement

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Purpose: Retrospective analysis to assess feasibility, results and characteristics of TIPS procedures performed with US-guided percutaneous puncture of hepatic veins.
Material and Methods: During 3 years, 127 patients were treated with TIPS. In 8 cases a percutaneous puncture of the middle (7) or right (1) hepatic vein was required, because the hepatic vein ostium was not accessible with an usual TIPS technique. TIPS indications were: 1 bleeding, 1 Budd-Chiari syndrome, 2 ascites, 1 reduced portal flow and 3 incomplete portal thrombosis. Through a 21-gauge needle, a 0.018-inch guidewire was anterogradely introduced in the hepatic vein to the inferior vena cava. Meanwhile a 25-mm snare loop catheter was introduced through the jugular access to retrieve the guidewire, achieving a through-and-through access. Thus, a Roche-Uchida set was used to place the TIPS with a traditional technique.
Results: This different type of TIPS access succeeded in 100% of the cases. No complication was observed. The follow-up US detected just 1 stent thrombosis. The performance status and the hepatic function were satisfactory at 6-month clinical follow-up. 3/8 patients are actually eligible for liver transplantation; the remaining patients are excluded for shunt thrombosis (1), age (1) and previous non-hepatic neoplastic disease (3).
Conclusion: For TIPS placement it is essential to catheterize the most suitable hepatic vein. Percutaneous approach to hepatic veins is safe and rapid in unfavourable conditions; indeed, it is useful in order to avoid unnecessary traumatic liver injuries.

Free Paper Session
PVD 2

2104.1

Rheolytic thrombectomy in the treatment of acute limb ischemia: interim results of a prospective multi-center registry

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Purpose: To report registry interim results for the treatment of acute limb ischemia with rheolytic thrombectomy.
Material and Methods: A two-phase ongoing prospective registry of the MEDRAD Angiojet catheter used in the treatment of acute limb ischemia was examined. Electronic data capture case report forms were completed by site staff collecting patient's history, procedural information including adjunctive treatments, outcomes and adverse events. Phase I patients were followed to 3 months post-procedure while the ongoing phase II patients will be followed for 12 months.
Results: Currently, 178 acute limb ischemia patients (37 centers) have been treated (98 males and 80 females, mean age 66; range 21 to 96 years). Baseline Rutherford classifications included 60-I, 53-IIa, 60-IIb, 2-III. All patients were treated with the Angiojet catheter, with 66% receiving power pulse spray or rapid lysis. CDT occurred in 44%. Full patency was achieved in 83%. 75% of cases were completed in < 24 hours. Initial hospitalization adverse events included: bleeding requiring transfusions 8/178 (4%), bypass surgery 10/178 (6%) and amputation 6/178 (3%). 162/178 (91%) had 3-month follow-up with 5/178 (3%) reporting bypass surgery and another 4/178 (2%) having an amputation.
Conclusion: Rheolytic thrombectomy combined with adjunctive treatments is an effective and safe strategy for limb ischemia.
Disclosure: speaker honorarium & steering committee member

2104.2

Five-year Irish trial of CLI patients with TASC II type C/D lesions undergoing subintimal angioplasty (SIA) or bypass surgery (BG) based on plaque echolucency

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Purpose: Of 1076 patients referred with PVD from 2002 to 2007, 206 SIAs in 190 patients and 128 bypass grafts in 119 patients were enrolled in the study.
Material and Methods: All patients had rest pain and/or tissue loss. Primary endpoints were survival free from amputation and sustained clinical improvement. Secondary endpoints were major adverse events (MAE), the binary restenosis rate, freedom from TLR, and a special quality-adjusted life year (QALY) endpoint (Q-TWiST) that incorporated both length and quality of life to evaluate treatments.
Results: At 5 years, clinical improvement was sustained in 82.8% of the SIA group versus 68.2% of the BG patients (p50.106). Five-year all-cause survival was similar for SIA (78.6%) and BG (80.1%; p=0.734), as was amputation-free survival (SIA 72.9% versus BG 71.2%; p=0.976). Hyperfibrinogenemia (p=0.009) and C-reactive protein (p=0.019) had negative effects on survival without amputation. Five-year freedom from binary restenosis rates were 72.8% for SIA versus 65.3% for BG (p=0.700). While the 5-year freedom from TLR rates (SIA 85.9% versus BS 72.1%, p=0.262) were not statistically significant, the risk of MAE (p<0.002) and length of hospital stay (p<0.0001) were significantly reduced. Q-TWiST significantly improved (p<0.001) and cost-per-QALY was reduced with SIA. The 5-year risk of re-intervention (p>0.05) and mean number of procedures (p=0.078) were similar.
Conclusion: Five-year freedom from MAE was enhanced by 20% in the SIA group, with substantial cost reduction and better Q-TWiST. SIA is a minimally invasive technique that expands amputation-free and symptom-free survival. SIA is a paradigm shift in the management of CLI.

2104.3

Subintimal angioplasty for superficial femoral artery TASC II D lesions in critical limb ischemia: outcomes with and without stenting and value of stent position for secondary patency after subintimal channel occlusion

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Purpose: In a prospective, double arm, non-randomized, single center consecutive series of subintimal angioplasty (SIA) with selective stent placement for superficial femoral and popliteal artery TASC II D lesions data were analyzed regarding the immediate outcome and follow-up success.
Material and Methods: All patients were treated with an transfemoral antegrade approach. Subintimal technique was used in all patients. 1, 6 and 12 months of follow-up were performed with US Doppler.
Results: SIA was successful in 398 patients of 406 critically limb ischemia (98%). Stents were released in the subintimal channel in 83 patients (21%) after suboptimal SIA. Primary patency at one-year follow-up was 79.5% and 66.7%, respectively, in patients treated with and without stent (p=0.02). Re-occlusions occurred in 147 patients treated by SIA alone (47%) and 27 patients treated by SIA and stent (32%) (p=0.02). Successful recanalization rate was higher for patients treated by SIA alone (95%) compared to patients in whom stent was released (81%) (p=0.04). Feasibility of stent recanalization was higher in patients treated by a stent released in contact with the true lumen (p=0.02).
Conclusion: SIA is a feasible and effective primary treatment for patient with TASC II D superficial femoral and popliteal artery lesions. The use of stent in subintimal angioplasty improves primary patency compared to SIA alone treatment. Stent position affects the technical approach for a second recanalization after stent occlusion.

2104.4

What with inadvertent subclavian artery puncture lesions? Percutaneous closure with a StarClose device

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Purpose: We want to report the technique of percutaneous closure with the Abbott StarClose device of inadvertent subclavian artery catheterization lesions. This iatrogenic trauma during central venous access procedures can lead to serious morbidity or mortality.
Material and Methods: From 2007 up till now, we had 10 patients with an accidentally catheterized subclavian artery with a 7 Fr. triple lumen catheter. All patients were critically ill. Because manual compression or surgical intervention was not a first option, we removed the catheter and closed the puncture lesion with a StarClose device (Abbott Laboratories, Redwood CA). First we prepare a retrograde brachial access, as a bail-out system. Then a wire is placed in the brachial artery and one in the misplaced catheter. Catheter is removed and the StarClose introducer is inserted, followed by percutaneous closure of the lesion with a StarClose.
Results: Nine procedures went all well. Control angiography showed no problems at the lesion/closure site in the subclavian artery. In one patient the closure failed because of a perforated side branch, this was treated with covered stent placement. Follow-up showed no early or late complications. Two patients died less than 30 days post-procedure (not intervention related).
Conclusion: Using a StarClose closing device can be a safe alternative for the traditional therapies like compression, surgical intervention, covered stent placement or other endovascular treatment for a subclavian artery catheterization lesion. This type of percutaneous closure is furthermore cost reducing, less invasive and can lower the high morbidity and mortality of this complication.
Disclosure: Consultant for Abbott, Atrium, Cordis J&J, IDEV

2104.5

Transradial vascular access for proximal iliofemoral percutaneous interventions: a single-center experience

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Purpose: Transradial approach (TRA) for iliofemoral interventions is appealing, allowing early deambulation and preventing haemorrhagic complications. However, its universal application is limited by a steep learning curve, as well as by the characteristics of the devices (catheter length). We present the results obtained during the last 4 years in performing percutaneous revascularizations on the iliofemoral territory through the TRA.
Material and Methods: Single-center observational study.
Population: all the consecutive patients with proximal iliofemoral non-occlusive disease, referred for percutaneous revascularization and a planned intervention through the TRA. Between March 2006 and November 2010, transradial iliofemoral interventions were attempted in 125 patients. 6 cases with common iliac occlusion were excluded from the study. The remaining 119 patients (97% male, mean age 64) are included in the analysis. Endpoints were technical success and access-site vascular complication rate.
Results: Technical success was obtained in 99% of the cases. The TRA was left in 104 cases (87%), right in 10 (9%), and bilateral in 5 (4%). The number of lesions treated was 163 (1.37/patient: common iliac 43%, external iliac 48%, common femoral 5%, superficial femoral 4%). Only-balloon angioplasty was performed in 29 lesions (18%). In the remaining 134 lesions, a total of 153 stents were implanted (balloon-expandable 29%, nitinol self-expandable 71%). Complications related to the vascular access were: 15 asymptomatic radial artery occlusions (13%); 2 reabsorbed forearm haematomas; and 1 traumatic peripheral neuropathy.
Conclusion: TRA for proximal iliofemoral percutaneous interventions is safe and feasible, with low minor complications, and high technical success rate.

2104.6

Cost-effectiveness analysis of infrapopliteal drug-eluting stents for critical limb ischemia treatment

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Purpose: To determine the cost-effectiveness of infrapopliteal drug-eluting stents for critical limb ischemia (CLI) treatment.
Material and Methods: Two different strategies of infrapopliteal placement of drug-eluting stents were examined. The first included provisional use of Sirolimus-eluting stents after suboptimal balloon angioplasty (group S) and the second primary Everolimus-eluting stenting (group E). Infrapopliteal balloon angioplasty and bail-out bare metal stenting served as the control group in both cases. Standard survival methods (Kaplan-Meier analysis) and multivariate (Cox proportional hazards regression analysis) statistical testing were applied to calculate overall patient event-free survival defined by the absence of any major events of death, major amputation or

target limb repeat procedures. The event-free survival curves were reconstructed from published infrapopliteal series. The mean survival gain was estimated from the respective area under the curve (AUC method by the trapezoidal rule) and the event-free survival gain per patient was calculated. The number-needed-to-treat (NNT) to avoid one major event and incremental cost-effectiveness ratios (ICERs) were calculated for a 3-year post-procedural period.
Results: Overall event-free survival was significantly improved in both strategies (HR[CI]:0.68[0.41-1.12] in group S and HR[CI]: 0.53[0.29-0.99] in group E. Mean event-free survival gain per patient was 0.89 years (range, 0.11-3.0) in group S and 0.91 years (range, 0.25-3.0) in group E. Estimated NNT was 4.6 (CI: 2.5-25.6) in group S and 2.7 (CI: 1.7-5.8) in group E. The calculated ICER for group S was 6518€ (range, 1685-10112€) and 11581€ for group E (range, 4945-21428€) per event-free life-year gained.
Conclusion: Both strategies of provisional and primary drug-eluting stent placement in the infrapopliteal arteries for critical limb ischemia treatment exhibit single-digit NNT and low corresponding ICER.

Free Paper Session
Venous interventions 2

2105.1

Ultrasound accelerated thrombolysis for the treatment of pulmonary embolism

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Purpose: Our single center experience is reported on the use of ultrasound accelerated thrombolysis (USAT) for endovascular management of intermediate and high-risk PE patients.
Material and Methods: Between February 2009 and July 2010, 22 PE patients were treated using the EKOS EkoSonic Endovascular System (EKOS Corporation, Bothell, WA) and rt-PA. Preliminary and post-treatment CT scans were performed on 21 patients. The primary endpoint was mortality. Secondary endpoints were improvement in the right ventricular to left ventricular end diastolic diameter ratio (RV/LV ratio) and reduction in clot burden.
Results: All 22 treated patients survived. In the 21 patients with CT scans, the average RV/LV ratio pre-treatment was 1.33 ± 0.23 and 1.00 ± 0.13 post-treatment ($p < 0.001$). Clot burden, calculated from the CT scans using the modified Miller score (maximum 36), was reduced from 17.8 ± 7.4 to 10.0 ± 4.0. Major bleeding complications occurred in 4 patients, all 4 requiring transfusion. Minor bleeding complications occurred in 2 patients. No other complications were observed. All bleeding complications were reported in the first 14 patients, who received an average of 47.6 mg of rt-PA delivered over 22 hours. The dosing regimen for rt-PA was reconsidered and reduced in the remaining 8 patients to an average dose of 20.8 mg of rt-PA over 14.3 hours, and no further bleeding complications were reported.
Conclusion: USAT is a safe and effective treatment for PE. Clinical outcomes were improved with no mortality, even with a reduced total dose of rt-PA to 21 mg.

2105.2

Results of symptomatic chronic benign central venous occlusion recanalization with radiofrequency (RF) puncture wire technique

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Purpose: To describe the technique and present the results of the use of RF wire puncture technique for the recanalization of chronic central venous obstructions in symptomatic patients.
Material and Methods: Between June/08 and Jan/2011, 31 patients (15 females), age ranging from 35 to 78 years, presented with swollen arm and/or face secondary to benign central venous occlusions (7 subclavian, 19 brachiocephalic veins, 5 superior vena cava) related to tunneled catheters (30 hemodialysis, 1 Crohns disease patients). Simultaneous upper extremity (brachial approach) and central venograms (femoral approach) defined the central occlusion site. The PowerWire^{TM} RF wire was advanced within a 5-Fr KMP catheter. A pre-stent 4mm balloon angioplasty was followed by 10-12mm stent placement. If the RF wire puncture was inadequate, a new location was pursued. There were clinical and venograms follow ups at 30 days and then at 3, 6 and 12 months.
Results: 29 patients were successfully treated with RF wire after previous failed attempts at recanalization using mechanical catheter/wire techniques. In two patients the procedure was aborted, in one due to hemothorax successfully treated with chest tube without clinical repercussions. All the successfully treated patients had resolution of symptoms in a 7 (3-18) months mean follow-up. 2/29 patients had stent occluded in 30 days and 27/29 stents were patent at 6 months and the patients were asymptomatic.
Conclusion: RF wire is a safe alternative in benign chronic central venous occlusions when conventional techniques failed and may provide good vessel patency rate.

2105.3

Prevention of death from PE: are caval filters underused?

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Purpose: Pulmonary embolism (PE) is believed to be a common cause of death of hospital in-patients. The aims of this study were to estimate the number of deaths caused by PE and the potential to reduce this by the use of caval filters according to accepted indications.
Material and Methods: Review of autopsy reports and death notification records from 2007 and 2008 in a large UK teaching hospital. When PE was given as cause of death, hospital records were reviewed for evidence of pre-mortem diagnosis of PE or deep vein thrombosis (DVT) and for evidence of accepted indications for caval filter placement according to CIRSE guidelines.
Results: From a total of 186,517 adult inpatient admissions there were 2583 (1.4%) adult in-patient deaths of which 696 (27%) underwent autopsy. Of those undergoing autopsy, 14 (2.0%) deaths were caused by PE. PE was recorded as a cause of death in a further 12 (0.7%) of 1773 patients who did not undergo autopsy. Five of these 26 patients had a pre-mortem diagnosis of DVT or PE. Three of these had an accepted indication for caval filter placement. In the same period of time, 31 patients had a caval filter placed.
Conclusion: The proportion of deaths caused by PE appears to be considerably lower than the widely published rate, and of this small number, very few have a pre-mortem diagnosis of DVT or PE. There

is limited potential for further reduction of PE mortality through the use of caval filters according to guidelines.

2105.4

Long-term follow-up of IVC filters: 24 years of all filters followed-up till death or the present day

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Purpose: To obtain robust prospective data on the long-term effectiveness, complications and morbidity of all IVC filters placed in one institution in the United Kingdom.
Material and Methods: Over a 24-year period, all patients who had an IVC filter placed were prospectively entered into a database. They were all then followed up with annual clinical interviews, plain abdominal radiographs and duplex ultrasound, performed by one of the authors, until death or the present day. Any other significant clinical data or imaging was recorded. Patients who had filters removed were followed up as far as possible.
Results: Over 400 filters have been inserted. Over 95% of all patients have been followed up to death or the present day. Total length of this ongoing study is >24 years, longest follow up on individual patients is >20 years. Recurrent pulmonary embolism rate is <4%. Recurrent deep vein thrombosis rate (any incidence of venous thrombo-embolism since the insertion of the filter) is 16%. Caval thrombosis or obstruction rate is <4%. No other significant symptomatic complications have occurred. 35% of patients are on long-term anti-coagulation. 40% of this series of patients have had a diagnosis of malignant disease. Extraction of filters has been attempted or carried out in <14%.
Conclusion: The use of IVC filters is safe and effective. They are not associated with increased deep vein thrombosis. The rate of complications is small. Symptomatic complications are very rare. Removal of IVC filters may not be necessary.
Disclosure: I provide Proctorship services for Cook Medical.

2105.5

Device-related complications and effectiveness of the OptEase filter: a retrospective study of 149 cases

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Purpose: To investigate the incidence of device-related complications and post-filter PE and DVT.
Material and Methods: Between 2004 and 2010, 149 OptEase filters were placed. The imaging archive, patient administration and electronic result databases and case notes were reviewed. Indication, retrieval and device-related complications (fracture, migration, penetration, tilt, PE, caval occlusion and DVT) were recorded.
Results: Indications were peri-operative PE prophylaxis in 62, contraindication to anticoagulation in 39, VTE despite anticoagulation in 31, high risk of death from further PE in 9, paradoxical emboli in 1 and unknown in 7. At placement, 59 had PE, 25 had DVT/PE, 55 had DVT, 9 had no VTE, and 1 had paradoxical embolus. Twenty-three patients (15.4%) presented for retrieval. Two had significant residual thrombus. 16 of 21 filters (76.2%) were retrieved. Mean follow-up was 27.7 months in the 72 patients alive with the filter. There was 1 post-filter PE, 9 DVTs and 1 caval occlusion. Thrombus was seen in the filter in 12 cases but this did not progress to occlusion and was asymptomatic. There were 2 fractures and 2 cases of penetration. There was no secondary filter tilt. 5 cases of migration were seen, one of which prevented retrieval.
Conclusion: This large series with mean follow-up of 27.7 months provides further evidence that the OptEase filter has an acceptable long-term safety profile when left in situ to function as a permanent device. The short retrieval window may preclude retrieval, particularly when thrombus is found in the filter or if there are post-operative complications which delay filter retrieval.

2105.6

Rheolytic thrombectomy for deep vein thrombosis: a prospective multi-center registry report

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Purpose: To report registry procedure, safety and clinical outcome data in which upper and lower extremity DVT was treated with rheolytic, pharmacomechanical thrombolysis.
Material and Methods: A two-phase, multicenter ongoing prospective registry of the MEDRAD Angiojet catheter used in the treatment of upper and lower extremity DVT was examined. Electronic data capture case report forms were completed by site staff collecting patient DVT history, procedural information, adjunctive treatments, outcomes and adverse events. Phase one followed patients three months with documentation of symptomatic improvement. The ongoing phase two follows patient outcomes through 12 months.
Results: Currently, 214 treated patients (37 centers) include 132 males and 82 females (mean age 53; range 18-86). 31 upper and 184 lower extremity DVT cases were included. 151 patients (71%) reported onset of symptoms <14 days. Combined pharmacomechanical thrombolysis using power pulse spray or rapid lysis techniques were used in 86% of cases (184/213). 48% of cases were completed in <6 hours, 71% of cases were completed in <24 hours. Substantial or complete lysis was achieved in 93% of all treated vessels. Adjuvant stent placement was performed in 61 patients (29%). A 3.7% complication rate relating to the endovascular procedure was reported. To date, three-month follow-up was available for 159/184 (86%) of patients with 84% reporting continued symptomatic improvement.
Conclusion: PEARL Registry outcome data indicate that rheolytic pharmacomechanical thrombectomy is a safe and effective strategy for endovascular treatment of upper and lower extremity DVT.
Disclosure: Speaker/Honorarium

Free Paper Session
Innovations in IR

2106.1

Parstatin inhibits contrast-induced nephropathy in an animal experimental model

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Purpose: Parstatin, the N-terminal 41-amino-acid peptide cleaved by thrombin from the protease-activated receptor 1, has already been shown to protect against rat myocardial ischemia and reperfusion injury. We present the preliminary results of an experimental study investigating the hypothesis that parstatin may have a protective role against contrast-induced nephropathy (CIN).
Material and Methods: CIN was experimentally induced in New-Zealand-White (NZW) rabbits by intravenous administration of a high dose (10mg I/kg) of iodinated contrast medium (Iopromide 370mg I/ml) infused over 30min. Subjects received either pre-treatment with 10μg/kg parstatin 15 minutes before initiation of contrast infusion (Group P), or an equal volume of normal saline (control Group C). Blood serum creatinine (sCr) was measured at 48 hours in all subjects. CIN was defined as an increase of subject's sCr above 1.5mg/dl (normal rabbit sCr: 0.7-1.0mg/dl). Animals were euthanized at 48 hours and both kidneys were removed and sectioned for histological examination with hematoxylin and eosin staining.
Results: In total, 33 NZW rabbits were assigned in group P (n=18, 3.1±0.3kg) and group C (n=15, 3.0±0.2 kg). At 48 hours CIN was detected in a statistically significant higher proportion of subjects in the control group C (86.7%, 13/15) than in the parstatin-treated group P (27.8%, 5/18), p<0.001. Histology demonstrated more extensive tubular necrosis in group C compared to group P.
Conclusion: Parstatin successfully inhibits CIN in an animal model of contrast-induced nephropathy. Further studies are necessary to validate the protective role of parstatin against contrast nephrotoxicity in both experimental and clinical settings.
Disclosure: N. Tsopanoglou and D. Siablis declare competing financial interest because of submission of patent applications covering parstatin

2106.2

Endoureterotomy using Acucise balloon diathermy for the treatment of megaureter. Experimental study in an animal model

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Purpose: The aim of this study was to assess the usefulness of the Acucise® device for the endourological treatment of obstructive megaureter.
Material and Methods: 14 female swines were used for this study. Phase I, after measuring the juxtavesical ureteral diameter, a unilateral megaureter model was created in all animals. Phase II, 3 weeks after model creation retrograde ureteropyelography (RUP) and percutaneous ultrasonography was performed in all animals to confirm the existence of a megaureter. An Acucise® endoureterotomy was then performed. Phase III, 5 months after megaureter treatment animals were followed up using RUP, ultrasonography and excretory urography (EU). Treatment success was evaluated by renal ultrasonography, EU and the measurement of the evolution of the diameter on the target zone.
Results: Success or improvement after therapy was confirmed in 86% of cases, as defined by ultrasonography and the measurement of ureteral. A decrease in ureteral tortuosity, along with the disappearance of the ureteral dilatation cranial to the obstruction was also seen. No cases of vesicoureteral reflux were observed in this study. Hydronephrosis degree changed from III during phase II to I during phase III of the study. A marked retroperitoneal fibrosis was seen in all animals.
Conclusion: In this experimental setting, the Acucise® endoureterotomy has been shown to be highly effective in the treatment of obstructive megaureter in the swine model. A straight endoureterotomy was achieved in all cases. However, further studies are needed to limit adverse effects, such as retroperitoneal fibrosis.

2106.3

Solitaire™ FR revascularization device: a retrospective study as a first line device for acute ischemic stroke

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Purpose: To provide data on the Solitaire device when used in real practice as 1st choice device in revascularization of patients with acute ischemic stroke in European sites experienced with the use of Solitaire.
Material and Methods: Six European centers treated 141 patients for acute ischemic stroke using the Solitaire™ FR , as first intention device, in relation to their own clinical practice which involved the use of mechanical thrombectomy devices and pharmacologic agents from March 2009 to June 2010. The centers involved were Germans Trias Hospital in Barcelona, Geneva University Hospital, Inselspital University Hospital of Bern, Hôpital Gui de Chauliac in Montpellier, Karolinska sjukhuset in Stockholm, AKK Hospital in Essen.
Results: Of the 141 patients, 44% were females and 89% of the occlusions were in the anterior anatomy. The median baseline NIHSS score was 18. The revascularization success (TICI≥ 2b) was 90%. The median procedure time from groin puncture to revascularization was 45min. Good clinical outcome (mRS ≤ 2) at 90 days was 56%.
Conclusion: The results show the positive effect of use of Solitaire in the treatment of patients with acute ischemic stroke to restore flow.

2106.4

Pancreatic islet cell transplant: the outcomes of the first 50 patients

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Purpose: To present the outcomes of the first 50 patients in the islet cell transplant program for chronic pancreatitis.
Material and Methods: Data on 50 patients, 40 females and 10 males, 42 Caucasian, 6 African-American, 1 Asian and 1 native American were reviewed. Etiology: 23 had sphincter of Oddi dysfunction, 12 pancreas divisum, 9 were idiopathic, 4 were alcoholic, 4 familial, 2 had hypercalcemia and 2 hypertriglyceridemia. Islet pellet weight range 06-46g, islet equivalents per/kg 54-15,404. Elapsed time from excision to transplant range from 145-451 min.
Results: Hepatic pressures range: pre 2-15 mmHg, mid 3-33 mmHg, post 4-37 mmHg. Insulin use range in units: pre 0-100, D1 1.8-92, D2 0-77, D3 0-72, discharge 0-60, 6 months 0-55, 12 months 0-71. Morphine equivalent (mg/day): daily in hospital 0-2223, discharge: 0-2518, month 6: 0-2334, month 12: 0-1431. Complication: surgical drain 7, reoperation 6, readmission 10, incisional 6, pneumonia 8, PE 1, on ventilator >48hs 1, cardiac arrest 2, intraperitoneal bleed 1, DVT 3, sepsis/shock 1/4, bile leak 2, biliary structure 1, hepatic abscess 1, death <30 days 1, death at 7 months 1, PV thrombosis 1, hepatic pseudoaneurysm (IR) 2.
Conclusion: Total pancreatectomy with islet cell autotransplant through percutaneous venous infusion is a feasible technique. Several complications (32) were related to the surgical procedure. Two hepatic artery pseudoaneurysms were related to the percutaneous infusion procedure. The majority of complications required less than 48hs in the hospital. Significant decrease in need for insulin was related to larger number of islet cells transplanted. There was no significant reduction in morphine use.

2106.5

Feasibility of a dual microcatheter-dual interlocking detachable coil technique in preoperative embolization in preparation for distal pancreatectomy with en bloc celiac axis resection for locally advanced pancreatic body cancer

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Purpose: To describe the feasibility of a dual microcatheter-dual interlocking detachable coil (DMDI) technique for preoperative embolization of the common hepatic artery (CHA) in preparation for distal pancreatectomy with en bloc celiac axis resection (DP-CAR) for locally advanced pancreatic body cancer.
Material and Methods: From January 2007 to December 2009, 26 patients underwent embolization of the CHA by the DMDI technique. For DMDI technique, we manipulated the first IDC to form a stable frame without detaching it. A second IDC was advanced inside the first IDC through another microcatheter. After confirming the stability, the second IDC was detached. Then, the residual first IDC left undetached was detached. We compared the results with those of 37 patients in whom the CHA was embolized by conventional techniques before the introduction of the DMDI technique from August 1998 to February 2007.
Results: With the DMDI technique, no coil migration or other embolization-related complications occurred. The success rate was 100%. The rate of embolization-related complications was significantly lower in the DMDI embolization group (0%) than in the conventional-embolization group (24.3%) (P=0.008). The frequency of improper positioning of the coil and/or coil anchor necessitating its removal during DP-CAR was significantly lower in the DMDI embolization group (10%) than in the conventional-embolization group (37.5%) (P=0.044).
Conclusion: The DMDI technique is feasible for embolization of the CHA in preparation for DP-CAR, in which distal embolization due to coil migration has to be avoided to preserve and develop collateral pathways, as well as to reduce the surgeonâ€™s burden in ligating the distal CHA.

2106.6

Implantations of a resonant vena cava filter in a Thiel-embalmed cadaver under MRI guidance

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Purpose: Experiments in MRI-guided deployment and retrieval of resonant vena cava filters (VCFs) were carried out in 4 Thiel-embalmed human cadavers. Resonant VCFs designed to locally increase the MR-signal allow the susceptibility and RF-artifacts of the implants to be overcome. Thiel-embalmed cadavers, in contrast to formalin-fixed cadavers, retain their natural colors and flexibility, features which are of considerable interest in interventional MR-guided procedures.
Material and Methods: Resonant VCFs, designed as a coil and coated with biocompatible insulation, were laser cut from a Nitinol tube and tuned to the frequency of 1.5T MR-scanner (64MHz). Access to the femoral vein was established at the groin of four cadavers (65kg-80kg) with a 16F sheath (Cook, USA). The filters were deployed in vena cava under MR-guidance (GE SignaHDx1.5T, FGRE, TR/TE=2.7/1.8ms, FA=30°). Slow venous flow (0.9%NaCl) and respiratory motion were established.
Results: The increase of the MR-signal in the VCFs was clearly visible. Due to the good physiological condition of the Thiel-embalmed cadavers' vascular systems (e.g. elasticity), resonant VCFs were successfully released and retrieved repeatedly under X-ray and MRI. The VCFs were visualized in MRI.
Conclusion: The reported results demonstrate the benefits of using the resonant technology when performing vascular interventions under MR-guidance. The enhancement of the MR signal was sufficient for successful tracking of the catheter and visualization of the VCFs. The experiments showed that the Thiel-embalmed human cadavers are an excellent alternative model to animal trials and due to the human anatomy more suitable in both research and development of MR-guided vascular interventions.

Free Paper Session
Oncologic IR 4

2107.1

Pre-treatment intra-hepatic distribution of technetium-99m MAA does not correlate with the post-treatment distribution of yttrium-90 in radioembolization patients

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Purpose: For improvements in radioembolization dose planning the partition method is advised, using technetium-99m-labeled MAA (MAA) as a predictor of yttrium-90 microspheres (Y90) dose distribution. To evaluate this method, the intra-hepatic distribution of MAA and Y90 in both primary (HCC) and secondary liver cancer (colorectal cancer; CRC) were compared using 2 methods.
Material and Methods: 33 lesions from 13 patients (CRC) and 14 lesions from 11 patients (HCC) treated with yttrium-90 radioembolization were analyzed. Regions and volumes of interest (ROIs and VOIs) were manually drawn on pre-treatment CT or MRI scan and fused with pre-treatment MAA and post-treatment Y90 SPECT images. The intra-hepatic tumor-to-non-tumor ratios using ROIs (T/N-ROI) and VOIs (T/N-VOI) for MAA and Y90 were calculated and compared using linear regression and Bland Altman plots.
Results: In all patients, and for both methods, a poor correlation was found between MAA and Y90 dose distribution ($r^2 < 0.40$). The used methods (T/N-ROI and T/N-VOI) did correlate with each other for MAA ($r^2 = 0.68$, CRC; $r^2 = 0.74$, HCC), and for Y90 ($r^2 = 0.86$, CRC; $r^2 = 0.89$, HCC). Bland Altman plots, however, only showed a strong correlation between T/N-ROI and T/N-VOI for MAA in CRC.
Conclusion: No correlation between the T/N ratio of MAA and the T/N ratio of Y90 could be demonstrated. This finding limits the feasibility of the partition method. The more straight forward ROIs can be used instead of VOIs in calculating T/N ratios for MAA. However, Yttrium 90 Bremsstrahlung SPECT poses limitations for post-treatment quantitative analysis of SPECT for comparison.

2107.2

Transarterial hepatic yttrium-90 radioembolization in patients with unresectable intrahepatic cholangiocarcinoma: factors associated with prolonged survival

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Purpose: In unresectable intrahepatic cholangiocarcinoma (ICC), systemic chemotherapy is often viewed as the only option, although efficacy is limited. Radioembolization (RE) using yttrium-90 (^{90}Y) microspheres is an accepted therapy for patients with hepatocellular-carcinoma or metastatic liver tumors. However, there are limited data on the value of RE in patients with ICC and few data on factors influencing prognosis. The aim of our retrospective analysis was to establish which factors influenced time-to-progression (TTP) and overall survival (OS).
Material and Methods: Patients with unresectable ICC were treated with ^{90}Y resin-microspheres and assessed at 3 monthly intervals. Radiologic response was evaluated using response criteria in solid tumors (RECIST). Baseline characteristics, biochemical/clinical toxicities and response were examined for impact on TTP and OS.
Results: 34 treatments were administered to 33 patients without major complications. By RECIST, 12 patients had a partial response, 17 stable diseases and 5 progressive diseases after 3 months. The median OS was 22 months post-treatment and 43.7 months post-diagnosis. Median TTP was 9.8 months. Survival and TTP were significantly prolonged in patients with ECOG 0 (versus ECOG 1 or 2, median OS: 29.4, 10.0 and 5.1 months; TTP: 17.5, 6.9 and 2.4 months), tumor burden $\leq$25% (OS: 26.7 versus 6.0 months; TTP: 17.5 versus 2.3 months) or tumor response (PR or SD versus PD, OS: 35.5, 17.7 versus 5.7 months; TTP: 31.9, 9.8 versus 2.5 months), respectively ($p<0.001$).
Conclusion: Radioembolization is an effective and safe option for patients with unresectable ICC. Predictors for prolonged survival are performance status, tumor burden and RECIST response.

2107.3

Embolization of parasitized extrahepatic arteries to reestablish intrahepatic arterial supply to tumors prior to 90Y radioembolization

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Purpose: Parasitized extrahepatic arteries (EHA) commonly supply large and/or peripherally located hepatic tumors, and compromise complete distribution of Y-90 microspheres administered into the hepatic artery. We embolized parasitized EHAs prior to radioembolization with intent to reestablish intrahepatic arterial supply, and evaluated the technical and clinical outcomes.
Material and Methods: In 201 retrospectively analyzed patients, a total of 73 parasitized EHAs were embolized in 35 patients. Most were embolized during preparatory angiography using large particles and coils. Digital subtraction angiography (DSA), C-arm computed tomography (CACT), and technetium ^{99m}Tc macroaggregated albumin (^{99m}TcMAA) scintigraphy were used to evaluate the immediate perfusion via intrahepatic collateral channels of target tumor areas previously supplied by parasitized EHAs. Follow-up imaging evaluation of differential regional tumor response was used to evaluate clinical outcome.
Results: After embolization, reestablishment of intrahepatic arterial supply was confirmed by both DSA and CACT in 94% of territories, and by scintigraphy in 96%. In 32% of patients, we were not able to evaluate the differential response of treatment due to uniform disease progression. However, symmetric regional tumor response in 94% of evaluable patients indicated successful delivery of microspheres to the territories previously supplied by parasitized EHAs.
Conclusion: Reestablishment of intrahepatic arterial inflow to hepatic tumors by embolization of parasitized EHAs is safe and effective, and results in successful delivery of ^{90}Y microspheres to tumors previously perfused by parasitized EHAs.
Disclosure: Daniel Y. Sze: Consultant to MDS Nordion, Inc.

2107.4

Effectiveness of repeat assessment in patients scheduled for radioembolization using yttrium-90 microspheres with extra-hepatic 99mTc-MAA accumulation to the gastrointestinal tract: a single center experience

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Purpose: To evaluate the efficacy of repeat assessment to recognize and eliminate the cause for ^{99}mTc-macroaggregated albumin (MAA) accumulation to the gastrointestinal (GI) tract in patients scheduled for radioembolization (RA).
Material and Methods: 29 out of 304 patients (9.5%) were identified who underwent repeat assessment for RA as a result of GI MAA accumulation despite protective coil embolization of extra-hepatic vessels. Initial and repeat angiograms as well as MAA scans were carefully reviewed to assign the site of GI MAA deposition to the responsible vessel and to evaluate the effectiveness of repeat assessment in order to eliminate extrahepatic MAA accumulation.
Results: At repeat angiography the source of extrahepatic flow was identified in 27 of 29 patients (93.1%). This was most frequently the right gastric artery (RGA; n=14; 51.8%) or small pancreaticoduodenal branches originating from a residually perfused stump of the gastroduodenal artery (GDA; n=4; 13.8%). In 18 patients (62.1%) successful embolization was achieved, in 9 patients (31.0%) MAA had to be given from a very distal position as catheterization of the target vessel was repeatedly not feasible. Afterwards, extrahepatic MAA deposition was eliminated in 26 patients (89.7%) and RA could be performed in 22 cases (75.9%) in both liver lobes, in another 4 cases (13.8%) in the right lobe.
Conclusion: RA can be performed in most patients with initial MAA accumulation to the GI tract. Protective embolization of the RGA and the proximal GDA were of paramount importance to reduce the rate of repeat assessments.

2107.5

The use of intra-arterial CT in addition to angiography and TC99-MAA to guide infusion of yttrium-90 for selective internal radiation therapy

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Purpose: To study the use of intra-arterial CT (IACT) to guide yttrium–90 (Y-90) infusion for selective internal radiation therapy (SIRT).
Material and Methods: From January 2008 to January 2011, 111 cases of SIRT with Y-90 were performed in 102 patients. In 77 cases, catheter-directed IACT using a hybrid 16-slice-CT/angiography system was used in addition to digital subtraction angiography (DSA) and technetium-99m-macroaggregated-albumin scintigraphy (Tc99-MAA) to guide infusion of Y-90 (IACT-group). In 31 cases, only DSA and Tc99-MAA were used (non-IACT-group). In 3 cases Dyna-CT was used in adjunction to DSA and Tc99-MAA and these were excluded from the study. Procedural images and electronic records were analyzed retrospectively to retrieve data on position of infusion of Y-90, coiling rates and patterns and complications due to non-intentional radiation to extra-hepatic organs.
Results: Compared to the non-IACT-group, the coiling rates of the gastroduodenal artery (GDA) and right gastric artery (RGA) were lower for the IACT-group: 6.5% (n=5) versus 19.4% (n=6) (p=0.074) and 5.2% (n=4) versus 12.9% (n=4) (p=0.22), respectively. The use of IACT-group resulted in a higher rate of detection and subsequent coiling of hepatic artery branches with supply to extra-hepatic organs: 14.3% (n=11) versus 9.7% (n=3) in the non-IACT-group (p=1.0). The complications related to inadvertent infusion into extra-hepatic branches were 3,9% (n=3) in the IACT-group versus 6,5% (n=2) in the non-IACT-group (p=0.62).
Conclusion: The additional use of IACT for planning of Y-90 infusion enables reduction of prophylactic coiling of the GDA and RGA and is of added value in picking up hepatic artery branches with supply to extra-hepatic organs.

2107.6

Colorectal cancer liver metastases: percutaneous tumor ablation with computed-tomography-guided high-dose-rate brachytherapy (CT-HDRBT)

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Purpose: To evaluate the clinical outcome of computed-tomography-guided high-dose-rate-brachytherapy (CT-HDRBT) ablation of hepatic metastases from colorectal cancer.
Material and Methods: Between January 2008 and October 2010, 54 patients (43 males and 11 females) with 121 metastases were treated with CT-HDRBT in 100 treatment sessions. The mean age was 65.66 years (range: 43-90). All patients have been rated unnamable for surgical therapy by visceral surgeons. Treatment was performed by CT-guided applicator placement and high-dose-rate brachytherapy with an iridium-192 source. The mean radiation dose was 18.93 Gy (SD 2.54). To evaluate tumor response a Gd-EOB-DTPA-enhanced liver MRI was performed before, six weeks after and every third month after treatment. Endpoints comprised local tumor control (LTC), progression-free survival (PFS), and overall survival (OS).
Results: All patients were available for MRI evaluation at a mean follow-up time of 12.9 months (range: 2-32 months). The mean tumor diameter was 4.2 cm (0.9–10.7 cm). No major complications were observed. Seven (5.8%) local recurrences were observed after a local tumor control of 2, 3, 5, 5, 6, 7 and 11 months, respectively. Twenty-eight patients (51%) experienced a distant tumor progression during the follow-up period. Thirteen patients (24%) died during the follow-up period (mean time 19 months). Overall survival (OS) probabilities were estimated with the Kaplan-Meier method. OS ranged from 5 to 32 months (mean: 12.9 months).
Conclusion: Minimally invasive CT-HDRBT is a safe and effective alternative to thermal ablation for patients with unresectable hepatic metastases from colorectal cancer.

Free Paper Session
EVAR and TEVAR 2

2108.1

The relevance of aortic endograft prosthetic infection

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Purpose: To describe the incidence, treatment options and outcome of endograft prosthetic infection after endovascular repair of abdominal (EVAR) and thoracic aortic aneurysm (TEVAR).

Material and Methods: A retrospective cohort study was performed in two large hospitals between March 1996 and June 2009. Diagnosis of infected endograft was based on clinical findings, blood tests and cultures, imaging studies (CT, FDG-PET), and intraoperative findings.
Results: Out of 1431 endovascular procedures, 11 patients with infected endograft were identified. One patient was referred from another hospital. Patients were 68 ± 9 years of age and all but one was male. Median time from the initial procedure to the diagnosis was 115 days (range 7-3748), with 42% of patients presenting within 3 months after (T)EVAR. Seven patients were diagnosed after elective, and 5 after emergency T(EVAR). The incidence of endograft infection was higher in acute patients (0.56% vs 2.79%, P=0.002). There was no significant difference between EVAR and TEVAR procedures (1.37% vs 0.77%). All patients were treated with antibiotics, which was complemented with surgical intervention in 6 patients. The infected graft material was explanted completely in 4 patients. Most frequently isolated were Staphylococcus species (n=4). Median time of follow up was 201 days (range 6-2023). During follow-up, 3 patients died of which 2 were treated conservatively (P=ns).
Conclusion: Although consensus is that infected graft material should be completely removed, this study shows no difference in mortality between conservatively and the surgically treated patients, which may suggest a role for conservative treatment in selected cases.

2108.2

Impact of covering renal polar arteries by stent grafts during EVAR (endovascular aneurysm repair) on renal function

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Purpose: Accessory renal polar arteries (RPA) are found with a frequency of up to 30% within the general population. In infra-renal abdominal aortic aneurysms the lower RPAs typically are covered by the stent-graft during endovascular aneurysm repair (EVAR). The study's aim was to evaluate renal function after covering of PRAs during EVAR.
Material and Methods: In a retrospective trial serum creatinine levels and two-phase computed tomographic (CT) scans of 129 patients undergoing EVAR were obtained. Glomerular filtration rate (GFR) was calculated using the abbreviated modification of diet in renal disease study equation (MDRD). Creatinine levels and GFR were monitored before, during hospital stay and 6 months after surgery. CT scans before surgery and during follow-up were evaluated for renal infarction, size and patency of RPAs.
Results: In 31 patients 34 RPAs were covered. CT follow-up showed patent RPAs in all cases though their size was reduced. Renal infarctions were apparent in 17 RPA-patients. No case of renal failure requiring dialysis was observed. In the post-operative course the GFR decreased in 19 patients (61%) of the RPA-group for 19.3±10.2 ml/min/1.73m^2 on average, contrasting with 27 (27%) patients in the control group (15.3±10.6 ml/min/1.73m^2). For a ratio of polar to renal artery size <0.5 GFR decreased 4.4±24.6 ml/min/1.73m^2, for a relation >0.5 it decreased 9.6±17.6 ml/min/1.73m^2. This was not explained by segmental renal infarctions or the amount of contrast agent applied.
Conclusion: Coverage of lower renal polar arteries during EVAR led to a decrease of the GFR, especially in case of a great ratio of polar to renal artery size.

2108.3

Hybrid endovascular repair of complex thoracic aortic arch pathology: long-term outcomes of extra-anatomic bypass grafting of the supra-aortic trunk. A 15-year UK single centre experience

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Purpose: Achieving proximal landing zones for hybrid endovascular repair of the thoracic aorta requires supra-aortic debranching (SAD) prior to delivery of stent-grafts (TEVAR). Hybrid strategies may offer improved patient outcomes compared to traditional repair; however, longer-term studies to assess patency of these extra-anatomic bypass grafts and outcomes are required. We report our experience of the hybrid approach to the aortic arch.
Material and Methods: A prospective-maintained database of 380 elective and urgent patients who had undergone TEVAR (1997-2011) was interrogated. Data were collected regarding demographics, presentation and complications for patients who underwent SAD+TEVAR.
Results: Median patient age was 71 (range 18-90) with mean follow-up of 15 months (range 0-61 months). Fifty-one patients (34 males; 17 females) underwent SAD+TEVAR. Peri-operative complications included mortality 12% (6/51), endoleak 16% (8/51), stroke 14% (7/51), paraplegia 6% (3/51), upper-limb ischaemia 2% (1/51), cranial nerve injury 4% (2/51), rupture 2% (1/51), bypass-graft occlusion 4% (2/51) and pulmonary complications in 12% (6/51). Three patients (6%) required emergent intervention for retrograde dissection (2 aortic-root repairs; 2-innominate stents). Early reintervention was also performed for type 1 endoleak in 2 patients (explantation N=1, proximal cuff N=1). One patient underwent an innominate stenting and revision of a SAD bypass for symptomatic re-stenosis. Median-survival was 57 months. Endoleaks were detected in 3 (6%) patients during follow-up (Type 1=2; type 2 N=1) requiring 2 intrathoracic debranching procedures with proximal stent-grafts. One patient ruptured a mycotic aneurysm and two thoracic arch-aneurysms expanded. No SAD grafts occluded beyond the peri-operative period.
Conclusion: Hybrid strategies to the aortic arch can be performed with better patient outcomes when compared to open surgery. Longer-term outcomes in this study demonstrate durability of this technique and patency of SAD.

2108.4

Anaconda™ fenestrated: initial experience with a new repositionable and flexible fenestrated stent graft

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Purpose: The Anaconda™ fenestrated stent graft is a new device that is repositionable during the procedure. This feature facilitates accurate initial deployment, and if required, subsequent

re-alignment of the stent graft. The flexibility of the main body makes it potentially suitable for use in aneurysms with angulated proximal landing zones. The aim of this study is to evaluate the feasibility of this device in the treatment of abdominal aortic aneurysms unsuitable for infrarenal EVAR.
Material and Methods: All patients undergoing Anaconda™ fenestrated stent graft placement between June 2010 and February 2011 at two UK, one French and one Swedish institutions were recruited prospectively. Follow-up consisted of clinical examination, blood tests and computed tomography angiography (CTA). Results were analysed retrospectively.
Results: At the time of submission, eleven patients (9 males; 1 female) have been recruited to this study. Mean age was 76.5 years (66-85 years). Mean AAA diameter was 61 mm (45-91mm). A total of 33 visceral vessels were accommodated with 22 fenestrations for renal arteries, 9 superior mesenteric artery (SMA) valleys and 2 SMA fenestrations. Vessel cannulation success rate was 100%. There was no peri-operative mortality. Currently, 6 patients have undergone one-month follow-up, all target vessels remained patent and renal function was unchanged (p=0.42).
Conclusion: The Anaconda™ fenestrated stent graft is both safe and efficacious for the repair of AAAs with neck anatomy unsuitable for conventional infrarenal EVAR, and has acceptable immediate and short-term results. The repositionability and flexibility of the device main body facilitate accurate initial deployment and subsequent adjustment if required.
Disclosure: I have signed a consultancy agreement with Vascutek, manufacturers of the Anaconda Fenestrated device, however I have so far accepted no payments from the company. Vascutek sponsored my attendance at the 2008 and 2010 Veith Symposiums.

2108.5

Post-EVAR aortic neck elongation: real phenomenon or conformational changes during the cardiac cycle?

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Purpose: To assess the magnitude of variations in length of proximal neck of AAA in patients selected to undergo EVAR using a 64-slice dynamic ECG-gated CTA.
Material and Methods: A prospective single-center study was carried out on patients with AAA who underwent both static as well as dynamic ECG-gated 64-CTA. The ethical conduct of the study was approved by our departmental review board and all patients provided written informed consent for the surveillance protocol with specific acceptance of double CT-acquisition. Dynamic ECG-gated datasets were acquired with a low-dose acquisition protocol using a 0.625-mm-slice-collimation and 1.25-mm reconstruction-increment (40mL iomeprol 400mgI/mL, Iomeron®-400, Bracco). Manual CTA measurements of aortic neck length were performed on reformatted coronal images by three independent readers, in order to determine the conformational changes obtained during cardiac cycle.
Results: A total of 40 patients were enrolled. Significant aortic longitudinal pulsatility was demonstrated within the aneurysm neck (mean variation: 19.1±8.6%; absolute change: 5.3mm±1.8mm). On the basis of dynamic measurements, the type of endograft selected on the basis of static images, in terms of fixation, would be potentially changed in 8/40 (20%) patients, whereas 4 patients (10%) were not considered eligible for EVAR in terms of aortic neck length.
Conclusion: Dynamic ECG-gated CT-imaging may provide information regarding longitudinal pulsatile motion that could change the EVAR planning based on static imaging. Furthermore, the previous reported post-EVAR elongation of the infrarenal aortic neck seems to be a unreal phenomenon only due to a conformational changes during the cardiac cycle.

2108.6

Emergency EVAR: the challenging anatomy of ruptured abdominal aortic aneurysm

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Purpose: The IMPROVE trial (ISRCTN 48334791) has independent reading of all CT scans of patients with ruptured abdominal aortic aneurysm (rAAA) who are randomised to a strategy of endovascular repair. Here, the anatomy of the first 30 patients, with a CT-confirmed diagnosis of rupture, is described.
Material and Methods: Patients with an in-hospital clinical diagnosis of rAAA are randomised to either immediate CT scan and endovascular repair if possible or to open repair. Copies of the CT scans are analysed centrally on a Vitrea workstation.
Results: For patients, with CT evidence of rupture, the following measurements were recorded:

N=30	Diameter Max (cm)	Neck length (cm)	Top neck diameter (cm)	Angle supra-renal aorta-neck, max°	Angle neck to aneurysm max°
median	7.8	1.3	2.3	22	43
IQR	6.9-9.3	0.5-3.3	2.1-2.7	10-41	27-67

Excluding the 4 patients with juxtarenal aneurysms, 7/26 (27%) had >4mm dilatation of the neck over the proximal centimetre.
Conclusion: The rAAA presenting to hospital have very large diameters and short, conical aneurysm necks. This may influence the proportion of patients deemed suitable for emergency EVAR as well as the technique used for endovascular repair. Aortic morphology is likely to determine clinical outcome and long-term analysis of clinical outcomes will guide how treatment should vary according to specific morphological parameters.
Disclosure: This abstract is submitted on behalf of the IMPROVE Triallists

Free Paper Session
Late Breaking Abstracts

2109.1

Phase II trial of sorafenib combined with concurrent transarterial chemoembolization with drug eluting beads for hepatocellular carcinoma

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Purpose: To evaluate safety and efficacy of combined transarterial chemoembolization (TACE) with doxorubicin eluting beads (DEB) and sorafenib in patients with advanced hepatocellular carcinoma (HCC).
Material and Methods: A prospective single center phase II study was undertaken involving patients with unresectable HCC. The protocol involved sorafenib 400mg BID combined with DEB-TACE. Safety and response were assessed.
Results: DEB-TACE in combination with sorafenib was successfully performed in 35 patients: mean 63 years, Childs A (89%), BCLC C (64%), ECOG 0/1 (46%/54%), and mean index tumor size 7.7 cm (±4.2 SD). Patients underwent 128 cycles of therapy (sorafenib+DEB-TACE,

60 cycles; sorafenib alone, 68 cycles). Median number of cycles per patient was 2 (range, 1 to 5) with median number of days treated with sorafenib being 71 (range, 4 to 620 days). The most common toxicities during cycle 1 were fatigue (94%), anorexia (67%), alterations in liver (64%) and dermatologic side effects (48%). While most patients experienced at least one grade 3-4 toxicity, most toxicities were minor (grade 1-2, 83% vs. grade 3-4, 17%). Toxicity during cycle 2 was decreased. Over the course of the study, there were 40 sorafenib dose interruptions and 25 sorafenib dose reductions. Sorafenib plus DEB-TACE was associated with a disease control rate of 95% (RECIST) / 100% (EASL) with an objective response of 58% (EASL).
Conclusion: The combination of sorafenib and DEB-TACE in patients with unresectable HCC was well-tolerated and safe with most toxicities related to sorafenib. Toxicity was manageable with dose adjustment of sorafenib. Preliminary efficacy data were promising.
Disclosure: Consultant for Bayer Oncology Consultant for Biocompatibles

2109.2

A novel biliary stent loaded with radioactive seeds in patients with malignant biliary obstruction: preliminary results versus the conventional biliary stent

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Purpose: To prospectively evaluate the preliminary results using a novel biliary stent loaded with iodine 125 seeds for intraluminal brachytherapy versus those with a bare self-expandable metal stent in patients with malignant biliary obstruction.
Material and Methods: A unicentric, single-blinded, randomized, two-group controlled study (NCT01320241) was designed. Patients with malignant biliary obstruction were randomly assigned in a 1:1 ratio to receive treatment with a biliary irradiation stent loaded with 125I seeds or a bare self-expandable biliary stent. After stent implantation, the outcomes were measured in terms of relief of obstructive jaundice, survival time, complications related to the procedure. A P value of less than ·05 was considered to indicate a significant difference.
Results: Between November of 2008 and October of 2010, 24 patients with malignant biliary obstruction were equally and randomly assigned to the irradiation stent group or the control group, one patient (control group) exited from the study, and no patient lost to follow-up.The baseline characteristics of the treatment groups looked well balanced. The stents were successfully placed in all 23 patients. The obstructive jaundice relived gradually in all patients except three patients in control group. The difference in the variance of peripheral bilirubin levels (pre-procedure subtract post-procedure) between two groups were significant. The median overall survival was 7·40 months (95% CI: 6·204, 8·596) in irradiation stent group versus 2·50 months (95% CI: 0·774, 4·226) in control group, mean overall survival was 8·03 months (95% CI: 6·142, 9·909) in irradiation stent group versus 3·36 months (95% CI: 1·189, 5·520) in control group (P=0·006, log-rank test). There were no significant differences in the complications related to stent insertion between the two groups.
Conclusion: In patients with malignant biliary obstruction, treatment with the novel biliary intraluminal irradiation stent loaded with ^{125}I seeds, compared with the bare self-expandable metal biliary stent, seems to have benefits in relieving jaundice and extending survival.

2109.3

Early results of percutaneous aspiration thrombectomy vs. anticoagulation in acute iliofemoral venous trombosis: a randomised clinical trial

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Purpose: To evaluate the efficacy and safety of percutaneous aspiration thrombectomy (PAT) compared to standard anticoagulation in acute iliofemoral-popliteal deep venous thrombosis.
Material and Methods: 42 patients with acute (<14 days) iliofemoral-popliteal DVT were prospectively randomised to either interventional therapy (PAT followed by anticoagulation) (n: 21) or to medical therapy (n: 21) (anticoagulation alone). Demographic data were similar in both groups. All patients underwent sonography of the lower extremities. PAT was performed with large bore guiding catheters (9F). Balloon angioplasties (n: 19) and stent placements (n:14) were performed after PAT for the residual stenotic segments (>50% luminal narrowing). Clot removal rates were measured with venography. Pre and post treatment (3rd month follow up) Doppler US and clinical symptom scorings were compared between two groups.
Results: Complete clot extraction was achieved in 19 patients (90,4%) with PAT. Prophylactic IVC filters were placed in 2 patients. Primary patency rates at 3rd month were 91.7% in the intervention group and 28.6% in the medical group. Clinical symptom scorings were significantly improved in the intervention group (4,23 pretreatment; 0,82 posttreatment) whereas no significant change was observed in the medical group (4,00 pre-treatment; 2,86 post-treatment). During follow-up pulmonary embolism was observed more in the medical group (n:4) than intervention group (n:1). No serious adverse events occurred in both groups.
Conclusion: Percutaneous aspiration thrombectomy (PAT) is a safe, feasible and cost effective endovascular technique with low major complication rates. PAT can be used as the first line treatment in the proximal acute DVT, especially when thrombolytic agents are contraindicated.

2109.4

High frequency jet ventilation helps targeting tumors that move with breathing

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Purpose: High frequency jet ventilation (HFJV) is a new ventilation technique that delivers high flow pulses at a low pressure and high frequency (up to 800 cycles/min). It allows maintaining adequate blood oxygenation without visible movements of the thorax in patients under general anesthesia.
Material and Methods: From our experience of 22 RF tumor ablations (6 lungs, 12 livers and 4 kidneys) performed under general anethesia with HFJV we wish to illustrate the principle of this technique and its potential benefits.
Results: HFJV yields complete immobility of the patient during the procedure. During lung tumor ablation, the intra alveolar pressure is lower than it is with conventional ventilation.
Therefore some advantages can be taken from HFJV:
-It makes localization of the lesion easier
-It makes needle positioning quicker
-Since the intra alveolar pressure in the lungs is low we might expect lower pneumothorax rates during lung RFA
-Since no apnea or specific respiratory maneuvers are needed, it

should limit radiation exposure of the anesthesiology team
Conclusion: HFJV is a promising way to limit breathing related movement of targets such as lung, liver or kidney tumors. It makes the positioning of the ablation probe easier and quicker. The effect of the lower pressure in the airways and on the rate of pneumothorax occuring during lung tumor ablation deserves to be investigated.

2109.5

Chemo-saturation with percutaneous hepatic perfusion (CS:PHP) using Melphalan for unresectable neuroendocrine tumor liver metastases (MNET)

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Purpose: Options for patients with unresectable NET liver metastases are few; response to medical/focal therapies is limited. CS:PHP could improve outcomes.
Material and Methods: CS:PHP with high-dose melphalan was administered into the hepatic artery with simultaneous extracorporeal hemofiltration of hepatic venous effluent with blood return via internal jugular vein. Patients received £4 cycles of melphalan (2.5-3.0mg/kg) q4-5 weeks in 2 NCI-IRB-approved studies. Patients had MNET, limited treatable extra-hepatic disease, adequate hepatic reserve, no portal hypertension, adequate vascular access. Primary objective was response rate; others: peri-procedural events, AEs and PFS.
Results: 23 patients had median 15 lesions; 9 minimal extra-hepatic disease, majority pancreatic MNET (n=17). Liver tumor involvement was <25% in 12 patients, 25-50% in 5, >50% in 6. Median cycles were 3/patient, total 68; median dose 180mg (126-220). 1 pt received 4 cycles plus three upon progression 4 years later. Acute procedure-related G3-4 labs were transaminitis (22% cycles), thrombocytopenia (21%), anemia (16%) and hyperbilirubinemia (9% cycles). One patient experienced tumor lysis, 1 carcinoid crisis and 1 CNS hemorrhage. Later grade 3-4 AEs were mainly hematological: neutropenia (47% cycles), thrombocytopenia (29%) and anemia (15%). The 1 treatment-related death was due to cholangitis (day 74). Response was 79% in 19 evaluable patients (2 CR, 13 PR). Median hepatic PFS was 39 months (n=20).
Conclusion: CS:PHP with melphalan has efficacy in patients with MNET liver metastases too extensive for other strategies. Response is long-lasting, with 39-month PFS and possibility of re-treatment upon progression. This promising novel therapy offers interventional radiologists a new tool and a central role in patient management.
Disclosure: Dr James Pingpank is the PI of the study and a consultant to Delcath Systems, Inc.

2109.6

EVAR with the ultra-low profile ovation™ abdominal stent graft system: 1st year results in a global multicenter trial

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Purpose: This study evaluates the safety and efficacy of the Ovation stent graft (TriVascular Inc., Santa Rosa (CA), USA) for treatment of endovascular abdominal aortic aneurysms. This study provides results about treating aortic necks as small as 7mm and the ability to treat AAA patients with narrow (starting from 4.7mm) and tortuous vessels.
Material and Methods: The Ovation stent graft has a unique deployment system of 2 polymer-filled proximal sealing rings that accommodate short proximal aortic neck length of >7 mm, and a hydrophilic coated 14F OD delivery system that accommodates access vessels >4.7 mm. This prospective multicenter trial evaluated the performance of the Ovation stent graft in 150 patients with AAA at 27 centers globally. Data were available for 123 patients through 1 month, 52 patients through 6 month and 8 patients through 1 yr follow-up. This study patient follow-up will continue through 5 years.
Results: As of March 22nd 2011, 123 patients (male: 87%, mean age: 74, mean AAA diameter: 58.8 mm) underwent EVAR with the Ovation stent graft; technical success was achieved in 100%. The mean procedure time was 113 minutes, and median hospital stay was 2.3 days. No aneurysm rupture, fracture, or migration was observed. The 30-day MAE rate was 1.6% and there were no other complications reported through 6 month and 1yr follow-up.
Conclusion: The preliminary results of this multi-center study with the Ovation stent graft are promising and indicate its safety in treating patients with aortic neck length of >7 mm. A distinct advantage of the Ovation device is that it allows treatment of AAA that might otherwise be unsuitable for EVAR with currently available stent grafts.

Free Paper Session Imaging

2907.1

Can real-time US-CT/MRI fusion imaging guidance enable ablation of liver malignancies that are undetectable with conventional US?

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Purpose: To assess the ability of real-time US-CT/MRI fusion imaging for guiding percutaneous ablation of liver malignancies undetectable with conventional US.
Material and Methods: From January 2003 to August 2009, 334 patients with 884 focal liver tumors (544 HCCs and 340 metastases) underwent percutaneous radiofrequency or microwave ablation guided by a novel image fusion system that combines real-time US with fusion to CT/MRI images (Esaote, Genoa, Italy). 85 HCCs and 68 metastases (N = 153 [17.3%]) in 67 patients were detectable only with contrast-enhanced CT or MRI, but undetectable with US due to small size (n=66), isoechogenicity with liver parenchyma (n=46), or obscuration due to location (n=41). 138/153 (90.2%) tumors were smaller than 2.0 cm and 58/153 (37.9%) smaller than 1 cm (mean 1.3 cm [range 0.5 – 4 cm]). Contrast-enhanced CT or MRI was performed at 24 hr to assess the technical efficacy (i.e. completeness of

ablation) and at 8 months to search for possible local tumor progression (i.e. clinical efficacy).
Results: At 24-hr follow-up imaging, 140/153 (91.5%) malignancies were completely ablated; 4 (2.6%) were partially ablated and 9 targets (5.9%) were completely missed. The four partially ablated nodules were successfully re-treated at 28-40 days using our technique describe above. At 8-month follow-up, local tumor progression was detected in 27/144 (18.7%) tumors (11 HCCs and 16 metastases). Thus, overall efficacy was 91.5% per tumor and 86.6% per patient.
Conclusion: A real-time fusion imaging system enables sufficiently precise targeting of many tumors undetectable with US alone to achieve complete ablation in a large majority of cases.

2907.2

Topographic mapping of the right hepatic artery segmental branches using 3D reconstructed CT overlaid images based on C-arm CT in patients undergoing TACE

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Purpose: To create a map for right hepatic artery (RHA) segmental branches using 3D in space technology of C-arm CT in TACE patients.
Material and Methods: The study was approved by the institutional review board and informed consent was obtained from all patients. The study was prospectively performed on 20 patients with primary or secondary hepatic malignancy. C -arm CT was performed during the first TACE session and the images were reconstructed using 3D reconstructed overlaid images. Segmental arteries of RHA were identified based on segmental liver enhancement when the CT images were overlaid on the 3D reconstructed model of RHA branches. Each segmental branch was evaluated regarding its calibre at origin (CO), detectable length (L), angle of origin (AO) from its main stem.
Results: In all 20 patients the anterior segmental artery was the direct continuation of the RHA and it gave origin to the arteries of segments 5 and 8. The mean calibre of artery to segment 5 (A5) at origin was 1.8 $\pm$ 0.7 mm , its length was 6.2 $\pm$ 2.01 cm , angle at origin 90,7 $\pm$ 44,3 while artery to segment 8 (A8) showed 4.7 $\pm$ 104 mm, 4.8 $\pm$ 1.7 cm & 0 angle. The posterior segmental artery gave origin to arteries of segment 6 and 7. Artery to segment 6 (A6) showed 2.5$\pm$ 1.04 mm, 6.3$\pm$ 1.9 cm and 90.5 $\pm$ 43. Artery to segment 7 (A7) showed 2.8 $\pm$ 1mm, 5.1$\pm$1.6 cm, 0 angle.
Conclusion: Knowing topographic mapping of RHA is helpful in producing superselective TACE producing minimally invasive, maximally effective therapeutic response.

2907.3

Low-dose multidetector-row CT angiography in the evaluation of infrarenal aorta and peripheral arterial occlusive disease

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Purpose: To investigate the possibility of reducing radiation dose exposure while maintaining image quality and to define the real influence of radiation dose on diagnostic accuracy of CT in the evaluation of infrarenal aorta and peripheral arterial occlusive disease (PAOD).
Material and Methods: We performed a prospective, single-center, randomized comparison of 3 X-ray exposure CT-acquisition protocols enrolling a total of 60 patients with PAOD referred to our department to undergo a lower-limb 64-MDCT angiography (0.625-mm collimation; 100mL Iomeprol 400mgI/mL, @ 4mL/s). All enrolled patients were randomized into one of the three X-ray exposure acquisition protocols: standard-dose (SMARTmA-Noise index: 26, 120 KV); low-dose (SMARTmA-Noise index: 26; 80 KV); ultra-low-dose (SMARTmA-Noise index: 30; 80 KV). Axial and 3D-images were evaluated and compared by three blinded readers both qualitatively and quantitatively for image noise and intraluminal contrast enhancement.
Results: Statistically significantly higher attenuation values were measured in the low-dose and ultra-low-dose acquisition protocol compared to the standard protocol, in all districts evaluated. Qualitatively, image quality was judged slightly better with the standard protocol than with the low-dose and ultra-low-dose protocol without significant differences on both axial and 3D images. Furthermore, no significant differences were found between the three protocols in terms of contrast-to-noise ratio (CNR). A significant overall dose reduction was observed for the low-dose and ultra-low-dose protocol compared with the standard protocol, respectively.
Conclusion: In peripheral CT-angiography, the use of a low-dose acquisition protocol provides a substantial reduction of radiation exposure allowing to maintain a constant CNR and a good image quality.

2907.4

Do trauma scores predict the requirement for intervention following liver trauma?

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Purpose: Non-operative management with radiological intervention has contributed to improved survival following blunt or penetrating liver injury, with embolisation for arterial haemorrhage and endoscopic biliary intervention fundamental to this strategy. Historically, trauma scores have been used as predictors of surgical intervention; this study analyses grading of liver injury as a predictor of radiological/endoscopic intervention.
Material and Methods: A retrospective review of 118 patients with documented liver trauma from November 1998 to January 2009 was conducted. CT injury grade, mechanism, radiological and endoscopic biliary intervention as well as outcome have been correlated.
Results: The management of 114 patients (ages: 5-81) was reviewed, of these 23 presented with a grade II injury, 47 with a grade III injury, 36 with a grade IV injury and 8 with a grade V injury. Hepatic angiography and embolisation was required in 34 patients [II (0), III (13), IV (16) and V (5)]. Endoscopic retrograde cholangiopancreatography (ERCP) with stent insertion was required in 37 patients [II (2), III (18), IV (14) and V (3)]. Initial grading directly correlates with the need for early intervention and subsequent likelihood of delayed biliary and vascular complication. In addition, specific CT features of arterial and biliary injury can accurately determine the need for intervention.
Conclusion: The severity of liver trauma directly correlates with the escalating need for both angiography and embolisation. The requirement for ERCP and biliary stenting is similar for both moderate and severe grades of liver trauma. As such, grading systems are a useful marker for predicting the need for acute and delayed vascular and biliary intervention in patients with liver trauma.

2907.5

Evaluation of a novel automatic vessel segmentation software using dual energy computed tomographic angiography data of the pelvis and lower extremities

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Purpose: First results of the evaluation of a fully automated vessel segmentation software (Angioscope, Cathi GmbH, Germany) with bone and calcification removal based on dual energy CT data against a commercially available vessel segmentation and bone removal tool (Leonardo, Siemens Medical Solutions, Erlangen, Germany).
Material and Methods: Eighteen patients (321 vessel segments) with peripheral arterial occlusive disease (PAOD) underwent dual energy CTA and DSA of the pelvis and lower extremities with intention to treat. CTA data were evaluated by four readers, two using the newly developed angioscope software (ASBE, automatic structured bone elimination) and two using a standard software (Leonardo, Siemens AG, Erlangen, Germany). Angioscope uses a graph-based matching technique and analysis of high contrast structures for vessel segmentation.
Results: Sensitivity and specificity increased from 92.7% to 97.6% and from 78.4% to 81.6%, respectively, data concordance with DSA increased from 64.8% to 68.4% using angioscope. Data concordance between the angioscope software and DSA was especially high in high-grade diseased blood vessels.
Conclusion: Automatic vessel segmentation using the post-processing software angioscope led to a significant increase in sensitivity and specificity of CTA of the pelvis and lower extremity.

2907.6

Prospective comparison between three CT angiographic acquisitions for peripheral arterial disease: empirical anterograde acquisition, adaptive anterograde acquisition and retrograde acquisition

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Purpose: To prospectively compare 3 methods of CT angiography for the lower limbs: an empiric anterograde method (EAM), an adaptive anterograde method (AAM) and a retrograde method (RM).
Material and Methods: Twenty patients were evaluated prospectively with EAM, 20 with AAM and 20 with RM. Attenuation was measured at different levels of interest. A grading scale was used (optimal, non-optimal or non-diagnostic in axial, MIP, VR views). The venous return was also considered (absent, present, or non-diagnostic).
Results: There is a significant difference between the 3 methods for the above-the-knee levels (EAM: 285.9+/-68.9 HU, AAM: 272.4+/-83.5 HU, RM: 188.6+/-86.6 HU, p less than 0.001). The attenuation is not significantly different for the below-the-knee levels (EAM: 199.3+/-89.3 HU, AAM: 214.0+/-85.4 HU, RM: 215.1+/-90.8 HU, p=0.56). Globally, AAM provides the highest percentage of optimal attenuation on axial images (EAM: 83.3%, AAM: 88.3%, RM: 65.0%, p less than 0.001). Distally, there is also a significant subjective difference (EAM: 4.2% of non-diagnostic segments, AAM: 1.9%, RM: 2.2%; p=0.002). RM shows important artefacts due to venous return at the aortic levels (9.4% of venous return contamination, 0% in the other methods).
Conclusion: AAM provides the highest percentage of optimal vascular attenuation. Nevertheless, it does not allow a higher attenuation in the foot vessels. Therefore, RM might represent an alternative option in patients with critical ischemia, if one would accept abdominal venous contamination.

Free Paper Session
PVD 3

2908.1

Management of peripheral arterial interventions with mono or dual antiplatelet therapy: the MIRROR study

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Purpose: To investigate the influence of dual antiplatelet therapy vs. Aspirin alone on local platelet activation and clinical endpoints in patients treated with endovascular therapy.
Material and Methods: MIRROR was performed as a randomized, double-blinded clinical trial. 40 patients received Aspirin 500 and Clopidogrel 300 before intervention and were furthermore treated with a daily dose of Aspirin 100 and Clopidogrel 75. 40 patients received same doses of Aspirin and Placebo instead of Clopidogrel. Primary endpoints were concentration of activation markers β-thromboglobulin and CD40L in the blood after having rotated in the Chandler-Loop vessel model and rate of patients resistant to Clopidogrel. The clinical development 6 months after the intervention was assessed.
Results: Concentration of β-TG in the Clopidogrel vs. Placebo group was 224.5 vs. 365.5 (p=0.03). Concentration of CD40L was 127 vs. 206.5 (p=0.05). 30% who received Clopidogrel were resistant on loading dose. 2 Clopidogrel and 8 Placebo patients required target lesion revascularization (p=0.04). Each of the 2 Verum patients who needed revascularization was resistant to Clopidogrel. Minor bleeding complications occurred at 1 Clopidogrel and 2 Placebo patients.
Conclusion: Periinterventional platelet activation can be reduced by combination of Clopidogrel and Aspirin. Clopidogrel+Aspirin can improve functional outcome and is a safe treatment. These results support dual antiplatelet therapy during and after peripheral arterial interventions.

2908.2

Endovascular peripheral and visceral aneurysms repair with cardiatis multilayer stent: Italian Multicenter Registry results at 6 and 12 months FU

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Purpose: To show preliminary results of cardiatis multilayer stent (CMPS), a flow diverter developed to treat peripheral and visceral aneurysms with/without collateral branches arising from the sac or proximal/distal neck.
Material and Methods: Between May 2009 and June 2010, 54 patients with peripheral and visceral aneurysms were treated with CMPS in 23 Italian clinical centers (17 Interventional Radiology, 3 Vascular Surgery, and 3 Cardiovascular Unit). 40/54 aneurysms had

collateral branches arising from the sac or the necks. Early (30 days), mid-term (6 month) and long-term (12 months) results were analyzed in terms of technical and clinical success (aneurysm thrombosis, stent and branches patency); we also assess the shrinkage of the sac at 6 and 12 months. All data were recorded in the Italian Registry of cardiatis procedures.
Results: Clinical success was evaluated with CT-angiography. We report the data we collected from all the patients with at least one month FU (49 patients). The 30-day, 6-month, and 1-year clinical success rates (aneurysm thrombosis) were 91.8% (45/49), 95.7% (45/47), and 94.1% (16/17) respectively, with a 100% rate of side branches patency and a 95.7% of primary stent patency at last FU. While shrinkage at 6 month FU was observed in 22/35 patients (62.8%), at 12 months FU it was present in 16/17 cases (94.1%).
Conclusion: CMPS appears to be an effective tool in endovascular exclusion of peripheral and visceral aneurysms with collateral branches, allowing a broader group of patients to be treated with endovascular repair; however, further studies are needed to evaluate the long-term results.

2908.3

E-MISAGO: the largest ongoing real life registry of Misago SX nitinol stent in daily use. The results of the first 1000 patients who reached primary safety endpoint at 1 month

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Purpose: This is a pre-specified interim analysis of the first 1000 patients who reached primary safety endpoint as a part of clinical evaluation of the Misago® SX nitinol stent used for the treatment of iliac and femoro-popliteal arteries, in real life setting.
Material and Methods: e-MISAGO currently enrolled 1500 patients treated with the Misago® stent in 54 European centers. Data were entered electronically and monitored online, and clinical events are independently adjudicated. The primary safety endpoint (at 30 days) and primary efficacy (at 1 year) endpoint and their definitions match the VIVA criteria.
Results: Patients (69.3% male) were 67+/-11 years old, 63% were smokers and 38% had diabetes mellitus. On average 1.2 vessels per patient were treated with 1.15 stents per lesion. Mean lesion length was 60+/-51 mm with RVD of 6.3 mm and 43% of the lesions being totally occluded. At baseline, mean ABI was 0.59 and mean Rutherford score 2.6. 30 days FUPs are ongoing and data are currently available for 78% of the patients. The technical and procedural success rates were 99.7% and 99.2%, respectively. The mean ABI increased by 0.30, Rutherford index worsened only in 3.2% of the patients while mean quality of life improved in 21% compared to baseline. The overall composite adverse event rate of death, amputation, revascularization, bleeding and vascular complications were 1.9%.
Conclusion: These interim results from the e-MISAGO registry indicate excellent device performance of the Misago® SX nitinol stent. Data on all 1000 patients will be available at the time of presentation.

2908.4

Long-term follow-up and total cost analysis of in-hospital invasive interdisciplinary treatment of critical limb ischemia: comparison of surgical and endovascular therapy

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Purpose: Critical limb ischemia is associated with high morbidity and mortality. Our aim was to evaluate outcome data (limb salvage and survival) as well as total costs for an inter-disciplinary treatment approach.
Material and Methods: We retrospectively included all patients treated invasively in 2005 and followed them up until 2009. We treated 90 extremities in 78 patients (29 females and 49 males). 50 extremities were treated by surgical, 40 by endovascular approach. The only significant differences were TASC stages (p = 0,0001) with a trend towards surgery for higher TASC stages.
Results: Overall limb salvage was 98% (30 days), 93% (one year), 93% (two years) and 86% (four years). 24 patients died during follow-up (30%). The overall survival rate was 96% (30 days), 86% (one year), 81% (two years) and 66% (four years). There was no significant outcome difference between the treatment groups (p = 0,62 (limb salvage) and p=0,24 (survival)). Costs per initial treatment per extremity were 15.416€ (surgery) and 9.858€ (endovascular). Total costs of follow-up treatment per extremity were 27.429€ (surgery) and 17.443€ (endovascular). Total costs of initial and follow-up treatment were 1.165.108€ and 905.040€, respectively, in total 2.070.148€.
Conclusion: An interdisciplinary treatment approach allows good limb-salvage and survival results. Total cost of the treatment is high, with endovascular treatment less expensive than surgical treatment.

2908.5

Paclitaxel-coated balloon angioplasty for lower extremity revascularization: better way to fight restenosis?

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Purpose: Drug-eluting balloons have shown good results in the treatment of coronary in-stent restenosis in experimental and clinical trials. We would like to evaluate mid-term patency of peripheral angioplasty with paclitaxel-coated balloons (DEB) in comparison with conventional balloons.
Material and Methods: Fifty consecutive patients with stenosis or occlusion of a femoropopliteal artery were enrolled and randomly assigned to treatment with DEB (25 pts, 50%; IN.PACT Amphirion, Invatec, Italy) and to treatment with uncoated balloons (25 pts, 50%; control group). The primary end point was late lumen loss at 6 months.
Results: The mean (+/-SD) age of the patients was 66+/-4 years, 28% were smokers, and 45% had diabetes. Patients' characteristics were similar in both groups. Twenty-two percent of the lesions were total occlusions, and 36% were stenotic lesions. The mean lesion length was 5.5+/-3.5 cm. There were no adverse events correlated to the paclitaxel-coated balloons. At 6 months, angiographic follow-up showed the mean late lumen loss of 1.6+/-1.7 mm

in the control group, as compared with 0.5+/-1.4 mm (P=0.001) in the group treated with DEB. The rate of revascularization of target lesions at 6 months was 9 of 25 (36%) in the control group, 2 of 25 (8%) in the group treated with paclitaxel-coated balloons (P=0.001 vs. control group).
Conclusion: The use of DEB in femoropopliteal disease is associated with significant reductions in late lumen loss and target-lesion revascularization.

2908.6

Unconventional techniques to treat below-the-knee lesions: single center long-term experience and technical aspects

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Purpose: To describe the technical aspects of alternative endovascular techniques and assess their feasibility and efficacy minimizing failure rates in the treatment of complex below-the knee occlusions which could not be crossed with a conventional antegrade access.
Material and Methods: Between January 2003 and March 2010, 1554 diabetic patients with CLI and Texas II D-III C,D foot ulcers (837 males, 717 females) underwent endovascular treatment for critical limb ischemia in our institution. In 184 (103 men, mean age 75 $\pm$ 6 yrs) patients a conventional common femoral artery antegrade approach failed and an alternative approach was performed. Of these failures, 56 (30.4%) were treated with combined intraluminal or subintimal recanalization with a double antegrade-retrograde intervention with foot artery puncture, 30 (16.3%) were treated with pedal-to-plantar and 44 (23.9%) with plantar-to-pedal loop technique, 54 (29.4%) with trans-collateral technique. An at least 2-year follow-up was performed evaluating limb salvage, ulcer healing, major and minor amputation, TcPO2 increasing.
Results: Technical success was achieved in 178 (96%) patients. Only 2 (1%) major and 12 (6.5%) minor complications were recorded. The primary patency and limb salvage rates were 78.5% and 93%, respectively, at 6 months, and 69.2% and 89% at 1 year.
Conclusion: The use of alternative endovascular techniques seems feasible in case of a failed antegrade below-the knee revascularization attempt and could minimize failure rates in the treatment of complex occlusions providing satisfying 1-year clinical success rates.

Free Paper Session
Oncologic IR 5

2909.1

Combined single-session embolization with microparticles (Embozene) and radiofrequency ablation of focal liver lesions: preliminary results

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Purpose: To evaluate the safety and efficacy of combined embolization and thermal ablation performed in a single-session in patients with focal liver lesion >3 cm.
Material and Methods: Between January 2009 and January 2011, 24 patients (15 men, 9 women; age range, 41-79 years; mean age, 67.2 years) with focal liver lesion were enrolled to undergo combined embolization and thermal ablation with radiofrequency (RF) or microwaves (MW) in the same single session. 42 metastatic lesions (3.0-6,5 cm; mean, 4.2 cm) from rectal (25), breast (8) cancer, sarcoma (3) and neuroendocrine tumors (6) were treated. Trans-arterial embolization (sTAE) was performed with micro-particles (Embozene, Celonova) (40 to 100 micron); in the same session RF ablation was performed. Imaging follow-up was obtained with CT, CEUS and diffusion weighted MRI (DW-MRI) at 1-month and then CT every 6 months. Tumor response or progression was always assessed. Complications rate was also evaluated.
Results: 1-month follow-up showed complete necrosis in 37/42 lesions; 5 lesions showed residual disease adjacent the treated area; accordingly, additional combined treatments were performed and resulted in complete necrosis. No local tumor progression was detected. One patient experienced intraoperative bleeding successfully treated with coils; one patient showed necrosis of the muscular wall of the abdomen with no involvement of the skin. 17/24 patients experienced the post-embolization syndrome, successfully treated with endo-venous administration of analgesics, antiemetics and fluids.
Conclusion: Single-session combined therapy is an effective and safe treatment for liver metastatic lesions >3 cm; however, a high incidence of post-embolization syndrome is expected to occur.

2909.2

Mid-term results of image-guided cryoablation of 116 renal tumours in 95 patients

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Purpose: The present study aims to determine the mid-term outcomes of percutaneous cryoablation (CRA) in solid renal tumours.
Material and Methods: All solid renal tumours treated with CRA from May 2007 to January 2011 were identified from our prospectively collected database. Tumour characteristics, technical success and complications were reviewed. All treatments were performed under general anaesthesia using ultrasound and CT guidance. Depending on size of the lesions, between 1 and 8 probes were used. Patients underwent follow-up imaging according to established local protocols.
Results: One hundred and sixteen tumours in 95 patients were identified. The mean patient age was 68 years (range 32-88 years) and mean tumour size was 31 mm (range 11-67 mm). Complete treatments (including retreatment for subtotal treatments) were achieved in 113 out of the 116 (97.4%) treated tumours. Nine tumours were subtotally treated at the first sitting. Six of these went on to complete treatment at a second procedure. Of the 3 incomplete treatments, 1 patient declined further treatment, 1 proceeded to nephrectomy for residual perihilar disease and 1 patient developed progressive disease and succumbed to disseminated metastatic disease. There has been 1 late local recurrence at a mean radiological follow up of 11 months (range 0-37 months) which has successfully been treated. There were 7 complications (6%), including 2 post-procedural perirenal bleeds, one requiring localised coil embolisation and the other, a 2 unit blood transfusion.
Conclusion: At an intermediate follow up of 11 months, image-guided CRA represents an effective treatment for T1a renal tumours and compares favourably with surgery.

2909.3

Super-micro-bland particle embolization combined with RF-ablation: angiographic, macroscopic and microscopic observations in porcine kidneys

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Purpose: To describe angiographic, macroscopic and microscopic observations of super-micro-bland particle embolization in combination with RF-ablation in kidneys. Thereby, a special focus was given on the impact of the sequence of the two different procedural steps (super-micro-bland particle embolization and RF-ablation).
Material and Methods: In ten pigs, super-micro-bland particle embolization combined with RF-ablation was carried out. Super-micro-bland embolization was performed with spherical particles of a very small size and a tight calibration (40Â±10Âµm). In the left kidneys, RF-ablations were performed before embolization (I). In the right kidneys, RF-ablations were performed after embolization (II). Angiographic (e.g. vessel architecture), macroscopic (e.g. long and short axes of the RF-ablations) and microscopic (e.g. particle distribution) study goals were defined.
Results: Angiography detected almost no vessels in the center of the RF-ablations in I. In II, angiography could not define the RF-ablations. Macroscopy detected significantly larger long and short axes of the RF-ablations in II compared to I (52.2/3.2mm vs. 45.3/6.9mm [P0.05] and 25.1/3.5mm vs. 20.0/1.9mm [P0.01], respectively). Microscopy detected irregular particle distribution at the rim of the RF-ablations in I. In II, microscopy detected homogeneous particle distribution at the rim of the RF-ablations.
Conclusion: The sequence of the two different procedural steps (super-micro-bland particle embolization and RF-ablation) impacts angiographic, macroscopic and microscopic observations in kidneys.

2909.4

Radiofrequency ablation of non-small-cell lung carcinoma

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Purpose: To evaluate radiofrequency ablation (RFA) in the treatment of non small-cell lung carcinoma.
Material and Methods: Between 2002 and 2010, 127 patients were treated with radiofrequency ablation for a non small cell lung carcinoma in two centers. Lung RFA was performed under general anesthesia or epidural anesthesia with CT guidance. The different endpoints were: complications, local efficacy (assessed by CT or PET CT images during the follow-up period), survival calculated with Kaplan Meier method (overall survival, survival without recurrence).
Results: Pneumothorax was the most frequent complication and occurred in 50 % of the procedures. An air embolism occured in one patient without consequences at 2 months. 1 patient died in the month following the procedure from a respiratory insufficiency The local failure was 7.5% at one year and 9.3% at 3 years. The local failure was significantly different (p=0.015) between tumors < 2cm (n=68 patients local failure 3.9% at one and 3 years) vs tumors > 2 cm (n= 73 patients local failure 11.6% at one year and 15.3% at 3 years) The 2-year overall survival was 70%, the 2-year survival without recurrence was 79%.
Conclusion: RFA is safe and efficient in the treatment of primary lung carcinoma

2909.5

Long-term outcome of doxorubicin-loaded DC Bead for HCC. Results of a prospective trial on 173 patients

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Purpose: To report on the long-term survival of patients that have been prospectively enrolled for the evaluation of the results of chemoembolization with DC Bead loaded with doxorubicin (DEB-DOX) in patients with HCC stage BCLC B.
Material and Methods: 173 HCC patients of BCLC stage B who had a minimum of two embolization sessions have been included. Patients should have a session schedule until 3 sequential embolizations every 2 months and then they were embolized on evidence of tumor progression with the same embolization technique and materials. Additional treatments with RFA, microwave ablation or administration of sorafenib after the initial 3 embolizations - if applied - were recorded. Patients with complete response from the first embolization had a second session and then were followed up.
Results: The mean sum longest diameter of the tumor/s was 7.6cm (range, 4-16 cm). The overall 1-, 2-, 3-, 4- and 5-year survival was 93.6%, 83.8%, 62%, 41.1%, and 22.5%, respectively. For single lesions <5cm 1-, 2-, 3-, 4- and 5-year survival rates were 100%, 95.2%, 71.4%, 66.6% and 47.6% for Child A patients, and 94.1%, 88.2%, 58.8%, 41.2%, 29.4% and 23.5% for Child B. Independent prognostic factors predicting poor survival in the Cox multivariate analysis included multifocal disease (RR 3.2 [95% CI 1.5-5.8]; p=0.002), and Child B with radiologically detectable ascites (RR 6.7 [95% CI 1.5-11.3]; p=0.007), while the presence of a single lesion <5cm was a predictor of longer survival (RR 3.2 [95% CI 1.7-7.2]; p= 0.005).
Conclusion: Survival of patients treated with DEB-DOX is high in well selected patients.

2909.6

Local control of focal hepatic malignancies treated with microwave ablation with a novel high-power applicator system: 14-month experience in 108 patients

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Purpose: To assess the efficacy and safety of microwave ablation for the treatment of hepatic malignancies using a novel high-power applicator system.
Material and Methods: Over an 18-month period, 189 hepatic malignancies (101 HCC, 1 cholangiocarcinoma and 87 metastases) in 108 patients were percutaneously treated under US guidance using a novel high-power (140 Watt, 2.45 GHz) microwave system (AMICA-Probe: Hospital Service, Aprilia, Italy) with either 14G or 16G antennas. Contrast-enhanced MDCT or MRI at 3-6-9-12 months was used for follow-up. Results were assessed after a minimum of 6-month follow-up for a total of 87 malignancies (52 HCCs and 35 metastases, size range 0.5-5.5 cm, mean 2.1) in 41 patients.

Results: Immediate complete ablation was achieved in 78/87 malignancies (89.7%); 46/52 (88.5%) HCCs and 32/35 metastases (91.5%). Local tumor progression occurred in 9/87 malignancies (10.3%): 2/45 (4.4%) with size ≤1.9 cm, 4/27 (14.8%) ranging 2.0-2.9 cm, and 3/15 (20%) > 3 cm. All local progressions were successfully retreated within 4 months using the same method. Minor complications occurred in 13/108 (12.0%) patients, requiring only symptomatic management. Only one delayed major complication was noted (0.8%); 60 days after ablation, a small intrahepatic hematoma in communication with both a perihepatic effusion and 5-cm blood collection in the adjacent pleural space was detected. Spontaneous regression occurred over 10 days of hospitalization

Conclusion: In our preliminary experience, this novel microwave ablation system provided valuable local control of hepatic malignancies without significant complications.

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CIRSE 2011

PART 3

Electronic Posters

**Abstracts of
electronic poster presentations
sorted by presentation numbers**

Cardiovascular and Interventional Radiological Society of Europe

CIRSE

Biliary intervention

P-1

Biliary drainage in patients with undilated bile ducts affected by biliary fistula due to pancreatobiliary surgical treatment

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Purpose: To evaluate technique, feasibility, complications and clinical outcome of percutaneous biliary drainage in patients with undilated biliary ducts affected by biliary fistula due to pancreatobiliary surgical treatment.
Material and Methods: PTC (percutaneous transhepatic cholangiography) and placement of a percutaneous biliary drainage (8-French) was attempted in 30 patients affected by biliary fistula, demonstrated by the presence of bile in abdominal surgical drainage, with normal levels of bilirubin and ultrasonographic evidence of undilated biliary ducts. Under ultrasonographic and fluoroscopic guide, the puncture attempted with Chiba needle (21G) was performed along the course of the sixth segment portal branch or in the left lobe in case of aerobilia.
Results: PTC was successfully performed in all patients (21 cases with right approach, 9 with left approach) with radiological demonstration of biliary fistula. Biliary drainage was placed in 27/30 patients (90%), in 22 cases external-internal, in 5 external, obtaining complete resolution of the fistula. In two patients surgical retreatment was necessary, in another patient fistula spontaneously resolved. No periprocedural complications were recorded.
Conclusion: Percutaneous biliary drainage in patients with undilated biliary ducts affected by biliary fistula under ultrasonographic/fluoroscopic guidance is feasible, effective, without significant complications and represents the first choice of treatment.

P-2

Effect on quality of life in patients with inoperable malignant biliary obstruction treated by percutaneous transhepatic biliary drainage

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Purpose: Aim of this study was to determine and to quantify changes in the quality of life in patients with inoperable malignant biliary obstruction after decompression by percutaneous transhepatic biliary drainage (PTBD).
Material and Methods: 49 patients of inoperable malignant biliary obstruction were treated by PTBD, in which 24 patients were managed by self-expandable metallic stents and remaining 25 patients by internal-external drainage catheters. The European Organisation for Research and Treatment of Cancer QOL questionnaire (EORTC QLQ-C30) (version 3) scores at baseline and 1 month after catheter/stent insertion were used to quantify quality of life. Results were correlated to clinical and laboratory parameters.
Results: At baseline mean total bilirubin was 19.5 mg/dL. After biliary drainage, complete follow-up information was available for 42 patients at one month. The mean increase in the functional parameter at one month was 19.35 (percentage increase was 46.19%). The mean decrease in the symptomatology parameter at one month was 21.47 (percent reduction was 38.5%). The mean increase in the global parameter at one month was 25.8 (percent increase was 85.8%), which were statistically significant. There was a statistically significant difference in the improvement of the QOL scores between patients who achieved clinical success. There was no significant difference in the QOL scores in patients stratified according to the amount of liver drained, the type of internalization used or the patency of the primary confluence.
Conclusion: Successful biliary drainage after either internal-external drainage catheter or stent insertion is associated with significant improvements in quality of life.

P-3

Percutaneous cholecystostomy as definitive treatment of acute cholecystitis in high surgical risk patients

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Purpose: This study aims to evaluate the safety and effectiveness of percutaneous cholecystostomy (PCS) without interval cholecystectomy as definitive treatment for acute cholecystitis in high surgical risk patients.
Material and Methods: Between January 2007 and December 2009, 52 patients that suffered from calculous (n=26) and acalculous (n=26) acute cholecystitis but were considered high risk for surgery (American Society of Anesthesiologists [ASA] class III or IV) underwent PCS as an emergency procedure. Patients' medical records were reviewed retrospectively for demographic data, technical success, complications, hospital stay, catheter indwelling time, recurrence of cholecystitis, and requirement of additional treatment.
Results: There were 27 male and 25 female patients with a median age of 72 years. Forty-one patients were classified as ASA class III and 11 as ASA class IV. PCS was technically successful in all patients. Clinical improvement was evident in all patients within 72 hours. The catheter was replaced in 12 patients due to tube dislodgement. The median hospital stay and catheter indwelling time were 15 days and 24 days, respectively. Nine patients (17.3%) developed recurrent cholecystitis (15 days-27 months) after initial PCS, which were treated with laparoscopic cholecystectomy (n=6) and repeat PCS (n=3). Fifteen patients died of their underlying conditions during the follow-up period (2-38 months, median 13.1).
Conclusion: PCS is a safe and effective treatment of acute cholecystitis in high surgical risk patients. It might be considered as a definitive treatment with high clinical success rate, low morbidity, and low recurrence rate.

P-4

Percutaneous interventions in pediatric patients after liver transplantation

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Purpose: The aim of this study was to determine the efficacy and safety of percutaneous treatment of vascular and biliary stenoses or occlusions in pediatric patients after liver transplantation.
Material and Methods: Within 46 months, 13 children with a mean age of 9.4 years (13 month to 17.7 years) were subjected to interventional procedures after liver transplantation. Patients suffered from

stenoses or occlusions of portal vein, hepatic vein, vena cava inferior, hepatic artery and biliary system. Technical and clinical success, as well as patency was determined.
Results: We performed 28 interventional procedures in pediatric patients. No major complications occurred. The technical and clinical success of biliary drainage placement was 100%. Resolution of the biliary stenoses was achieved by performing balloon dilation and long-term dilation with drainages (mean follow up 20 months). The technical and clinical success in balloon angioplasty (n = 7) and stent angioplasty (n = 2) was 100% (mean follow up 23 months). Thrombolysis of hepatic artery thrombosis failed in one patient.
Conclusion: Interventional radiology allows fast detection and treatment of vascular and biliary stenoses after pediatric liver transplantation and helps to improve graft and patient survival. Nevertheless, an individualized treatment with special concepts in each patient is necessary.

P-5

Percutaneous interventional therapy for anastomotic biliary strictures after orthotopic liver transplantation

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Purpose: To describe the technique, efficacy, and safety of percutaneous interventional therapy for anastomotic biliary strictures after orthotopic liver transplantation (OLT).
Material and Methods: From May 2004 to December 2009, twenty-five patients with anastomotic biliary strictures after OLT were closed in our study. All patients accepted percutaneous interventional therapy in our hospital, including PTBD only in 4 patients, PTBD combined with balloon dilation in 14 patients, balloon dilation and plastic stent implantation in 5 patients, balloon dilation and metallic stent implantation in 2 patients. The modalities of biliary drainage included external drainage in 22 patients, and external-internal drainage in 3 patients who underwent re-transplantation. The drainage catheters were exchanged every 1 to 3 months.
Results: The success rate of PTBD was 100%. Of the all 25 patients, 15 (60%) patients were cured, 10 (40%) patients were improved. The drainage catheters failed to pass through the narrow bile duct when initial PTBD in 7 patients, and it succeed in 3 patients by operating again after biliary drainage for one week. In the other 4 patients, anastomotic bile ducts were occluded which was confirmed by cholangiography after biliary drainage for 4 to 8 weeks. The rate of biliary tract infection was 24% (6/25). No serious procedure-related complications occurred in the all 25 patients.
Conclusion: PTBD combined with balloon dilation and biliary stenting is a effective and safe therapeutic modality for anastomotic biliary strictures after OLT. To avoid bile duct occlusion, the drainage catheters should be passed through the narrow segments of bile duct when initial PTBD.

P-6

Study of percutaneous interventional treatment for biliary complications after liver transplantation

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Purpose: To assess the efficacy and safety of percutaneous interventional treatment for biliary complications after orthotopic liver transplantation (OLT).
Material and Methods: From January 2004 to October 2009, 126 patients were diagnosed with biliary complications after OLT in the third affiliated hospital of Sun Yat-sen University. Of these 126 patients, 90 patients were included in our study. The modalities of interventional treatment were as follows: percutaneous transhepatic biliary drainage (PTBD) only (n=19 cases), PTBD combined with balloon dilation (n=50 cases), and PTBD combined with stent implantation (n=21 cases). The modalities of biliary drainage included external drainage and external-internal drainage. The drainage catheters were exchanged every 1 to 3 months.
Results: Of all 90 patients, 75 patients with biliary strictures, 8 patients with biliary leakage, and 7 patients with bilomas. After accepting percutaneous interventional treatment, 34 (37.8%) were cured, 42 (46.7%) improved, and 14 (15.5%) ineffective. In biliary stricture group, the cure, improvement and inefficacy rates were 34.7% (26/75), 52.0% (39/75) and 13.3% (10/75), respectively. The correspondent rates in biliary leakage group were 100% (8/8), 0 and 0, respectively, in bilomas group were 0, 42.9% (3/7) and 57.1% (4/7), respectively. The efficacy was the best in bilary leakage group, and it was the unsatisfied in bilomas group (P<0.05).
Conclusion: PTBD combined with balloon dilation and biliary stenting is an effective and safe therapeutic modality for biliary complications after OLT, which can improve the patients' clinical symptoms, elevate patients' quality of life. The patients with intrahepatic multiple bilomas should be treated by retransplantation as soon as possible.

P-7

Effects of percutaneous transhepatic biliary drainage on inflammatory response in patients with obstructive jaundice

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Purpose: To investigate the effects of percutaneous transhepatic biliary drainage (PTBD) on liver functions and inflammatory response in patients with obstructive jaundice.
Material and Methods: 50 patients with obstructive jaundice [age: 63,7±13,5 years (mean±SD)] (11 benign, 39 malignant) were studied at admission, 5th hour and 5th days after PTBD for liver function and TNF-α, IL-6, IL-10 levels.
Results: Bilirubin levels and liver enzyme activities have been decreased in all patients (p=0,0001 for all). IL-6 (from 41,94±83,86 to 77,87±119,89 pg/mL), TNF-α (from 54,13±71,46 to 97,89±132,9 pg/mL), leukocyte (from 9,29±4,78 to 10,38±5,73 $x10^3mm^3$) and CRP (from 6,53±6,5 to 9,39±7,63 mg/dL) levels were increased significantly in all patients (p<0,05). The slight elevation in IL-10 levels in 5th hours has been decreased 5th days after PTBD (before: 475±1124, 5th hour: 565±1066, 5th day: 398±754 pg/mL, p<0,05). However in malignant patients, IL-6, IL-10 and TNF-α were not changed significantly.

Procedure-related mortality was nil, seven malignant patients died within thirty days (18%) due to their underlying diseases. TNF-a (150,5±146,6 vs. 36,2±35,9 pg/mL) IL-6 (202,6±175,4 vs. 35,37±38,98 pg/mL) and creatinine (1,6±0,61 vs. 0,83±0,39 mg/dL) levels have been shown to be significantly high in dying patients (p<0,05).
Conclusion: PTBD stimulates inflammatory response, depresses existing anti-inflammatory state in short term. However in malignant patients, IL-6, IL-10 and TNF-α were not influenced by drainage, indicating ongoing release. PTBD has positive effects on liver functions. Short-term predictors of mortality in the malignant obstructive jaundice are increased proinflammatory and anti-inflammatory responses and the presence of renal dysfunction.

P-8

A newly designed Y-configurated stent graft for the palliative treatment of the hilar obstructive malignant biliary carcinomas

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Purpose: To investigate the technical efficacy of a newly designed Y-shaped stent for the hilar cholangiocarcinoma patients in terms of providing long term patency of the bilateral hepatic ducts without sacrificing branching bile duct.
Material and Methods: This is a phantom study and we used a PTFE-covered stent system lining and an outer supporting structure of nitinol wire. We used two pieces of covered stent system to have a Y-configuration for the biliary drainage of both lobes of liver. One main piece of covered stent has a long leg and another short leg. First, we inserted this main piece into the common bile duct through the right PTBD tract. Proximal end of the main piece was located into the right bile duct. Another piece of covered stent is to connect between the short leg of the main piece and the bile duct of the left lobe of liver. All procedures were done under the guidance of a 0.035-inch guide wire. Cholangiogram was obtained through the intrahepatic bile duct for the evaluation of biliary drainage of both lobes of liver. We demonstrated above procedure with phantom five times.
Results: Placement was successful in all cases. All cases had showed adequate drainages.
Conclusion: This study suggests that they are safe and potentially clinically effective for the palliative treatment of hilar obstructive malignant biliary carcinoma.

P-9

Biliary patency restoration by percutaneous endobiliary RF ablation and ductoplasty in pancreatic head cancer

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CBD patency was restored successfully by percutaneous endobiliary RFA and balloon ductoplasty after the preliminary PTC in 2 patients with obstructive jaundice, caused by pancreatic head neoplasm.

P-10

Biliary patency restoration by percutaneous endobiliary RF ablation and ductoplasty in benign biliary obstruction

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Bile duct patency was successfully restored by percutaneous endobiliary RFA and balloon ductoplasty performed after the preliminary PTC to the patient with hepatic duct stricture.

P-11

Percutaneous transhepatic bile duct ablation with n-butyl cyanoacrylate in the treatment of a iatrogenic biliary leakage

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The patient presented a iatrogenic bile leakage, persistent despite prolonged biliary drainage. Through the same percutaneous access, the embolization was performed first using coils and after n-butyl cyanoacrylate (NABC). Few percutaneous embolization experiences are present, and even less using NACB.

P-12

Biliary patency restoration by percutaneous endobiliary RFA procedure, performed to tumor blocked metal stent

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Biliary patency was successfully restored by percutaneous endobiliary RFA and balloon ductoplasty to the patient with obstructed CBD metallic stent; obstruction was caused by tumor ingrowth into the stent.

P-13

Biliary patency restoration by extra and intrahepatic stent percutaneous placement in the case of advanced gallbladder carcinoma

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The patient with inoperable gallbladder carcinoma, causing biliary obstruction (Bismuth III) underwent hepatic duct and right-left hepatic duct connection percutaneous stenting after multiple PTC; the whole biliary tree patency has been restored.

P-14

PTCD in infancy: use for dealing with the complications after surgical resection of a choledochus cyst type Ia

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A 11-month-old infant developed postoperative insufficiency of the bilio-digestive anastomosis after resection of a huge congenital bile duct cyst type Ia. Unsuccessful reoperation followed by a

sonography- and fluorsocopy-guided PTCD which finally eliminated biliary leakage and aided to quick recovery.

P-15

Percutaneous removal of Kher tube fragment

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A 76-year-old man experienced Kher tube placement. When tube withdrawal was attempted, it turned out in tube tear and a missing fragment disloged in the biliary tree; removal was achieved with hydrophilic guide wire and balloon catheter.

Bone, spine and soft tissue intervention

P-16

Posterior vertebral arch cement augmentation (laminoplasty) to prevent fracture of spinous processes after interspinous spacer implant

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Purpose: To assess the safety, feasibility, and effectiveness of posterior vertebral arch cement augmentation in preventing delayed spinous processes' fracture after interspinous spacer implant, in patients with risk factors for fragility fractures.
Material and Methods: we implanted interspinous spacers in 35 eligible patients with risk factors for fragility fractures. In 19 of them, after assessment of the theoretical biomechanical effects of cement augmentation of the laminae by finite elements analysis, a percutaneous cement augmentation of the posterior vertebral arch (laminoplasty) was also performed. Clinical and radiological follow-up ranged between 3 and 14 months after the intervention.
Results: Neither intra-procedural spinous processes nor laminar fractures were observed in either groups. A symptomatic delayed spinous process fracture was diagnosed in 4 out of 16 patients who did not undergo laminoplasty (25.0%), while no fractures were diagnosed in the 19 treated patients (p=0.035).
Conclusion: Intralaminar cement injection is feasible and safe. It has a biomechanical rationale, seems effective in preventing delayed fractures of the posterior arch post-interspinous spacer placement, in patients at risk for fragility fractures.

P-17

Efficacy of percutaneous interspinous spacer in the treatment of neurogenic intermittent claudication due to lumbar spinal stenosis

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Purpose: Degenerative lumbar spinal stenosis (LSS) is a narrowing of the spinal canal that causes several symptoms, in particular neurogenic intermittent claudication (NIC). The aim of this study is to provide the efficacy of a percutaneous interspinous spacer.
Material and Methods: From November 2009 to October 2010, sixty-three patients were selected for implantation of percutaneous interspinous spacer. Diagnosis was confirmed by conventional X-ray, CT and MRI. Each procedure was performed using the Aperius PercLID system (Kyphon Medtronic). All devices were implanted under fluoroscopic guidance and with local anesthesia. Clinical evaluation, assessment of pain by means of a 11-point visual analogue scale (VAS, 0-10) and of function by means of the Oswestry disability scale (ODI 0-50) was performed at baseline and at one month after the procedure. CTMS checks have been performed in order to evaluate the areas of both neuroforamens and of the spinal canal before and after the implantation.
Results: Baseline pain was 8.1 ± 2.0, baseline ODI was 23.3 ± 10.0. At one month, pain was 4.4 ± 2.0, while ODI was 11.7 ± 8.5 ($p<0.01$). We reported an increase of 14.8% and 15.3% in the areas of the foramens (Av. Area Dx before: 0.97, after: 1.11mm3 (Av. Area Sn before: 0.95, after: 1.09mm3) and an increase of 15.3% in spinal canal dimension (Av. Axial area before: 1.85, after: 2.14). One dislocation was reported after three days.
Conclusion: Implant of percutaneous interspinous spacer is an effective and safe procedure in reducing NIC and in determining an increase of dimensions of the neuroforamens and of the spinal canal.

P-18

Evaluation of a novel laser navigation system (LNS) for CT-guided interventions

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Purpose: Available aids for CT-guided interventions increase the precision and reduce X-ray exposure but suffer from low acceptance because their operation is time-consuming. In this study, a novel laser navigation system (LNS, amedo STS, Bochum, Germany) for CT-guided interventions was evaluated. Procedure time, precision of puncture and number of control scans with LNS were compared with conventional freehand punctures of a well trained interventionalist.
Material and Methods: 98 patients underwent LNS-assisted CT-guided drug deliveries. 1 to 4 needles were positioned in the cervical, thoracic or lumbar spine for lateral or epidural periradicular therapies or facet joint treatments. 31 patients underwent two periradicular therapies (PRT): one freehand and the other with LNS. Procedure time, precision and number of control scans of PRTs were compared by calculations of mean values and standard deviations. Significance was tested with paired t-test (Shapiro-Wilk > 0.1) or Wilcoxon signed-rank test (non-Gaussian distribution).
Results: All 98 treatments were technically successful. Procedure times for freehand treatments were 544 ± 213 sec and 425 ± 99 sec for LNS-guidance ($p = 0.006$, t-test). The deviations between planed and reached target points were 4.10 ± 2.83 mm for freehand puncture and 1.03 ± 0.97 mm with the laser navigation system ($p < 0.0001$, t-test). With freehand puncture 1.9 ± 1.2 slices and with LNS 1.1 ± 0.3 slices were acquired till the needle reached an acceptable position ($p = 0.0004$, Wilcoxon).
Conclusion: LNS is a promising assistance system for CT-guided needle interventions because it simplifies procedures, saves time, reduces needle deviations and minimizes X-ray exposure.
Disclosure: The coauthor Martin Deli works part-time for the company amedo (manufacturer of LNS).

P-19

1H-MR spectroscopy in the evaluation of osteoporotic and neoplastic vertebral fractures prior percutaneous vertebroplasty

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Purpose: The detection of spongious vertebral molecular variations can be utilized to distinguish the different sources of bone pathology. The relative water intensity correlates with hematopoietic elements dominating in youth. Instead fat cell proportion increases with age resulting in a conversion of red/yellow marrow.
Material and Methods: The study was performed with a 3T Magnetic Resonance; we used a single voxel (SV) method (TR/TE 2000/40 msec) with point-resolved spectroscopy sequence (PRESS). We measured % FF and lipid/water ratio (LWR) in 63 subjects with MR findings of vertebral fractures related to osteoporosis, multiple myeloma and metastasis. The control group consisted of 65 subjects with no spinal pathologies.
Results: In accordance with the relative presence of fat and water within the vertebral body, we found that in osteoporotic vertebral fracture and in hematopoietic diseases an inversion of physiological LWR is present. This is probably due to intraspongious edema and malignant cells infiltration with replacement of lipid-containing cells.
Conclusion: 1H MRS provides a fine evaluation of vertebral bone marrow changes due to primary or secondary pathologies and allows appreciated differences not easily assessable with conventional imaging. In the upcoming future, MR spectroscopy may be powerful in identifying physiological as well as pathological biochemical changes in vertebral bone. This evaluation will be useful in pre-vertebroplasty planning in order to evaluate vertebrae must be treated.

P-20

Percutaneous vertebroplasty in vertebral compression fractures of osteoporotic, neoplasmatic or traumatic origin: a prospective study of 1188 patients with follow-up of 12 months

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Purpose: Vertebral compression fractures and associated complications incur high health care costs. Due demographical changes their incidence is expected to grow, increasing the importance of reliable and efficient treatment modalities. The purpose of the study was to prospectively assess the quality of life in patients treated with vertebroplasty in a midterm follow-up of 12 months, taking the underlying etiology into account.
Material and Methods: Prospective two-center study comprising quality of life variables "pain", "mobility" and "analgesic agents" in ordinal scales 24 h pre- and postinterventionally and in intervals up to 12 months, constantly acquired by the same interviewer. Vertebroplasty was performed in acute and subacute (not exceeding 3 months) vertebral compression fractures.
Results: 1980 compression fractures were treated in 1188 patients, the most common underlying etiology being osteoporosis (75%). In comparison with the preinterventional status there was a statistically relevant ($p<0.01$) improvement in all parameters during follow-up. The better part of the effect is seen directly after the procedure while an ongoing, statistically relevant improvement could be observed for up to 6 months.
Conclusion: Vertebroplasty alleviates pain directly, improves mobility and decreases the use of analgesic agents in vertebral compression fractures. Its therapeutical effect may lead to a continuous increase in quality of life for up to 6 months in osteoporotic fractures.

P-21

Ultrasound-guided subacromial injection of hyaluronic acid in the treatment of elderly patients affected by massive rupture of the rotator cuff

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Purpose: The massive rupture of the rotator cuff in elderly patients is not treated with a surgical approach. Our purpose was to test the effectiveness of an ultrasound-guided injection of hyaluronic acid in the subacromial space in patients affected by a massive rupture of the rotator cuff with a neo-articulation between acromion and humeral head.
Material and Methods: IRB approval and patients' informed consent were obtained. We studied 38 patients (28 females; mean age 72±7.6 years), who presented at our Department with a painful shoulder, in which the ultrasound examination demonstrated a massive rupture of the rotator cuff and a neo-articulation of the humeral head with the inferior surface of the acromion. Under ultrasound guidance (12-5 MHz probe, iU22, Philips), we injected 6ml of low molecular-weight hyaluronic acid (Hyalgan, Fidia, Italy) in the subacromial space. Patients were clinically evaluated before the procedure and at monthly follow ups up to six months by means of a visual analogue scale (VAS). Wilcoxon test was used.
Results: No immediate or delayed complication was observed. VAS score before treatment was 7.4±2.2. After the injection, VAS score was 1.8±1.2 at one month ($p<.01$), 1,7±1,0 at two months ($p<.01$), 2.1±1.2 at three months ($p<.01$), 2.6±1.1 at four months ($p<.01$), 3.9±1.8 at five months ($p<.01$), and 5.0±2.7 at six months ($p=.04$).
Conclusion: The viscosupplementation of the acromion-humeral neo-joint in patients affected by massive rupture of the rotator cuff is effective in shoulder pain reduction. This treatment could represent a low-cost non-invasive alternative to biceps tendon tenolysis that usually leads to a quicker progression of humeral osteoarthritis. However, the evolution of VAS at different timepoints indicates that this treatment has a time-limited effectiveness despite the significant difference with the baseline value.

P-22

One-year outcome of ultrasound-guided percutaneous treatment of plantar fasciitis: a randomized controlled trial

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Purpose: The purpose of our work was to compare the short- and long-term outcome of US-guided percutaneous treatment of plantar fasciitis based on dry needling and local injection of steroid of patient affected with plantar fasciitis, compared with similar patients treated with simple steroid injection or dry needling.
Material and Methods: IRB approval and informed consent were obtained. Among 75 patients referred for US-guided treatment of plantar fasciitis, 25 (12 males; age 43.8±7.6 [mean± standard deviation]) were treated with dry needling and local injection of steroid together; 25 (12 males; age 46.2± 12.3) were treated with dry

needling only; 25 (11 males; age 52.7±10.0) were treated only with local injection of steroid. Pain was assessed using the visual analogue scale (VAS) at baseline and at 7, 14, 30, 90, 180, 360 days after the procedure; fascial thickness was measured with US scanning at baseline and at 180 and 360 days later. Kruskall Wallis test was used.
Results: Patients treated with the complete procedure had a faster and more permanent decrease of symptoms (VAS at 7 days=1.2±0.4 and VAS at 360 days=0.0± 0.1). Patients treated only with injection of steroid had a quick decrease of pain that was not permanent on a long-term basis (VAS at 7 days=1.2±0.6 and VAS at 360 days=5.2±0.4). Patients treated only with needling had a permanent but very slow decrease of symptoms (VAS at 7 days=5.7±0.5,at 30 days (VAS=2.6±0.4), at 90 days (VAS=0.3±0.8), and at 360 days (VAS=0.1±0.2). Difference was statistically significant (p<.001).
Conclusion: Patients treated with the combined procedure had a better outcome than other groups. Pain relief is faster and more permanent compared with slower or not stable results obtained in the other patients.

P-23

MR-guided high intensity focused ultrasound for palliation of bone metastasis

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Purpose: To confirm safety and demonstrate technical effectiveness of MRI-guided high intensity focused ultrasound (MR-HIFU) for ablating bone metastasis with volumetric heating and realtime feedback technique.
Material and Methods: MR-HIFU treatment was performed using a focused ultrasound phased array system integrated with a clinical 1.5T MRI system (Sonalleve®-Philips medical System) with real time feedback. The inclusion criteria were patient with bone metastasis without chemotherapy or radiotherapy within 2 weeks and pain score >4. After MR-HIFU, Safety, improvement in pain score (10-point visual analogue scale), and changes in pain medication are valuated during 60 days.
Results: At this time 1 patient was included and is still under follow-up. No major complication or unintended lesions were observed during, or after the procedure. Only minor complications (pain during sonications) occurred during treatment. Minor complication after procedure included moderate musculoskeletal pain. This seems to be related to patient position during treatment. The pain score decreased at day 14 post-procedure from an average of 3-4 (with a maximum of 6) before treatment to an average of 2-3 (with a maximum of 5) without modification of pain drug.
Conclusion: Although they must be confirmed by new inclusions in progress, these preliminary results demonstrate that MR-HIFU can be a safe and effective therapy for palliation of bone metastasis using volumetric heating and real time feedback technique.
Disclosure: Clinical investigation agreement with Philips

P-24

Radiofrequency facet joint denervation: a progress report

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Purpose: Facet joint intraarticular steroid injections combined with anesthetics are a standard treatment of lumbar zygapophysial joint pain. In our institute, we use for selected indication radiofrequency facet joint denervation (RFD) for two years. This paper presents our first experiences of RFD compared to facet joint intraarticular steroid injections.
Material and Methods: For image guidance we used a 4-slice CT scanner (Siemens Volume Zoom) with collimation 4x1mm *slices*. After written consent, the patient was positioned prone on the table for CT-guided needle placement. Before ablation (thermocoagulation) of the medial branch of the dorsal branch Nervi spinalis stimulation of the sensitive and motoric fibers was performed to assure the correct needle position. Ablation time was usually 60 sec. per branch with a temperature of 80° C.
Results: 60 RFD procedures were performed in 48 patients. The procedure takes 30 minutes including patient positioning. 70% of patients reported a 50% or greater relieve in back pain, benefit in mobility, reduction of analgesic consumption and prolongation of therapeutic effects. The duration of the effect reached from 3 up to 10 months.
Conclusion: Facet joint denervation is a good alternative to standard treatment in lumbar facet joint syndrome as it reduces repetitive steroid injections.

P-25

Life expectancy following diagnosis of a vertebral compression fracture

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WITHDRAWN

P-26

Spinal imaging evolution after placement of an Aperius™ percutaneous interspinous spacer using a positional MRI in 17 patients

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Purpose: To evaluate disc height, foraminal and spinal canal surface evolution after placement of an interspinous spacer.
Material and Methods: Study population consisted of 17 patients (M:F=9:8, mean age:72y, range 61-84).
Pre-op and post-op (7 days and 1 year) positional MR examinations (Upright MRI scanner, Fonar Corporation, USA) were performed in neutral, standing, flexion and extension positions.
The following electronic measurements were simultaneously performed at all time points and positions, at same location, at the device level: - Mean disc height on sagittal T2w images. - Narrowest left/right foraminal surface on sagittal T2w images. - Narrowest dural sac surface on axial T2w images.
Changes were assessed by the paired t-test and were significant at p<0.5.
Results: 15/17 patients presented sufficient image quality enabling comparison in extension at baseline with 7 days and 12 months examinations.
At the level of the device, analysis showed:
- statistically significant increase of foraminal surface at 7 days (left: p<0.0001, right: p<0.0001) and 12 months (left: p<0.0001, right: p=0.002).

- no statistically significant increase of spinal canal surface at 7 days (p=0.077) and 12 months (p=0.62).
- no statistically significant variation of disc height at 7 days (p=0.21) and 12 months (p=0.48). At all time points and any position, no decrease in foraminal surface was observed at the level of the device. No other statistically significant results were found.

Conclusion: The Aperius™ percutaneous interspinous spacer prevents collapse of foramen when the patient is standing and extending the lumbar spine. A higher number of patients should be examined to enable statistically significant results in other positions.

Disclosure: Consultant for Medtronic

P-27

Clinical significance of repeat vertebroplasty for recurrent pain at cemented vertebra with fluid sign

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Purpose: The aims of this study were to determine the association between recurrent pain and fluid sign following percutaneous vertebroplasty (PV) and to assess the clinical significance of retreatment for cemented vertebrae with fluid sign.

Material and Methods: 545 patients (mean age, 78.5 years; range, 58-96 years) and 1214 vertebral bodies were treated from January 2008 to December 2009. All patients underwent preoperative magnetic resonance imaging (MRI) with contrast enhancement and computed tomography (CT). Almost all patients showed good response after initial PV. Sixty-one patients developed recurrent pain following successful PV within a year. Of them, 57 revealed subsequent fracture in the adjacent or distant vertebra from the treated vertebra. Another 4 patients who complained of recurrent pain demonstrated only fluid sign at the bone-cement interface without obvious compression fracture.

Results: In all these 4 patients, large cavity formation (cleft) in the vertebral body was noted and there was destruction of the posterior wall of the vertebra in preoperative MRI and CT. Definite mismatch was noted in fluid cleft size on STIR images and ill-enhanced area around the enhanced area of fat-suppressed contrast-enhanced images on preoperative MRI. This mismatch area was consisted to be necrotic debris which was thought to be responsible for development of fluid in the treated vertebra.

Conclusion: Fluid sign in the treated body represents unhealed bone-cement interface and cement instability. The existence of a large cleft (vacuum or fluid filled) in the treated vertebrae and destruction of vertebral posterior wall may be important factors influencing instability of the injected cement.

P-28

A prospective study of percutaneous vertebroplasty in patients with myeloma and spinal metastases

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Purpose: Percutaneous vertebroplasty is frequently used for the management of pain from myeloma and spinal metastases. Prospective data on patient outcome are limited with few studies and small patient numbers. The aim of this study was to assess patient outcome in a consecutive series of patients with myeloma and spinal metastases.

Material and Methods: Data were gathered prospectively on all patients undergoing percutaneous vertebroplasty between June 2001 and June 2010. Outcome measures included visual analogue pain scores (VAS), Roland-Morris disability index (RDQ), complications and long-term outcome.

Results: One hundred and twenty-eight patients underwent percutaneous vertebroplasty for myeloma (n=41) or spinal metastases (n=87) over a nine-year period. VAS scores fell from 7.75 +/- 1.88 pre-vertebroplasty to 4.77 +/- 2.69 post-vertebroplasty (p=0.001). RDQ scores improved from 18.55 +/- 4.79 to 13.5 +/- 6.96 (p=0.001). Complications were recorded in three patients: cement extension to vena cava (n=1), local haematoma (n=1) and loss of sensation over T1 dermatome (n=1). The Kaplan Meier estimate of 5-year survival post-vertebroplasty was 40% for patients with myeloma and 25% for those with metastases.

Conclusion: Percutaneous vertebroplasty reduces pain and improves disability in patients from intractable pain from myeloma or spinal metastases and now forms an important part of the multimodality treatment for these patients.

P-29

Vertebral osteonecrosis and vesselplasty

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Purpose: The incidence of compression vertebral fracture has increased in the last years. This is due to the high prevalence of osteoporosis and tumoral diseases affecting vertebral bodies. There are situations of greater vertebral weakness, as in case of osteonecrosis or plasmacytoma. In these cases, medical management cannot prevent evolution to collapse, and is often unable to relieve patient's pain. Besides, vertebroplasty in this patients could theoretically present complications as cement migration. We propose the use of vesselplasty in this context, in order to reduce potential cement leak risk, allow patients to improve in a shorter period of time, and reincorporate to normal activity.

Material and Methods: We recruited 5 patients (3 with osteonecrosis and 2 with plasmacytoma) out of the 200 patients treated with vesselplasty in our institution. Vertebrography followed by vesselplasty was performed using the Vessel-X Bone Filling Container System according to the standardized procedure. Three outcome variables were evaluated: pain, mobility analgesic drugs use, all of them were characterized using numerical scales.

Results: All patients presented significant improvement in the three outcome variables. No clinical complications were found.

Conclusion: Vesselplasty is a promising technique to improve pain, increase mobility, and reduce the need for analgesia in patients with pathologic vertebral fractures due to osteonecrosis or plasmacytoma; its use could reduce potential cement migrations (further studies comparing with vertebroplasty are needed).

P-30

Imaging of Aperius® percutaneous interspinous spacer: what should you look at?

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Learning objectives: 1. To evaluate placement of an Aperius® percutaneous interspinous spacer. 2. To recognize adverse events that could impair clinical outcome.

Background: Stand alone interspinous devices as an alternative treatment to open decompression for degenerative lumbar spine stenosis (DLSS) with neurologic intermittent claudication are currently evaluated. Relevant imaging findings may impact patient management and should be recognized.

Clinical Findings/Procedure Details: Based on a prospective imaging evaluation in a 1-year/5 time-points multicentric follow-up on 157 patients, relevant MRI and x-ray findings to be considered are explained and illustrated using the above-mentioned imaging database. Pre-op imaging should include MRI of the lumbar spine to confirm a central or foraminal spinal stenosis and depict exclusion criteria, such as spondylolisthesis greater than grade I, severe facet joint disease and other conditions causing lumbar spinal stenosis. Pre-op AP and lateral x-rays of the lumbar spine should be performed, as well at 48h and 1 year after the intervention in order to: evaluate correct positioning of the device, measure L1-S1 angle evolution and disc height evolution at the treated level(s), exclude adverse events such as slipping or bending/fracture of device wings, spinous process fracture, morphological changes of spinous processes (subsidence).
Conclusion: This presentation summarizes correct evaluation of interspinous spacer positioning and discrimination between relevant and unrelevant findings on follow-up imaging.
Disclosure: Consultant for Medtronic

P-31

Bilateral versus unilateral approach to balloon kyphoplasty… does it matter?

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Learning objectives: The purpose of this study was to determine if a difference exists in balloon lift force, balloon contact area and balloon exerted stress between a unilateral and bilateral approach to balloon kyphoplasty.
Background: Balloon kyphoplasty is a therapeutic intervention for treating and reducing vertebral compression fractures from osteoporosis and metastatic disease. This investigation involved assessing two procedural approaches currently in clinical use, unilateral and bilateral, which involve the use of inflatable bone tamps (IBT).
Clinical Findings/Procedure Details: Biomechanical performance of these two approaches was assessed in-vitro. Ten sets of 15/3 Kyphon Xpander^{TM} IBTs were inserted into a benchtop constrained polyurethane foam environment (simulated vertebral body) mimicking clinical methods. Either one IBT (unilateral) or two IBTs (bilateral) were introduced into the model and inflated to rated maximum inflation volume at a prescribed rate. Lift force exerted by the IBT(s) and the inflated contact area were measured at specific volume increments while exerted stress was calculated. At the IBT's maximum inflation volume of 4.0cc, lift force of the bilateral approach was 105% greater than that of unilateral approach, and contact area was 279% larger than that of unilateral approach. The exerted stress of bilateral approach was 26% less than that of unilateral approach (77.97psi vs. 105.00psi).
Conclusion: The unilateral and bilateral approaches are not statistically equivalent in balloon lifting force, balloon contact area and balloon exerted stress. These benchtop results, observed in a simulated in-vitro environment, illustrate that Kyphon balloon kyphoplasty using a bilateral approach results in a marked improvement in lift force with less exerted stress.

P-32

Transarterial embolisation for preoperative devascularisation of osseous tumors: case review and management options

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Learning objectives: Current perspective of transarterial embolisation for preoperative devascularisation of surgically resectable primary and secondary osseous tumors. Illustrated case guide of potential management strategies and complications with highlighted key teaching points emphasised. To learn optimal techniques and methods for enhanced interventionalist success when facing challenging cases.
Background: Primary and hypervascular metastatic skeletal tumors provide a therapeutic dilemma. Complete surgical resection is often complex due to awkward tumor location, involvement of adjacent vasculature and associated neoplastic hypervascularity. These factors serve to potentiate the perioperative risk of significant and uncontrollable bleeding, with prolonged operative times also problematic. Preoperative embolisation and intra-arterial chemotherapy can assist by potentially reducing perioperative hypovolemia, enhancing surgical hemostasis and reducing operating and anaesthesia time.
Clinical Findings/Procedure Details: From a case series of embolic musculoskeletal procedures performed primarily in a single institution an illustrated case guide of management strategies, complications and outcomes will be presented. Patients underwent DSA-guided transarterial embolisation with intraoperative and early post-operative bleeding monitored at subsequent surgery. Cases include primary and metastatic tumours of the cervical, thoracic and lumbar spine and also tumors of the appendicular skeleton. Tumor pathologies include osteosarcoma, hypervascular renal cell and hepatocellular metastases.
Conclusion: An algorithm is suggested for successful embolic management, including identification and prevention of potential complications.

P-33

Interventional MRI of the musculoskeletal system in children and adults: principles and procedures

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Learning objectives:
- To review the basic principles of interventional MRI.
- To review the concepts and pitfalls for successful and reliable device visualization.
- To illustrate a wide spectrum of MR-guided musculoskeletal procedures.

Background: Interventional MR imaging provides an ideal imaging modality to comply with the ALARA practice mandate. This is of particular interest in the pediatric patient population as well as in young adults, but for interventionalists and their staff who are exposed to radiation while performing procedures on a daily basis. In addition to unique features of interventional MRI for musculoskeletal procedures, recent developments in MRI scanner design have expanded the spectrum and possibilities of MR-guided musculoskeletal procedures in children and adults considerably.

Clinical Findings/Procedure Details:
Principles:
· Pulse sequences.
· Device visualization.
· Navigation techniques.
· Safety.
· Tips, tricks, advantages and drawbacks.
Clinical applications and procedures:
· Bone biopsy.
· Soft tissue biopsy.
· Preoperative percutaneous tumor marking.
· Spinal injection procedures, including transforaminal injections, epidural injections, facet joint injections, sacroiliac joint injections, and discography.
· Lumbar blocks and sympathectomies.
· Sclerotherapy.
· Temporomandibular joint injections.
Conclusion: Familiarity with basic concepts of interventional MR imaging, as well as techniques, applications, advantages and limitations of various MR imaging guided procedures will ensure successful interventions and patient safety.

P-34

Biomechanical features of percutaneous cementoplasty: what the radiologist needs to know

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Learning objectives: 1. To know the intrinsic biomechanical properties of PMMA and research thrusts of new cements. 2. To have general notions of biomechanics of the skeleton and to know the areas subject to compressive forces. 3. To know the criteria for determining biomechanic success of cement filling in cementoplasty and its involvement in reducing bone pain.
Background: Vertebroplasty in osteoporotic indication allows bone healing to prevent vertebral collapse. PMMA cement has high resistance to compressive forces and poor resistance to twisting forces. Bearing areas and joint surfaces are mainly subject to compressive forces.
Clinical Findings/Procedure Details: Good indications for mechanical consolidation in cementoplasty are vertebrae, sacrum, acetabulum, condyle, scapular glenoid, humeral head. The intersection zones of the bone trabeculae are more constrained and should be targets for consolidation if the bone is pathological. Consolidation is not the only mechanism involved in the reduction of pain as sternum, ilium, scapula could effectively benefit from vertebroplasty in some articles. However, treatment with thermal ablation should be at least as effective in these indications purely analgesics. Vertebroplasty in the diaphyses of long bones is not an indication of mechanical consolidation and if the palliative indication is maintained secondary fracture risk should be explained to the patient. Evolution should be percutaneous screwing in weakened bone combined with cementoplasty to provide a consolidation.
Conclusion: The biomechanical properties of cement and the skeleton can target indications of cementoplasty for which the mechanical consolidation is possible. The quality of the filling determines the effectiveness of stabilization and it should focus on bearing areas subject to compression.

P-35

The diagnostic methods and interventional therapies of symptomatic thoracic disc herniation

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Learning objectives: To report general information and interventional therapies using CT fluoroscopy on herniated thoracic disc.
Background: Thoracic disc herniation is rare, but current studies using MRI reported prevalence rates of over 10%. In the clinical fields, the accurate diagnosis and subsequent treatment continues to pose a considerable challenge because of various nonspecific symptoms. Even though a symptomatic herniated thoracic disc was found, adequate treatments are still a problem because the thoracic spine has unique anatomical and biomechanical properties so that access to the thoracic disc under fluoroscopy guidance may not be easy.
Clinical Findings/Procedure Details: The symptoms of thoracic disc herniation are pain, numbness and weakness in the lower limbs and paresthesia. Back pain could be divided into two types as interscapular back pain and lower thoracic back pain depending on the level of herniated disc. Pain without tenderness is main symptom in most patients, while intercostal radiating pain is much less than thought. Discography has been used to evaluate symptomatic thoracic disc herniation. But in my experience, CT-guided diagnostic nerve root block (NRB) is much more useful as a diagnostic and therapeutic method. If the patient doesn't get better or worse after 2 to 3 times of NRBs, percutaneous laser decompression can be considered. Under the CT guidance, percutaneous thoracic disc decompression (PTDD) using laser is a more minimally invasive spine surgery with fewer incisions, shorter operation times. Indication of CT-guided PTDD is soft disc herniation.
Conclusion: Accurate diagnosis and appropriate interventional treatment using CT fluoroscopy provide good results to manage symptomatic thoracic disc herniation.

P-36

Ablation in MSK neoplasias

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Learning objectives: The purpose of this presentation is to assess the technical success, effectiveness and possible complications of different percutaneous ablation therapies in patients with bone benign tumours, malignant tumours and also about benign and malignant tumours of soft tissue.
Background: Patient selection and choice of the most appropriate ablation treatment was made based on lesion characteristics. Different technologies were applied like radiofrequency, plasma-mediated radiofrequency, microwave and possible association with cementoplasty. Before undergoing ablation treatment, patients were evaluated by means of a validated visual analogue scale (VAS) for pain assessment and by recording any use of analgesics. The site corresponding to the lesion was detected by computed tomography (CT) or magnetic resonance imaging (MRI). For benign bone lesion (osteoid osteoma), ablation was performed with curative intent; for malignant bone lesions, ablation has a palliative role for pain control; in the cases of soft tissue tumours curative role can be considered in benign lesions and cytoreductive intent is considered for malignant tumours.
Clinical Findings/Procedure Details: In all cases of malignant bone

tumours, 3-month follow-up showed a statistically significant reduction of pain. In no case did local complications occur either during or after treatment. For osteoid osteoma the rate of success is very high, in fact now radiofrequency is considered the standard of care for this pathology.
Conclusion: Percutaneous ablation therapies represent a safe and valuable alternative for treating bone and soft tissue tumours, providing rapid relief of symptoms and improving the quality of life of patients. In case of cytoreductive intent ablations can work synergistically with chemotherapy.

P-37

Vertebral body stenting: why, when, and how

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Learning objectives: To report the best indications and contra-indications of vertebral body stenting (VBS). To describe the technique with step by step explanations. To precise the advantages and drawbacks of VBS.
Background: Percutaneous vertebral augmentation techniques include: vertebroplasty, kyphoplasty and, more recently, vertebral body stenting. Though vertebroplasty is a good consolidation technique, it usually does not restore vertebral height. Kyphoplasty can achieve vertebral height restoration; however, after balloon deflation this restoration is not always maintained. VBS is a minimal invasive percutaneous technique, similar to kyphoplasty, using two metallic stents allowing preservation of the vertebral augmentation until the cement injection.
Clinical Findings/Procedure Details: Current indication for VBS is height restoration in fresh vertebral compression fractures (type A1, Magerl classification). The procedure is performed under general anaesthesia. Flat-panel CT, or combined CT-fluoroscopic guidance is mandatory for precise positioning of the stent. After 3D control of the proper positioning of the stents in the fractured vertebral body, the balloons are gently insufflated until the stents are completely deployed. Finally, cement is injected under fluoroscopic control to consolidate the fracture.
Conclusion: Vertebral body stenting is a promising technique, ensuring an excellent vertebral body augmentation without height loss between balloon deflation and cement injection. In non-osteoporotic patients, the vertebral height restoration is optimal, given that the VBS is performed during the first seven days after the trauma.

P-38

Preoperative MRI-guided marking of a non-palpable soft tissue mass using an open clinical 1.5 MR scanner with intra-operative correlation

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We describe a new stereotactic method for preoperative marking of the extend of a clinically occult soft tissue mass using interventional MR imaging. We provide a detailed step-by-step description of this technique and illustrate the surgical resection of this case.

P-39

A paraspinous muscle hemangioma

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A 16-year-old girl presented with intramuscular mass into the right paraspinous muscle. MRI, CT and angiography showed a well-defined mostly liquid mass, slowly enhancing, fed by a branch of IX intercostal. Embolization of this vessel was performed using Glubran2/Lipiodol (1/5).

Clinical practice development

P-40

Sedation and local anesthesia in the radiology department

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Purpose: The purpose of this study was to assess the level of understanding in the use of local anaesthesia and conscious sedation by radiologists in practice.
Material and Methods: An online survey was sent to consultant and trainee radiologists via the Faculty of Radiologists, Royal College of Surgeons in Ireland.
Results: 59 questionnaires were completed (28 consultant, 20 post-fellowship trainees, 11 trainees). 81% (n = 48) use local anaesthesia or conscious sedation more that 3 times a month. 47% of responders (n=28) hold a valid ACLS or BLS certificate. A minority of responders knew the duration of action for commonly used agents (15% correct for 1% Lignocaine, 57% for Fentanyl, 32% for Midazolam). Similar results were seen for knowledge on duration of onset (25% correct for 1% Lignocaine, 15% for Fentanyl, 28% for Midazolam). Whilst the majority of responders knew the names of reversal agents (96% correct for Midazolam, 92% for Fentanyl) only 56% and 53% knew the dose for flumazenil and naloxone, respectively.
Conclusion: Whilst the majority of respondents were aware of important issues such as the names of reversal agents; there was a significant lack of knowledge regarding duration of onset, duration of action and doses of reversal agents. Radiologists using these medications should undergo training to address this issue.

P-41

Introduction of the WHO safety checklist in the IR suite: whom does it protect?

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Learning objectives: The purpose of this study is to assess the ease and efficacy of the use of the WHO surgical safety checklist in the IR suite.
Background: The WHO surgical safety checklist has been in use worldwide in surgical theatres for some time; a version for use in IR has now been developed. This has stemmed from the need to minimise procedural errors.
Clinical Findings/Procedure Details: The use of the IR safety checklist was adopted in our District General Hospital, in August 2010 and is now routinely used prior to all vascular interventions. Key points include identification of patient, staff, and procedure side, plus clinical safety checks. All checklists are subsequently saved

electronically to be instantly accessible. We present the results of a retrospective audit of its use during the initial six months. Use and completeness of the checklist was analysed, and adverse patient incidents during the audit period were recorded. Only 60% of the checklists had all sections completely filled in and 88% had been saved electronically. However, the use of the checklist has also resulted in other non-measurable outcomes. The IR team now feels more involved and works better as a cohesive unit. The patients, mostly awake, have expressed satisfaction at audibly hearing the checklist being completed. No untoward incident has occurred during the use of the checklist and its use has now become the most important trigger at the start of a case.
Conclusion: The use of the WHO safety checklist has helped ensure patient safety in the IR suite. It has also enabled better team building, improved staff morale and patient satisfaction.

Dialysis intervention and venous access

P-42

Value of fibrin sheath stripping in restoring CVC dialysis catheter function

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Purpose: To evaluate safety and efficacy of trans-femoral fibrin sheath stripping in maintaining tunneled central venous (CVC) dialysis catheter function.
Material and Methods: 84 perm-cath studies carried out over a period of four years (2005-2009) in 76 patients with clinically dysfunctional CVC were analyzed retrospectively. All patients were followed-up to a minimum of 1 year. Patient electronic records were used to examine patients' demographics, perm-cath study findings, post-catheter stripping patency rate and procedure-related complications.
Results: Nearly half [31/64 (48.4%)] of all positive perm-cath studies were regarded as good candidates for trans-femoral fibrin sheath stripping. The stripping procedure was technically successful in 27/31 (87.1%) patients and failed in 4/31 (12.9 %) due to various unforeseen clinical and technical factors. In the technical success group, resolution of the fibrin sheath was angiographically evident on immediate post stripping perm-cath study in 27/27 (100%) catheters. 23/27 (85.1%) catheters maintained function up to 6 months (short-term patency) and 4/27 (14.9%) remained functional over 6 months (long-term patency). There were no reported major complications.
Conclusion: Fibrin sheath stripping is a safe and efficacious means of improving short-term patency and function of CVC dialysis catheters.

P-43

Non-infectious complications associated with implantation of port-catheter device: a troubleshooting guide for interventionalists

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Learning objectives: 1. To review the potentials complications related to port-catheter device implantation with illustrated clinical cases. 2. To explain and illustrate the management of non-infectious complications with emphasis on the role of image-guided techniques. 3. To review the reported data in the literature.
Background: Port-catheter devices are generally associated with fewer infectious complications compared to external catheters, allowing unrestricted mobility and greater freedom in choice of activities. However, these devices have non-infectious complications related to the time of insertion and maintenance. The complications include fibrin sheath formation, catheter kink and dislodgement, port malfunction, device migration, device thrombosis, skin necrosis with port protrusion and device fragments retain. Interventional radiologists have the unique advantageous technique of combining real-time sonographic and fluoroscopic guidances to implant the port-catheter device and manage its complications with image-guided techniques.
Clinical Findings/Procedure Details: The poster will provide an illustrated overview of different non-infectious complications of port-catheter devices that may encountered after implantation. The prevention and management will be discussed based on interventional radiology perspectives with emphasis on the image-guided techniques.
Conclusion: Understanding the potential complications associated with implantation of port-catheter devices for venous access is essential for interventional radiologists and health care practitioners. Image-guided techniques have an important role in the prevention and management of these complications effectively and safely.

P-44

Vascular access in dialysis patients: what a junior interventional radiologist should know

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Learning objectives: To provide an overview of how to establish a vascular access in a patient with end stage kidney disease. To review the causes of vascular access dysfunction pertinent to interventional treatment. To learn tips and tricks. To learn how to avoid or face complications. To learn which tools you always need to have in your department's shelves.
Background: The management of vascular access dysfunction in dialysis patients consists a significant part of the daily practice of an interventional radiology department. There is the need, especially for the junior doctors, to identify and comprehend the nature of vascular access pathology in dialysis patients, for the planning of the treatment strategies, to assess the techniques, results and complications of interventional procedures.
Clinical Findings/Procedure Details: The literature and our department's experience of >300 procedures will be reviewed to provide information on the technique, the results and complications of interventional treatment in this patient group.
Conclusion:
- Venous anastomotic stenosis is the commonest cause of vascular access dysfunction.
- Balloon angioplasty is usually all that is needed, but in some cases cutting balloons, stents and stent-grafts are required to achieve immediate and long-term patency.
- Interventional procedures increase the patency rates of the vascular access in dialysis patients.

P-45

Peripherally inserted central catheter (PICC): insertion techniques and new developments

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Learning objectives: Based on experience, this educational poster exhibit reviews the different types of PICCs, clinical indications, complications as well as new upcoming developments. A specific regard is given to the description of the insertion procedure step-by-step.
Background: During the last decade, technical improvement in peripherally inserted central catheter (PICC) allows a significant increase of using these catheters in various clinical indications, particularly in Europe. More than 1500 PICCs were implanted between 2005 and 2010 in our department. The radiologist should play a major role in PICC insertion and management.
Clinical Findings/Procedure Details: The main indications are extended antibiotic therapy, chemotherapy, nutrition, administration of blood or poor venous access. PICC insertion is a sterile procedure using US guidance for a peripheral vein puncture in the upper arm. Fluoroscopy confirms the correct placement of the tip of the PICC, which is usually in the distal superior vena cava. Common complications are infection such as phlebitis, thrombosis of the vein, catheter malposition or breakage. Product advancement in PICCs includes multiple lumens for multiple access, PICCs for neonatal use, cardiac monitoring of central venous pressures as well as new advances for placement (use of electromagnetic visualization).
Conclusion: New areas of development improve actual products and techniques and since PICC promotes patient comfort and outpatient treatment their placement should be a significant activity in interventional radiology.

P-46

Maintenance of radiocephalic fistula by collaterization of ulnar artery flow across the palmar arch in patients with radial artery occlusion: report of 3 cases

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Fistulogram revealed collaterization of ulnar artery flow across the palmar arch and occluded radial artery in 3 patients with radiocephalic fistula. Balloon dilation of the stenosis between cephalic vein and reconstituted radial artery was successfully performed in all 3 patients.

P-47

24-Hour pericatheter TPA infusion to aid removal of adherent peripherally inserted central venous catheter

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A 56-year-old male presented with thrombus surrounding a basilic vein PICC. The catheter could not be removed due to thrombus adherence. An infusion catheter was positioned within the pericatheter thrombus and TPA administered x24hrs. The line was easily removed subsequently.

P-48

Totally ultrasound-guided insertion of an amplatzer vascular plug to occlude a dialysis AV fistula

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Successful embolisation of a dialysis brachio-cephalic fistula for significant steal in a patient with severe contrast allergy performed solely under ultrasound control.

P-49

A cautionary tale of arteriovenous fistula (AVF) stenosis venoplasty when treating concurrent proximal and central lesions

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WITHDRAWN

Embolotherapy (excluding oncology)

P-50

Can angina or myocardial infarction be symptoms of paradoxical emboli due to pulmonary arteriovenous malformations in patients with hereditary hemorrhagic telangiectasia?

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Purpose: To explore whether pulmonary arteriovenous malformations (PAVMs) may be the source of angina-like symptoms in HHT patients without known coronary artery disease. In theory, a paradoxical embolus to a coronary artery could cause myocardial ischemia or infarction; this phenomenon has been described in other right-to-left shunts.
Material and Methods: Patients with confirmed or probable HHT and PAVMs followed at a large HHT center were contacted by telephone; verbal consent was obtained. Patients were asked about chest pain symptoms before and after PAVM embolization, post-procedure hospitalizations, myocardial infarctions (MI) and/or coronary artery disease (CAD) and history of cardiac catheterization. CAD risk factors, including family history, high cholesterol and/or blood pressure, diabetes, and smoking were determined. 84 patients with at least one treated PAVM and 14 patients with HHT and tiny untreated PAVM were included, mean age 45 (range, 3-85).
Results: No patient declined participation. 6/98 patients had experienced typical angina-like chest pain. 3 of these had had a myocardial infarction prior to PAVM embolotherapy; 5 had had cardiac catheterization. Of these, 4 had normal cardiac catheterizations, and 1 had single vessel occlusion with otherwise normal coronary arteries. 1 patient had a normal EKG at the time of her chest pain; she did not experience an MI and did not undergo cardiac catheterization. 1 patient with atypical symptoms had a negative cardiac catheterization.
Conclusion: Our results suggest that angina and/or myocardial infarction can be a symptom of paradoxical emboli in patients with PAVMs: 3% (3/98) of our patients had completed MI with normal coronary arteries; an additional 3% have highly suggestive histories. We believe cardiac events should be added to the list of symptoms of paradoxical emboli potentially associated with PAVMs.

P-51

Prostatic arterial supply: anatomical and imaging findings

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Purpose: To describe the anatomy and imaging findings of the prostatic arteries (PAs). To identify the main anatomical patterns and variations of the PAs.
Material and Methods: From March 2009 to December 2010, 63 male patients (126 pelvic sides) underwent pelvic angio CT and selective pelvic arterial angiography before prostatic arterial embolization (PAE) for benign prostatic hyperplasia (BPH). PAs were classified on each pelvic side based on the number of vascular pedicles, their origin, trajectory, termination and anastomoses with adjacent arteries.
Results: In 56.3% (n=71) there was only one PA, while in 43.7% (n=55) two independent PAs were identified on each pelvic side, with a total of 181 PAs. In 39.7% (n=72) the PAs originated from the internal pudendal artery; in 21% (n=38) from the anterior common gluteal-pudendal trunk; in 18.2% (n=33) from the superior vesical artery and in 12.1% (n=22) from the obturator artery. Rare origins were from the inferior gluteal artery (3.9%; n=7); rectal branches (1.7%; n=3); superior gluteal artery (1.7%; n=3) and accessory pudendal artery (1.7%; n=3). In 42.1% (n=53) of cases no significant anastomoses were identified, while in 57.9% (n=73) anastomoses to adjacent arteries were documented: internal pudendal arteries (41.6%); contra-lateral (18.2%) and ipsilateral (11.7%) prostatic branches; rectal arteries (15.6%) and vesical arteries (12.9%).
Conclusion: PAs almost always arise from the internal pudendal artery, anterior common gluteal-pudendal trunk, superior vesical artery or obturator artery. The number of independent vascular pedicles and the presence of anastomoses with surrounding arteries should be taken into account when planning PAE.

P-52

Emergency bronchial artery embolization for massive hemoptysis

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Purpose: To present our experience of emergency bronchial artery embolization to treat massive hemoptysis along with the results of follow up over 3-year period.
Material and Methods: Between January 2007 and May 2010, 69 patients underwent emergency bronchial artery embolization to treat massive hemoptysis in our division. Preoperative conservative management, chest computerized tomography, angiographic findings, endovascular procedures, morbidity and mortality and follow up outcomes were retrospectively reviewed.
Results: Preoperative thorax computerized tomography revealed abnormalities in all our patients, with nonspecific findings in 14 patients. Technical success rate was 98.6% (68/69). Clinical failure was met in 2 patients. Recurrence of hemoptysis was encountered in 12 patients (recurrence rate 21%).
Conclusion: Emergency bronchial artery embolization is a safe and effective nonsurgical therapy to treat massive hemoptysis with sufficient preoperative workup. The mid-term result of emergency bronchial artery embolization is satisfactory.

P-53

Epoxy embolization to augment surgical resection: a novel approach to the treatment of venous malformations of the forearm and hand

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Purpose: Typical management of venous malformations (VMs) of the hand and forearm includes either embolization/sclerosis or resection. Ethanol-based sclerosis can lead to nerve deficits, strictures, and contractures. Surgical resection can minimize these complications, but lesion localization and decompression make resection challenging. We present the use of pre-operative percutaneous epoxy embolization prior to surgical resection to minimize these challenges.
Material and Methods: We present 11 patients who underwent 14 VM resections of the hand/forearm after pre-operative embolization (27 sites) using either n-Butyl-Cyanoacrylate (n-BCA) or Onyx. Malformations were analyzed on pre-procedural MRIs. Surgical outcomes were based on operative notes and clinical follow-up.
Results: Age range was 2-47 years (mean 17). Lesions were found in the following locations: hand (10), wrist (3), forearm (8), around the elbow (6). Mean lesion volume was 9.44 cc (0.95-43.5cc; n=21). There was nerve involvement in 75% of lesions (18/24), and tendon involvement in 25% (6/24). 25% (6/24) of the lesions were subcutaneous, 29% (7/24) were both subcutaneous and intramuscular, 29% (7/24) were intramuscular, and 17% (4/24) were both intramuscular and peri-osseus. Some lesions could not be assessed for volume (6) and or for nerve/tendon involvement (3) due to poor MRI quality. 8 lesions were injected with n-BCA (mean volume injected 2.40cc) and 19 with Onyx (mean volume injected 3.92cc). In all cases pre-operative embolization made localization, demarcation, and removal of the malformation easier/more effective. In all cases there was complete resection of the malformations with no long-term morbidity. To date 2 of the treated lesions recurred.
Conclusion: Pre-operative epoxy/Onyx-embolization of VMs of the forearm/hand may improve treatment outcomes by facilitating localization and stability during resection, and by avoiding the complications of standard sclerosants.

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Transcatheter arterial embolization for pelvic fractures with retroperitoneal hemorrhage: involvement of external iliac artery branches

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Purpose: To investigate the characteristics and outcomes of patients who underwent urgent transcatheter arterial embolization (TAE) for pelvic fractures with retroperitoneal hemorrhage.
Material and Methods: We retrospectively reviewed 33 patients who received TAE for retroperitoneal bleeding due to pelvic fractures from April, 2009 to December, 2010. The distribution of the arterial injuries was identified by angiography review. Injury severity score (ISS), the response to fluid resuscitation, the time between the injury and the start time of the procedure, arterial injuries outside the pelvis, injuries to branches of the external iliac artery (EIA) and mortality were evaluated. Two patients in whom follow up was

impossible were excluded from the survival analyses.
Results: Hemodynamically stabilization was obtained in all cases. Twenty-four patients (77.4%) survived to discharges. The bleeding vessels were identified in 30 patients (90.9%) by angiography; the obturator arteries were mostly injured in 26 sites of 20 patients (60.6%). The obturator arteries arised from the EIA were found in three sites of two patients. Extravasations were observed in the branches of the EIA: deep circumflex iliac artery (3 sites/3 patients); medial femoral circumflex artery (5 sites/4 patients) and others. Eleven branches of the EIA were embolized in 10 patients (30.3%). The significant correlation was only shown between the procedure time and mortality in the survival analyses (p=0.03).
Conclusion: TAE was an effective therapeutic approach for pelvic fractures with the arterial injuries. The obturator artery was often injured, and the contributions of the external iliac artery branches were found in one-third patients. The factors associated with the prognosis were uncertain enough, but it may be important that we accomplished a procedure as quickly as possible.

P-55

Embolization of anticoagulation-related soft tissue bleeding: immediate results

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Purpose: To evaluate the efficiency of embolization in the management of anticoagulation-related soft tissue bleeding (AcSTB).
Material and Methods: Between June 2001 and June 2010, all consecutive patients who underwent embolization for AcSTB in our department were included. All patients were treated by oral anticoagulation (n = 13), or heparin (n = 22). Patient features were as follows (n=35): mean age 74 y.o; women/men =65/35%; mean initial hemoglobin/prothrombin time =8 g/dl / 46%. CT scans was performed before embolization in all patients in order to confirm the diagnosis, appreciate the topography of the hematoma and search for active bleeding. Global angiography was followed by super selective catheterization of the bleeding artery and subsequent embolization was performed. In case of normal angiogram, the arteries feeding the anatomic compartment of the hematoma were empirically embolized. Clinical success was assessed as one month survival.
Results: In all patients but 7, angiography demonstrated active bleeding (n=24), pseudo-aneurysm (n=2), hypervascular blush (n=2). Embolization material used was: gelfoam (n=26), coils (n=7), calibrated microparticles (n=4), covered stent graft (n=2). Embolized arteries were: lumbar (n=15), inferior epigastric (n=10), deep circumflex iliac (n=7), ilio-lumbar (n=5), superficial femoral (n=1), deep femoral (n=1), iliac (n=1), lateral thoracic (n=1). One-month survival was 68.6% (24/35), comprising 4 cases of early re-embolisation. Half of the death were related to uncontrollable bleeding. Mean IGSII score was higher in patient who ultimately died (74.3 versus 31.4 ; p = 0.004).
Conclusion: AcSTB can be efficiently treated by embolisation, however rebleeding is not uncommon.

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Post-partum hemorrhage gelfoam mixture embolization with super selective technique immediate results and 1-month MRI follow-up

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Purpose: To evaluate the efficacy and impact of super selective embolization of the uterine arteries in the management of post-partum hemorrhage.
Material and Methods: Between Nov. 2004 and Jan 2011, 44 consecutive women (mean age 34,2 y.o.+/- 3 (range 23 – 41)) were referred for post-partum hemorrhage management. All were embolized with a super selective technique: 2.7 Fr micro-catheter placed deep into the uterine arteries upstream the cervico-vaginal arteries ostium. The embolic agent was a mixture of contrast medium and 5/5cm pieces of gelfoam (Gelita-Spon TM) modified into a gelatin emulsion as follows: rapid mixing through a 3-way stopcock using 2 syringes. 1 month after the embolization all patients underwent MRI/MRA and clinical examination.
Results: Technical and clinical success was 100%. 35 patients had a bleeding related to poor uterin retraction, 7 patients because of cervix tear, and 2 of vaginal hematoma. Pre- and postembolization blood red cell transfusion units were 3.84 U. 1-month. MR follow-up showed no sign of ischemic myometrium, necrosis, uterine rupture or pelvic vein thrombosis. Incidental findings were 2 intramyometrial hematic collections and 15-endocavity sero-hematic collections. All uterine arteries were patent. 17 patients had concomitant fibroids that all appeared hypovascular.
Conclusion: This technique allows to achieve good clinical result with no significant damage to the uterine arteries or uterus itself.

P-57

Active diffuse renal cortical haemorrhage in setting of subcapsular hematoma: an entity scarcely described

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Purpose: To describe the radiological findings observed in patients with renal subcapsular hematoma and active multifocal bleeding or the renal cortex and to discuss the proposed mechanism for this complication.
Material and Methods: Seven patients that presented with subcapsular renal hematoma and multiple foci of active bleeding were reviewed. 5 had interventions (3 nephrostomy and 2 percutaneous biopsies). Another patient had a neuroendovascular intervention through a femoral approach. The remainder, under antiplatelet therapy, developed spontaneous renal hematoma. CT and angiography were performed in all cases.
Results: 6 of 7 patients had CT evidence of multifocal active cortical bleeds with subcapsular hematoma. Angiography confirmed the CT findings for all patients, which appeared not related to previous intervention. Selective embolization was performed in one patient. In the remaining 6 patients selective embolization was unsuccessful in hemorrhage control, resulting in the need for nonselective embolization with subsequent organ loss.
Conclusion: Multiple foci of active renal cortical hemorrhage may be seen in some cases of subcapsular hematoma, unrelated to previous site of puncture. These are likely a result of rupture of perforating arteries from expanding subcapsular hematomas. This entity must be taken into account due to the important clinical implication and high risk of organ loss.

P-58

Use of Onyx in the treatment of endoleaks following endovascular aortic aneurysm repair

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Purpose: To describe the use of Onyx in the treatment of Type II endoleaks following endovascular repair of abdominal aortic aneurysms.
Material and Methods: Since July 2006, a total of twelve patients with abdominal aortic endografts have been treated with Onyx-18 (ethylene-vinyl alcohol copolymer) for embolization of a type II endoleak. The Onyx was delivered using co-axial 3Fr microcatheter technique. In three patients only Onyx was used, in two it was used in conjunction with microcoils and in the remainder used in conjunction with Embospheres.
Results: The majority of the endoleaks were from hypogastric-iliolumbar-lumbar artery collaterals. In two patients the leak was from the inferior mesenteric artery. Three patients required more than one treatment; however, the time for retreatment varied from 2 years in two patients to three years in another. The remaining patients required only one treatment. The endoleaks were successfully occluded using the Onyx-embolic treatment. In the patients who returned for additional treatment, the Onyx occlusion was seen to be permanent. There were no major complications with Onyx.
Conclusion: Onyx is a useful permanent embolic agent for the transcatheter treatment of aortic endoleaks.

P-59

Coil embolizations in animal model: comparative study among devices currently available for peripheral applications

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Purpose: Comparative 3 different coil embolic agents in a swine model. The goal is to evaluate if there are technical, angiographic and pathologic differences among them.
Material and Methods: Four Yucatan pigs were used as animal model. Under general anesthesia and fluoroscopic guidance, selective embolizations of one kidney (upper, middle and lower branches) were performed using three different coils (Azur - Terumo Medical; Nester coils – Cook Medical; Interlock – Boston Scientific) and then evaluated one immediately, one at 30, one at 90 and the last at 120 days. The embolic agents were used in a standardized fashion, the procedures were videotaped, and pre- and post-procedure angiographies and post-euthanasia pathology analysis were pooled together to evaluate variables: in vivo evaluation of coil stability, embolization efficacy, recanalization rate, grade of kidney necrosis and inflammatory response, time to obtain hemostasis and number of coils necessary for complete embolization. The contra-lateral kidney (not embolized) was used for control.
Results: The results of the analyzed variables are going to be presented, including pre- and post-angiographic and videotaped findings and the final pathologic analysis from each end-point.
Conclusion: The conclusion will address if there are differences among these coils for embolization procedures.
Disclosure: Consulting position: - Cook Medical - Terumo Interventional Systems

P-60

Strategies for endovascular management of visceral aneurysms and pseudoaneurysms

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Purpose: To present the endovascular experience in percutaneous treatment of visceral aneurysms and pseudoaneurysms in a period of thirteen years from 1997 to 2010.
Material and Methods: In all 40 patients were treated: they were divided into 18 aneurysms and 23 pseudoaneurysms (27 males and 13 females, mean age: 58 years) 26 vascular lesions underwent percutaneous treatment in emergency and 15 lesions occurred in occasional radiological diagnosis. In 27 aneurysms/pseudoaneurysms were used coils: 6 cases (4 used Guglielmi Detachable Coil) had profit by direct embolization of the sac and 21 cases had embolization on either side of the lesion with 'sandwich technique' to prevent retrograde filling. In 14 aneurysms/pseudoaneurysms were used stents: 1 self-expanding stent, 3 self-expanding stents in association with coils, 9 stentgrafts, 1 stentgraft with coils embolization. A radiological follow up was performed using angio-CT at 12-48 months.
Results: Technical success was achieved in 37 patients (16 aneurysms and 22 pseudoaneurysms), in 4 cases an incomplete exclusion of the sac was just obtained. In emergency regimen the exclusion of the aneurysm was obtained with an immediate stop of bleeding. In 1 case splenectomy was necessary for subsequent splenic ischaemia, in 2 cases splenic micro infarctions solved spontaneously with a 'restitutio ad integrum'.
Conclusion: The endovascular techniques are the first choice approach in emergency patients with bleeding aneurysms and in routine setting. The percutaneous treatments perform a profitable option to surgery for the low risks and lower economic hospital burden.

P-61

Report of our results of systemic artery embolization with Embozene to control hemoptysis

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Purpose: Report of our results of systemic artery embolization with Embozene to control hemoptysis.
Material and Methods: We reviewed patients treated by Embozene to control hemoptysis during 13-month period (January 2010 to January 2011). Clinical charts, hemoptysis amount, endovascular treatment approach (size of particles, size of microcatheter, anastomosis), short-term results (one month), and the cause of failure or recurrence were recorded.
Results: Eighty-six patients (59 males; 27 females; mean age: 52.1 yrs old) were treated for hemoptysis (n=24, volume 100 to 200mL; n=10, chronic hemoptysis; n=52, volume >200mL). The etiology of hemoptysis was cryptogenic (n=14), active tuberculosis (n=6), sequelae of tuberculosis (n=8), aspergilloma (n=8), lung cancer (n=16), Bronchiectasis (n=22), and others (n=12). Progreat 2.7 permit the administration of Embozene 1300µ, and 1100µ in, respectively, 10 and 5 patients. Progreat 2.4 permit the administration of Embozene 1100µ and 900µ in, respectively, 30 and 21 patients. Because occlusion of the origin of bronchial arteries, embolization through anastomosis was required, it was possible in all the 7 patients. Hemoptysis was controlled in all patients but six (missed bronchial and nonbronchial systemic artery (n=4), and pulmonary artery injuries (n=2)). The success rate at one month was 95%.
Conclusion: Embozene is effective to control hemoptysis. Deformability permits the administration of large particles through microcatheter and anastomosis. Pay attention to the non-targetable arteries.

P-62

Onyx embolic agent preparation, tips and tricks and how to avoid complications during peripheral embolization procedures

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Purpose: Onyx is rarely used in the peripheral embolization procedures. Here is presented technical details, tips and different applications of Onyx in several peripheral embolization procedures.
Material and Methods: Onyx with densities 18 and 34 were used in 14 peripheral embolization procedures (4 visceral and 1 leg aneurysms, 6 AAA endoleaks type 2, 2 in splenic and 2 in liver haemorrhages). Technical details such as microcatheter selection, stable position, Onyx manipulation, the formation of the "plug" in the tip of the microcatheter and "remodelling technique" for flow control with balloon catheter will be presented.
Results: Technical success was 100%, no complications were observed during the follow-up. There was no evidence of lesions recurrence. Onyx embolization was effective in the exclusion of a profunda femoris and renal arterial aneurysms when remodelling technique was used (balloon catheter inflated to close the aneurysm neck), as well as in the control of solid organs (liver and spleen) bleeding and in the treatment of endoleaks type 2 (using remodelling technique and direct aneurysm sac puncture approach). Onyx could be more popular if there is reduction of costs.
Conclusion: Onyx is an excellent tool for the embolization of peripheral vascular lesions, there is low risk of complication when appropriate technique is used. Specific skills and cost are still limiting factors for not using this good embolic device more often.

P-63

The use of Amplatzer Vascular Plug 4 in emergency bleeding

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Purpose: To describe the use of Amplatzer Vascular Plug 4 (AVP 4) in vascular embolization for emergency bleeding.
Material and Methods: The AVP 4 (as a single device) was used from August 2009 to December 2010 for vascular embolization in nine patients with active bleeding: renal pseudoaneurysm (n = 2), post-surgical peritoneal bleeding (n = 3), post-traumatic gluteal hemorrhage (n = 2), post-traumatic spleen hemorrhage (n = 1) and deep circumflex artery pseudoaneurysm (n = 1) . Occlusion time was recorded. Patients were followed up clinically and by imaging at least for 3 months after the procedures.
Results: All treated vessels were successfully occluded within 3 min for low-flow circulation and over 8 min for high-flow circulation. On follow-up, all patients were symptom free. All deployed devices remained in the original locations and in desirable configurations.
Conclusion: The AVP 4 seems to be safe and effective for occluding bleeding peripheral vessels in an emergency. Because of its compatibility with 0.038 in. catheters, it can be deployed through a diagnostic catheter following angiography without exchanging a sheath or guiding catheter. AVP 4 allows for fast procedure times and decreased exposure to radiation.

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Accessory pudendal arteries: what is in the name? Relevance for prostatic arterial embolization

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Purpose: To compare the prevalence of accessory pudendal arteries (aPAs) using two different definitions in patients undergoing prostatic arterial embolization (PAE) for benign prostatic hyperplasia (BPH).
Material and Methods: From March 2009 to December 2010, 126 male pelvic sides were studied by angio-CT and selective arterial angiography. Definition 1 of aPAs was any artery located within the periprostatic region running parallel to the dorsal vascular complex. Definition 2 considered only those aPAs that terminate as the dorsal artery of the penis.
Results: Using definition 1 the prevalence of aPAs was 21.4% (n=27), while it was 3.2% (n=4) using definition 2. aPAs could be sub classified as lateral in 77.8% (n=21), coursing along the lateral aspect of the prostate and apical in 22.2% (n=6), emerging near the prostatic apex. All aPAs in definition 2 were lateral. When definition 1 is used, the dorsal artery of the penis usually arises from the internal pudendal artery, and the lateral aPAs appear as an anastomotic arch, allowing careful embolization. When definition 2 is used, the internal pudendal artery has a proximal termination, with the dorsal artery of the penis arising from the aPAs. In these cases, the prostatic branches must be selectively embolized to maintain the patency of the aPAs.
Conclusion: The variable prevalence and clinical relevance of aPAs are probably associated with its definition. aPAs closer to prostatic arteries (lateral) that are solely responsible for arterial blood supply to the corpora cavernosa (definition 2) must be considered before PAE (3.2% of cases).

P-65

Selective arterial embolization performed for recurrent hemarthrosis

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Purpose: The aim of this study was to evaluate feasibility and safety of selective arterial embolization for recurrent hemarthrosis.
Material and Methods: Five transcatheter arterial embolizations for recurrent hemarthrosis were performed on four patients (4 females; mean age, 76.3 years) between May 2009 and October 2010. Selective arterial embolization of the feeding artery was done by using a 2.5-Fr microcatheter and 1-mm gelatin particles were used as embolic material.
Results: The catheter was inserted from the contralateral femoral artery in two cases, and from the ipsilateral femoral artery in three cases. In one of the two cases when the catheter was inserted from the contralateral femoral artery, all feeding arteries could not be selected; therefore, an additional transarterial embolization was performed from the ipsilateral femoral artery on another day. In all cases, angiography showed staining around the knee joint and no vascular malformation, aneurysm, or angioma was identified. The

feeding arteries were the lateral superior genicular artery in four patients, the lateral inferior genicular artery in three, the medial superior genicular artery in one, the medial inferior genicular artery in one, the middle genicular artery in one and the descending genicular artery in one. In all four patients, the transcatheter arterial embolization was completed and significant diminishment of the staining around the knee joint was obtained. No complication was observed. The hemarthrosis improved after the embolization, and the postoperative course was uneventful with no recurrence of hemarthrosis in all patients.
Conclusion: These results suggest that selective arterial embolization for recurrent hemarthrosis is safe and useful.

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Transcatheter arterial embolization of acute gastrointestinal bleeding with N-butyl cyanoacrylate

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Purpose: To assess the clinical usefulness of transcatheter embolization with n-butyl cyanoacrylate (NBCA) for the treatment of acute gastrointestinal (GI) bleeding.
Material and Methods: We retrospectively studied the outcomes of 23 patients who underwent emergency transcatheter embolization for acute GI bleeding. They consisted of 17 men and 6 women and their mean age was 70.0 years. Bleeding was from the left gastric artery (n = 4), right gastric artery (n = 4), right colic artery (n = 4), pancreaticoduodenal artery (n = 2), ileocaecal artery (n = 3), gastroduodenal artery (n = 2), jejunal artery (n = 1), ileal artery (n = 1) and branch of IMA (n = 2). Cause of bleeding was related to peptic ulcer (n = 7), colon diverticulum (n = 6), ruptured pseudoaneurysm (n = 6), GI neoplasms (n = 3) and AVM (n = 1). Of the 23 patients, 15 patients showed hemodynamic instability and 4 patients had coagulopathy. Six patients underwent coil embolization prior to NBCA administration for flow control. Outcomes including hemostasis, recurrent bleeding and complications were evaluated.
Results: Successful embolization was achieved in all cases. Bleeding was stopped and immediate hemodynamic stabilization was exhibited in all cases after embolization. Although one patient with ruptured pseudoaneurysm died within 30 days because of multi-organ failure, rebleeding was observed in none of the patients. There was no major complication in all cases; neither end-organ damage nor organ ischemia related to the procedure was observed except for two cases of asymptomatic gastric ulcer formation.
Conclusion: NBCA embolization is a feasible technique for acute GI bleeding and it can prevent recurrent bleeding with a low risk of critical gastrointestinal ischemia.

P-67

Abdominal wall hemorrhage: the utility of abdomen computed tomography and embolotherapy

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Purpose: To evaluate the diagnostic value of computed tomography(CT) and therapeutic efficacy of the embolotherapy in patients with abdominal wall hemorrhage.
Material and Methods: We reviewed the charts and radiologic images of all patients with abdominal wall hemorrhage consecutively registered at our institution between May 2004 and December 2010, retrospectively. The inclusion criteria were as follows: development of abdominal wall hemorrhage during anticoagulation therapy; spontaneous origin of abdominal wall hemorrhage without apparent trauma; and hemorrhage considered clinically relevant, that is, associated with arterial hypotension necessitating fluid resuscitation or with persistent bleeding despite reversal of anticoagulation status. Sixteen women and two men were included and the mean age was 53 years (range, 30-77 years). These patients except for two were performed contrast-enhanced CT scan before treatment of embolotherapy. Injured arteries were treated with transcatheter embolization in fifteen and percutaneous thrombin injection in three.
Results: The cause of the abdominal wall hemorrhage was surgical trauma, paracentesis, percutaneous catheterization, fall down, spontaneous hemorrhage in 9, 4, 3, 1, and 1 patient, retrospectively. The hemorrhage was manifested as contrast leakage and pseudoaneurysm in 15 and 3 patients on CT examination, respectively. The technical success and clinical success rates of the embolotherapy were 100% and 94%, respectively. One patient who had a severe coagulopathy continued bleeding despite no active bleeding on repeated angiography.
Conclusion: CT imaging could play a significant role in shortening the process of embolotherapy by identifying the site of extravasation or pseudoaneurysm before embolotherapy. And the embolotherapy for treatment of abdominal wall hemorrhage is highly successful and relatively safe.

P-68

Role of angioembolization in endoscopically unmanageable non variceal upper gastrointestinal bleeding

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Purpose: The aim of this study was to evaluate the efficacy of endovascular embolization in patients with endoscopically unmanageable acute nonvariceal upper gastrointestinal bleed and to study the parameters affecting the outcome of angioembolization.
Material and Methods: 32 patients with signs and symptoms of non variceal upper gastrointestinal bleed were followed up retrospectively and prospectively. Clinical data for each patient was recorded from medical records. Angioembolization was done using coils and gelfoam. Post procedure follow-up was done and the effect of various parameters like coagulopathy, sepsis and multiorgan failure on the outcome of angioembolization was studied.
Results: Angioembolization is the management of choice in endoscopically unmanageable non variceal upper gastrointestinal bleeding. 32 patients were examined during a period extending from 2007 to 2010. 71.8% of patients presented with either hematemesis or malena. Embolization was done using sandwich technique. Coagulopathy (seen in 47% of patients), had a significant effect on survival (p=.015). Post procedure complications were divided into rebleed, technical problems and ischemia. Rebleed was seen in 3 patients, technical problems in 1 patient, ischemia in 2 patients in form of splenic ischemia and dissection of celiac artery in 1 patient. Clinical success was seen in 30 patients (n=30) (93.7%).
Conclusion: Transcatheter embolisation is a safe and effective procedure and involves no risk of ischaemic complications. Angiographic embolization is a viable option in poor candidates for surgery. It has the potential to reduce mortality in acute non variceal upper gastrointestinal bleeding provided we continue our efforts to optimize the occlusive technique and enhance the hemostatic effects.

P-69

Superselective embolization of the delayed bleeding after endoscopic sphincterotomy: feasibility and outcome

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Purpose: We retrospectively evaluated the feasibility and outcome of the superselective embolization of the delayed bleeding after endoscopic sphincterotomy.
Material and Methods: We reviewed the records of the nine patients who had delayed post-sphincterotomy bleeding and underwent superselective embolization from 2002 through 2008. We analyzed the endoscopic procedures, the delay time of the bleeding, underlying clinical condition of the patients, the angiographic findings, the interventional procedures, and the outcome.
Results: All patients underwent sphincterotomy with needle knife sphincterotomy (n=3) and standard sphincterotomy (n=6). The delay of the bleeding time was from one day to eight days (3±2.4). The coagulopathy was found in three patients. Embolization was performed in all patients. In seven patients, the source of the bleeding was clearly identified and superselectively embolized. In two patients, the source of the bleeding was not clearly identified and embolization was done for pancreaticoduodenal arcade. Bleeding was stopped in all patients immediately after embolization. In one patient, bleeding was recurred and re-embolization was performed after five days. Six patients had no bleeding until discharge. Two patients expired due to septic shock.
Conclusion: Superselective embolization is feasible and effective hemostatic procedure for the delayed postsphincterotomy bleeding.

P-70

Role of endovascular treatment of pelvic fractures bleeding in emergency setting

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Purpose: The aim of this study is to evaluate the role of endovascular treatment in controlling active bleeding, false aneurysm or vessel occlusion in politrauma patients with pelvic vascular injuries with or without associated fractures of the pelvis.
Material and Methods: From March 2009 to April 2010, 36 patients (25 men - 11 women) with major pelvic trauma associated with high-flow hemorrhage were referred to our emergency department. All patients underwent CT examination. Vascular injuries were in 11 of the cases superior gluteal artery, 5 of lateral sacral artery, 7 of internal pudendal artery, 2 lumbar artery, 4 of common femoral artery, 1 of external iliac artery, 1 of inferior gluteal artery, 2 of obturator artery and 3 cases of the hypogastric artery. In 34 cases embolization was performed using steel coils and in 2 cases bleeding was treated using a stentgraft. Multiple small distal bleeding sites were embolized with Gelfoam suspension.
Results: The technical success rate was 100% documented at post-procedural angiography; no complications occurred during the procedures. Clinical efficacy was 100%; in fact, none of the patients had to undergo repeat arteriography due to the recurrence of hemorrhage. 34 pts had a stabilization of vital parameters. Two patients died.
Conclusion: In our study, percutaneous control of pelvic hemorrhages was shown to be a valuable therapeutic option: transarterial embolization is a rapid, safe, effective and minimally invasive technique, features that make it very useful in this setting, where the clinical course and prognosis are related to the achievement of hemodynamic stability.

P-71

Embolotherapy of pulmonary arteriovenous malformations: venous sac embolization using detachable coils under blood flow control with balloon catheter

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Purpose: To evaluate the effectiveness and the safety of venous sac embolization using detachable coils under blood flow control with balloon catheter for treatment of pulmonary arteriovenous malformations (PAVMs).
Material and Methods: Between 1998 and 2010 venous sac embolization was performed for treatment of 18 PAVMs in 9 patients (4 male, 5 female; mean age 49.2 years). Pulmonary arteriogram was initially performed. Then a microcatheter was advanced into the venous sac of PAVMs through the balloon catheter coaxially. Venous sac embolization was performed using Guglielmi detachable coils or interlocking detachable coils under blood flow control with balloon catheter. After venous sac was packed with detachable coils, fibered platinum coils were also deployed in the feeding arteries.
Results: All PAVMs were successfully embolized without any serious complications such as systemic migration of coils. Even if the feeding artery was small and tortuous, the microcatheter was advanced into all venous sacs successfully. With use of balloon catheter and packing of venous sac with detachable coils, systemic migration of coils was reliably prevented. The only complication was transient hemisensory disturbance in one patient. The symptom was resolved conservatively. In all patients, the arterial oxygen pressure was raised and the arteriovenous shunt ratio was decreased on RI scintigraphy. No clinical symptoms of recurrence were observed in all patients during the mean follow-up period of 29.7 months.
Conclusion: Venous sac embolization using detachable coils under blood flow control is an effective and safe procedure especially in the case of large venous sac with tortuous and short feeding artery.

P-72

Endovascular treatment of large pulmonary arteriovenous malformations with Amplatzer vascular plug

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Purpose: To describe endovascular treatment of large pulmonary arteriovenous malformations with amplatzer vascular plug.
Material and Methods: Five patients with 7 large pulmonary arteriovenous malformations (PAVM) were treated with Amplatzer vascular plug 1 (AVP1). Pre and postinterventional partial oxygen saturations (PaO2) were recorded. The patients were followed up with CT examinations. Pre and post interventional aneurysm sac diameters, sac perfusion, sac shrinkage or complete resolutions were analysed.
Results: There were 86% simple and 14% complex PAVMs. Mean follow-up period was 29.33±10.63 (between 16-40) months. Mean largest preinterventional sac diameter was 47.85± 8.76 (between 40-62) mm. Mean pre and post interventional PaO2 was 83.71±8.10 (between 75-92)% and 96.28±0.49 (between 96-97)%. In the postinterventional period there were no persistent sac perfusions and recanalizations. All PAVMs were shrinked and 86% were completely resolved.
Conclusion: Endovascular treatment of large pulmonary arteriovenous malformations with Amplatzer vascular plug I is a safe and effective method.

P-73

Clinical result of bronchial artery embolization in cystic fibrosis patients with hemoptysis: a single centre experience

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Purpose: Chronic recurrent hemoptysis, refractory to medical therapy, is a common complication in cystic fibrosis patients that affects the quality of life. To evaluate the medium-long term clinical result of bronchial artery embolization (BAE).
Material and Methods: From 2006 to 2010 we consecutively treated with BAE 23 patients (mean age 26, range 16-42) with cystic fibrosis and chronic recurrent hemoptysis. All patients were studied preliminarily with angio-MDCT. BAE was performed either with Contour PVA particles (500-1000 micron) or microspheres (500-1200 micron). Clinical result was defined as elimination or significant reduction in the bleeding frequency.
Results: Sixty-four bronchial arteries were identified (mean 3/patient) with a medium diameter of 3.5 mm (range 1,5-8,4). A total of 37 procedures were performed. Medium follow-up was 28 months (range 6-58). The overall clinical result after a medium of 1,6 procedures per patient was 91.3% (21/23 patients). In six patients we embolized all bronchial arteries in one or more sessions, with a clinical result of 100%. Conversely, in patients with embolization of only more pathological and compromised arteries recurrence rate was after first and second partial embolization of 50% (10/20 patients) and 57% (4/7 patients), respectively. There was no procedure-related major complication.
Conclusion: In our experience in patients with complete embolization we obtained a clinical result of 100%, while an overall recurrence rate of 43.47% occurred in those patients in whom embolization was not completed. We think it is better to embolize, in one or more close sessions, all the pathological bronchial arteries to complete treatment and prevent relapse of bleeding.

P-74

Splenic embolization for hypersplenism due to portal hypertension: 18 patients

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Purpose: To assess efficacy and safety of embolisation for hypersplenism caused by portal hypertension, depending on the volume of embolized spleen.
Material and Methods: Between 08/1999 and 10/2009, 18 patients with portal hypertension were embolized for thrombopenia or haemorrhagic syndrome. Fourteen presented portal hypertension due to intrahepatic block (group 1) were treated by parenchymal embolization. Four presented segmental portal hypertension (group 2) were treated by proximal splenic artery embolization. Clinical evolution, platelet count and CT scan were retrospectively analysed. Results were compared in regard to extension of parenchymal exclusion.
Results: Overall success rate was 95%. In the group 1, mean volume of infarcted spleen was 63%. Increase in the mean platelet count at the 6-month follow-up was 232%. It was measured above 80 000/ml in 12 patients at the 1-week follow-up, 13 patients at 1 month and 10 at 6 months. All patients with less than 80 000/ml platelets at 6 months presented less than 50% of infarcted spleen volume. In the second group, mean infarcted volume was 63%. External bleeding episodes stopped and platelet counts above 80000/ml were noted in all patients. Six patients presented subsequent complications: 2 were minor and 4 were major (2 splenic abscesses, 1 respiratory failure associated with ascites and transient ascites with portal vein thrombosis). Infarcted splenic volume in these 6 patients was always equal to or greater than 70%.
Conclusion: Partial splenic embolisation over 50% of splenic volume is an effective treatment for hypersplenism, but carries significant morbidity depending on the volume of embolized spleen.

P-75

Acute lower gastrointestinal hemorrhage: superselective arterial embolization using 0.010-inch detachable microcoils

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Purpose: To evaluate the safety and efficacy of embolization using 0.010-inch detachable microcoils for treating lower gastrointestinal hemorrhage.
Material and Methods: From November 2008 to October 2010, five patients with unsuccessful endoscopic hemostasis for acute lower gastrointestinal hemorrhage underwent transcatheter arterial embolization with 1.7-F microcatheters and 0.010-inch detachable microcoils (six procedures total). We evaluated the technical success, clinical success, and clinical failure rates of the embolization procedures. We also examined the following:
arteries involved in hemorrhage, whether or not superselective catheterization at the bleeding vessel was achieved, vascular calibers of embolized arteries, and the relationship between coagulopathy and embolization efficacy.
Results: We achieved 100% technical success for the six transcatheter arterial embolizations. One patient required embolization twice due to bleeding from different sites, but died of malignant lymphoma. Therefore, the clinical success rate was 80% (4/5) and the clinical failure rate was 20% (1/5). In all procedures, catheterization of the long branch of the vasa recta was possible with a microcatheter; average artery diameter was 0.4 mm. We also achieved high embolization efficacy in patients with coagulopathy. No rebleeding, intestinal ischemia, or necrosis was observed after embolization.
Conclusion: Embolization with 0.010-inch detachable microcoils allows for the use of a 1.7-F microcatheter and thus, the catheterization of the long branch alone of the vasa recta. This increases embolization success rates and decreases complication rates. Our findings suggest that 0.010-inch detachable coils are useful for embolization to treat cases of lower gastrointestinal hemorrhage.

P-76

Hepatic arterial infusion chemotherapy with a coaxial reservoir system: clinical and experimental approach

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Purpose: To evaluate the efficacy of an intra-arterial port catheter employing a microcatheter (i.e., coaxial reservoir) for hepatic arterial infusion chemotherapy.
Material and Methods: Due to the difficulty of implanting conventional reservoirs, coaxial reservoirs were implanted via the femoral artery of 156 patients. We implanted a non-braided 2.7-F microcatheter with a spiral shaped tip, 5-F catheter, and one of two types of port (port A or B). Clinical assessment included evaluation of technical success and complications. Experimental assessment included

evaluation of pressure tolerance/flow rate of ports, and strength of connection between the 2.7 -F catheter and port.
Results: Percutaneous port catheter placement was successful in all patients (100%, n=156). Complications included hepatic arterial occlusion (9.6%, n=15), catheter tip dislocation (1.9%, n=3), catheter occlusion (1.3%, n=2), port breakage (Port A; 1.9%, n=3), wound infection (0.6%, n=1), and disconnection between catheter and port (Port A; 1.3%, n=2). Experimental evaluation of the ports at their maximum load pressure showed that flow of contrast medium (30% dilution) was 1.
53 ml/sec for port A and 2.91 ml/sec for port B. Connection strength was 4.2N between the 2.7-F catheter and port A, and 13.4N between the 2.7-F catheter and port B.
Conclusion: Arterial infusion with a coaxial reservoir system is safe and effective for treating liver malignancies assuming that appropriate devices and procedures are selected.

P-77

Transcatheter shunt occlusion for porto-systemic encephalopathy: interventional management and clinical outcome

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Purpose: To evaluate our clinical outcome of transchatheter shunt occlusion for porto-systemic encephalopathy.
Material and Methods: From November 2003 to August 2010, 16 patients were treated by shunt occlusion for porto-systemic encephalopathy. Mesocaval shunt; 7pts, Paraumbilical vein shunt; 1pt, Spleno-renal shunt (SR shunt); 5pts, gastro-renal shunt (GR shunt); 1pt, SR+GR shunt; 1pt, GR+paraumbilical vein shunt; 1pt.
Results: Technical success rate was 93.8% (15/16). Twelve patients (80%) were performed B-RTO. Three patients underwent coil embolization and/or DBOE. Clinical improvement; 93.3% (14/15), recurrence rate; 20% (3/14), improvement of hepatic function reserve; 46.7% (7/15). Complications included: hemoglobinuria (n=6), worsening of esophageal varices (n=4), portal vein thrombosis (n=3) and ascites (n=4). A patient with severe hepatic function damage (Child C) died from paralytic ileus with intestinal stasis on 12 days after the procedure. A patient did not undergo the procedure for fear of acute portal hypertension syndrome.
Conclusion: Transcatheter shunt occlusion is an effective treatment for porto-systemic encephalopathy. And it also contributes to the improvement of the hepatic function. However, a special attention should be paid to elevation of portal pressure after shunt occlusion.

P-78

Clinical outcome and treatment of portal vein thrombosis after partial splenic embolization

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Purpose: To investigate the clinical outcome and treatment of portal vein thrombosis (PVT) following partial splenic embolization (PSE).
Material and Methods: From April 2006 to April 2010, 105 patients with hypersplenism caused by cirrhotic portal hypertension were treated with PSE. Contrast-enhanced abdominal CT or MRI was performed routinely in 60 patients before PSE as well as 1-3 months after PSE. PVT was detected in 10 patients on images after the procedures. After PVT was discovered, 4 patients received anticoagulant therapy immediately, and the other 6 patients did not receive therapy. Clinical data of 10 patients with PVT were analyzed retrospectively.
Results: 3 of 4 patients who received anticoagulant therapy had complete or partial resolution of the thrombus, and one developed mild ascites without thrombus progression. Of the 6 patients who did not receive anticoagulant therapy, follow-up studies (6-48 months, mean 16.9 months) demonstrated partial calcification of embolus in 1, progression of thrombosis in 5. Among 5 patients with thrombus progression, two experienced hematemesis due to variceal hemorrhage, two developed cavernous transformation, extensive collateral flow, ascites and variceal progression, and the remaining patient had variceal progression with melena during the follow-up period.
Conclusion: PVT is a severe complication of PSE. Early diagnosis and prompt anticoagulant therapy can reduce the development of complications of PVT.

P-79

Proximal splenic artery embolization with detachable balloon-assisted technique

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Purpose: To evaluate the safety and efficacy of detachable balloon-assisted proximal splenic artery embolization in cases with large and tortuous arterial anatomy.
Material and Methods: During two years, seven cases suffering from bleeding fundal varices (n=2), liver cirrhosis (n=3) and hyperplenism with pancytopenia (n=1), thalassemia intermedia with a giant spleen (n=1), orthotopic liver transplantation with high splenic flow (n=1) were embolized with detachable balloon-assisted technique. A 6 or 7 French introducer-guiding catheter was first inserted to splenic artery origin. A Goldbal 4 or 5 balloon was inflated with the assistance of Magic microcatheter and detached giving attention to pancreatic feeders. Embolization was completed with long (30-50 cm) three or four electrically detachable coils. Patients were followed up clinically and with multiphasic CT after one month and with color Doppler at the sixth month.
Results: In all cases embolization was successfully achieved. No complications or pos tprocedure patient discomfort was experienced. During the follow-up, no recanalization, distal embolization or parenchymal necrosis was encountered. On clinical follow-up symptoms of patients improved and no bleeding episode developed in patients with varices. Platelet counts increased 2-3 folds from the baseline values in patients with pancytopenia.
Conclusion: Endovascular proximal splenic artery embolization with detachable balloon-assisted technique seems feasible and effective. We suggest this approach for safe embolization in cases with high flow and tortuous arterial anatomy for preventing distal embolization and parenchymal necrosis.

P-80

Sclerotherapy of lymphomatous malformations using OK 432

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Purpose: To evaluate safety and efficiency of sclerotherapy of lymphomatous malformations (LM) using OK 432 (picibanil) at the University of Alberta Hospital.
Material and Methods: The records of 32 patients who received ultrasound-guided direct lesion sclerotherapy using OK 432 for symptomatic LM over a two-year period were reviewed with up to one-year follow-up. Male-to-female ratio of 5:4, with an age range of 3 months to 80 years (mean of 15). Up to one-third of the patients underwent the procedure under general anaesthesia. The diagnosis

of LM was made clinically and radiologically by MR or CT and US. The lesions were mostly of the macrocystic type (28,88%) and 4 microcystic. Two patients had other previous non-effective treatment. The majority of lesions were in the head and neck (29,90%).
Results: The number of required treatments per lesion ranged from 1 to 4 with an average of 2.4 at an average of six-week intervals between treatments. 28 Patients had complete response (88%). Of the remainder (4,12%), 2 (6%) had more than 50% reduction in size, 2 (6%) had recurrence requiring other form of treatment (Doxycycline sclerotherapy) and 2 (6%) had surgery. Minor spontaneously resolving complications (erythema, initial swelling) were reported in 4 (12%) and there were no major complications.
Conclusion: LM sclerotherapy with OK 432 is effective and safe with no major complications.

P-81

Minimally invasive treatment of giant hemangiomas of the liver: embolization with bleomycin

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Purpose: Management of patients with giant hemangiomas of the liver encounters persistent controversy. Although the treatment method for symptomatic giant hemangiomas is surgery, the classical paradigm of operative resection remains. The aim of this study is to evaluate the symptomatic improvement and size reduction effect of embolization with bleomycin mixed lipiodol for the treatment of symptomatic giant hepatic hemangiomas.
Material and Methods: Twelve patients (3 males and 9 females, mean age of 49±6,9) with symptomatic giant hemangiomas (>4 cm) unfit for surgery were treated with selective embolization by bleomycin (15 mg) mixed with lipiodol (10 ml). Same principles were utilized with TACE. They were followed up (3-24 months) clinically and by imaging methods every 3 months. The statistical analysis was made by SPSS 16.0 and P values under 0.05 were accepted as statistically significant.
Results: Embolization was performed for 18 lesions in 12 patients. The median volume of the hemangiomas was 210,028cm^3 (min 9,27 max 9020) before the intervention and it became 86,814 cm^3 (min 0,9 max 5030 cm^3) thereafter. There were no mortality and morbidity related to the treatment. The procedure was repeated in only one patient. Symptomatic improvement was observed in all patients and significant volume reduction was achieved (p=0.001).
Conclusion: Clinical observation is preferred and operative management is denied in most of the patients with giant liver hemangiomas as both methods have similar complication rates. Minimally invasive embolization offers an alternative and effective treatment of giant symptomatic hemangiomas of the liver.

P-82

Splenic artery steal syndrome: transcatheter splenic artery embolization with Amplatzer vascular plug

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Purpose: To review our experience with proximal splenic artery embolization in splenic artery steal syndrome, specifically with Amplatzer vascular plug (AVP) after orthotopic liver transplantation.
Material and Methods: Five liver transplant patients had proximal splenic artery embolization performed with an AVP to treat splenic artery steal syndrome. Diagnosis was suspected by elevated liver enzymes and Doppler ultrasound. It was confirmed by celiac trunk angiogram. Devices ranging from 12 to 14 cm were placed through 6-F guiding catheters. All of them were plug I except one that it was a plug type II. Desired AVP location was distal to the dorsal pancreatic artery and proximal to the most peripheral pancreatica magna branch. Laboratory liver function tests and US follow-up were performed in all patients.
Results: Splenic artery embolization was successful in all cases, with device repositioning required in two. Occlusion took an average of approximately 5 minutes. Additional embolization material was not necessary. A second AVP was necessary placed in one patient. There were no complications of the procedures. Clinical improvement and normalization of US parameters was seen completely in 4 patients at 24 hours. In one patient there was an irreversible ischemic area in right hepatic lobe at 7-day post-transplantation US.
Conclusion: Splenic artery steal syndrome following liver transplantation can be treated by splenic artery embolization with Amplatzer vascular plug safety. It is a minimally invasive procedure which leads to immediate clinical improvement.

P-83

Multimodal endovascular approach in the treatment of peripheral arterio-venous malformations

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Learning objectives: To describe 1) approaches, 2) techniques and 3) embolizing agents for endovascular treatment of peripheral arterio-venous malformations (AVMs).
Background: AVMs are a major challenge in medical practice. Embolotherapy is considered the primary mode of treatment for the management of AVMs. The nidus is the causative factor that leads to high-flow shunting and is fed by and recruits adjacent arteries to hypertrophy causing adjacent venous engorgement and high flow. Only the complete eradication of the nidus offers the potential for cure.
Clinical Findings/Procedure Details: 1) The nidus of the AVM can be achieved through the transarterial, transvenous, or direct puncture approaches. 2) Two categories of techniques can be employed: a "selective nidal-specific access site" or some form of "flow reduction or cessation" for sclerosant delivery. These techniques, often used in concert, leave the nidus maximally ''vulnerable'' to the effects of the chosen agent with minimization of complications. 3) Embolic agents employed in AVM treatment are divided into liquid agents (such as ethanol, cyanoacrylates and Onyx) that occlude at the level of the arterioles or capillary bed, and mechanical devices (coils, Amplatzer Vascular Plug) that are equivalent to surgical ligations and occlude medium-sized to small arteries.
Conclusion: Endovascular treatment of peripheral AVM represents an efficacy therapeutic option but requires the expertise of interventional radiologist who are experienced with the available embolizing agents and techniques.

P-84

Peripheral venous malformations, clinical and radiological correlation: management of peripheral venous malformations - from diagnosis to treatment

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Learning objectives: 1. To describe clinical manifestations of venous malformations. 2. To assess the different imaging modalities used in the diagnosis of these anomalies. 3. To describe our experience in the management of this pathology discussing current endovascular treatment options.
Background: Venous malformations are the most common peripheral vascular malformations. Despite their typical location in the skin and subcutaneous tissue, they can also involve underlying tissues. Clinical evaluation often underestimates the involvement of deep structures. Multiple imaging modalities must be used to evaluate characteristics of the lesion such as size, flow, relation to the surrounding structures and lesion content in order to establish a differential diagnosis. The patient's age and the lesion's size, location and complications that may range from cosmetic deformity to life threatening conditions determine a multidisciplinary therapeutic approach. Several sclerosing agents can be used depending on the characteristics of the lesion.
Clinical Findings/Procedure Details: We reviewed the clinical and radiological features of the venous malformations and analyzed the utility and advantages of different imaging techniques, focussing on the identification of some relevant characteristics that will determine their prognosis and will condition the therapeutic approach. Some educational cases are shown to illustrate all the aforementioned.
Conclusion: Diagnosis of venous malformations is usually based on medical history and physical examination, but imaging techniques are essential to confirm the diagnosis and to plan the appropriate treatment. The more useful techniques are MRI and ultrasound. The role of the interventional radiology as a part of an interdisciplinary group is relevant to treat these anomalies.

P-85

Pre-operative transcatheter arterial embolization of giant symptomatic haemangiomas

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Learning objectives: To describe the imaging work-up, embolisation technique and results from our experience in the preoperative transcatheter embolisation of symptomatic large hepatic haemangiomas.
Background: Symptomatic giant haemangiomas are a rare entity. Pre-operative embolisation is often a complex procedure due to their rich arterial supply. Supraselective embolisation in tandem with CT angiography results in excellent devascularisation of these lesions. The vast majority of hepatic haemangiomas are small, asymptomatic, incidental findings that require no treatment. A small percentage of patients have symptoms of pain and pressure which may be directly attributable to a large haemangioma. These cases require careful clinical and radiological evaluation to ensure that symptoms do relate to the haemangioma. The treatment is usually surgical, but embolisation plays a key role in preoperative devascularisation. CT angiography plays a vital role in planning surgery and embolisation, with lesions often having a dual arterial supply. Embolisation is predominantly performed with particulate material. In our institution, a variety of giant haemangiomas have been treated in this format.
Clinical Findings/Procedure Details: Following CT angiography, supraselective catherisation of the vessels was performed to ensure all feeding and aberrant vessels were evaluated. Embosphere embolisation was then performed with post-procedural angiography and CT angiography to evaluate for adequate devascularisation. Surgical resection was evaluated histologically with a particular emphasis on the level of microinfarction achieved.
Conclusion: Symptomatic giant haemangiomas are a rare entity. Pre-operative embolisation is often a complex procedure due to their rich arterial supply. Supraselective embolisation in tandem with CT angiography results in excellent devascularisation of these lesions.

P-86

Embolotherapy in acute renal hemorrhage: a review of most frequent causes leading to emergency embolotherapy, using a supraselective approach whenever possible

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Learning objectives: The first objective will be to identify the imaging characteristics that define renal hemorrhage. We will also learn to identify important imaging findings on CT scans that will give us invaluable information to shorten intervention time or even change our approach. Second objective is to learn how to perform renal emergency embolotherapy as we do it, explaining materials, technique, and tips. We will try to be supraselective whenever possible to try to preserve as much kidney as possible.
Background: Renal hemorrhage is a frequent cause of emergency embolotherapy. We will review most frequent causes: trauma and iatrogenia, and even some tumoral massive bleeding. If hemorrhage can be controlled with selective embolotherapy patient, in most cases will avoid emergency nephrectomy decreasing overall morbimortality.
Clinical Findings/Procedure Details: Contrast-enhanced CT scan is the key to diagnose severe acute renal bleeding that needs emergency treatment. Apart from contrast extravasation there are many other imaging findings that will have influence on posterior percutaneous embolotherapy. Embolotherapy is usually performed through a 4F sheath and a Simmons 1 catheter to enter renal artery. If it is possible we will attempt a supraselective embolization using microcatheter to try to preserve as much parenchyma as possible. Microspheres and microcoils are our preferred embolic materials in these cases.
Conclusion: Severe renal hemorrhage that needs emergency treatment can be accurately diagnosed using contrast-enhanced CT scan. Embolotherapy in these cases is a safe and highly effective way to stop bleeding, decreasing morbimortality compared to emergency nephrectomy.

P-87

Endovascular superselective embolization of prostatic arteries as the new method of BPH less invasive treatment

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Learning objectives: In cases of significantly enlarged prostate open prostatectomy should be recommended. However, in patients who suffer from severe general diseases and/or in patients with a gross prostate volume (more than 150 grams) all conventional surgery may cause undesirable complications. In these patients we use the new alternative method of less invasive surgery – endovascular superselective embolization of prostatic arteries (ESEPA).
Background: We have the experience of treating 12 men with moderate–to–severe BPH symptoms and prostate enlargement who underwent ESEPA during the period from September 2009 till November 2010. The patients had total prostate volume of 105–248 grams (median 160 grams), middle IPSS score - 22, middle urinary flow rate (Qmax) 5,7ml/sec. and serum PSA 1.5–3.5 (middle 2.34) ng/mL. End point of embolization: blocked artery supply in prostate nodules and arterial reflux.
Clinical Findings/Procedure Details: All men noticed significant improvement of LUTS 3-5 days just after the procedure. All patients were totally satisfied in 3 months - the middle IPSS score was 7,3. In 12 months, the middle IPSS score was 4,2 and it was significantly ($p<0.001$) lower than before the treatment. Middle Qmax after 12 month became 15,8 ml/sec.
Conclusion: Our results demonstrate that ESEPA may be considered as the real alternative technology for BPH treatment in patients with large prostate volume and/or with high risk of surgery.

P-88

Transcatheter embolization of bronchial and pulmonary arteries: indications, techniques and complications

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Learning objectives: To describe the clinical utility, the technique and complications of bronchial and pulmonary arteries embolization.
Background: Embolization of the bronchial and/or pulmonary arteries may be useful in various sets of clinical situations such as life-threatening hemoptysis in oncology patients, hypoxia by arteriovenous malformations, in autoimmune disease and as treatment of unresectable lung tumors or metastases.
Clinical Findings/Procedure Details: To describe the various clinical forms of lung disease who benefit from the execution of an embolization of bronchial and/or pulmonary arteries. To detect bronchial arteries of anomalous origin. To describe the techniques and devices, in particular guide wires, catheters, coils and beads to perform embolization. Possible complications are also shown together with tricks to avoid them.
Conclusion: The embolization of bronchial and pulmonary arteries is now indicated in various lung diseases. The techniques are highly effective but not free of complications.

P-89

True-and pseudo-aneurysms around the pancreas: various clinical and imaging manifestation and the role of endovascular therapy

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Learning objectives: To review the prevalence, pathophysiology and clinical manifestation of true and pseudo-aneurysms around the pancreas (15 lesions, including cases of tumor, trauma, pancreatitis, hemosuccus pancreaticus, and post-operative complication, etc.). To illustrate the typical imaging findings using MDCT, angiography and endoscopy of various kinds of aneurysms. To demonstrate the role of transcatheter techniques in management of the lesions (Superselective embolization technique using microcoils, NBCA, emphasize the efficacy of NBCA-coil isolation technique).
Background: True-and pseudo-aneurysms around the pancreas are rare but potentially life threatening. MDCT is now the first line imaging tool for diagnosis, supplemented by angiography and endoscopy. Transcatheter embolization is an effective alternative to surgical interventions.
Clinical Findings/Procedure Details: Using 15 cases from our hospital, we will: present clinical and imaging findings included MDCT and angiographic findings, discuss endovascular interventional techniques for the treatment of aneurysms.
Conclusion: On this exhibit, the wide spectrum of radiological findings and transcatheter techniques for the treatment of true and pseudo-aneurysm around the pancreas are presented.

P-90

Embolization of anticoagulation-related soft tissue bleeding: when and how do I do?

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Interventional Radiology, Georges Pompidou European Hospital, Paris, France.

Learning objectives: To describe indications of embolization in the management of anticoagulation-related soft tissue bleeding (AcSTB) and the target arteries as a function of the localization of the hematoma.
Background: Soft tissue bleedings are more and more frequently involved in hemodynamic collapse in patients treated by oral/parenteral anticoagulation. The availability of better suited embolization material and microcatheter as well as the more wide spread use of triphasic CT has increased the role of IR in this disease.
Clinical Findings/Procedure Details: The two more frequent localizations of AcSTB are ilio-psoas muscle and anterior rectus sheath. Multiphasic CT scan is able to confirm the diagnosis, appreciate the topography of the hematoma and search for active bleeding. All hemodynamically unstable patient, or with active bleeding on CT should undergo embolization. A global angiogram seems still necessary in all cases and all potential target arteries of the bleeding site should be selectively opacified as follows. For ilio-psoas hematomas, the target arteries are the lumbar, the ilio-lumbar and deep circumflex iliac. Concerning anterior rectus sheath hematomas, the targets are the inferiors epigastrics and deep circumflex iliac. All bleeding sites (active extravasation, arterio-venous fistula, pseudo aneurysm, abrupt cut off artery, etc.) should be occluded preferably by definitive material. Like in upper GI bleeding, empiric embolization is efficient. This poster will review the major clinical anatomical and technical basis that IRs should know in order to achieve good clinical result in this highly fatal condition
Conclusion: AcSTB can be efficiently treated by embolization, all IR should promote and perform this life saving intervention.

P-91

Complex pseudoaneurysms: the good, the bad and the ugly

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[1]Vascular Radiology Unit, Hull Royal Infirmary, Hull, United Kingdom, [2]Interventional Radiology, John Radcliffe Hospital, Oxford, United Kingdom.

Learning objectives: To demonstrate complexity of pseudoaneurysms arising from intervention in different clinical specialties and to highlight the variety of endovascular techniques used in their management with discussion of their potential challenges and complication.
Background: Over the last decade, endovascular management of pseudoaneurysms have become a well established and increasingly attractive alternative to open surgery. Pseudoaneurysms occur in a wide variety of locations and can be treated using different endovascular techniques, each with its own unique challenges and potential for complications. We present 5 cases that highlight the variety, different endovascular techniques and ranging complexity of pseudoaneurysms treated by vascular interventional radiologists.
Clinical Findings/Procedure Details: Case 1: Aortic root pseudoaneurysm in a patient with previous aortic valve replacement treated with microcoils and percutaneous thrombin injection. Case 2: Radial artery pseudoaneurysm in the dominant hand of a 60 y/o patient after attempted arterial sample for an arterial blood gas. Treated with percutaneous thrombin with endovascular balloon protection. Case 3: Profunda femoris artery pseudoaneurysm after cardiac catheterization. Initial percutaneous thrombin injection which recanalised in 48h. Proceeded to be treated successfully by occluding the feeding branch of the profunda femoris artery with microcoils.Case 4: Ruptured splenic artery pseudoaneurysm in a man with pancreatitis successfully treated with microcoils and Gelfoam particles. Case 5: A patient that presented with recurrent haemathroses after total knee replacment was found to have a geniculate artery pseudoaneurysm that was successfully treated using microcoils.
Conclusion: Interventional radiology plays a key role in successfully managing complex pseudoaneurysms that arise from varying anatomical areas referred from a range of clinical specialities.

P-92

Acute gastrointestinal bleeding: superselective embolization with Onyx® liquid embolizer

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Learning objectives: To understand the principle of superselective embolization in the gastrointestinal tract for acute bleeding. To be familiar with using Onyx®, the liquid embolizer, from preparation to delivery, in the treatment of acute bleeding.
Background: Acute GI bleeding is a challenging medical condition that requires accurate localization of the bleeding source, and quick control of the bleeding to stabilize the patient. The purpose of this educational material is to illustrate a new embolization tool, namely Onyx® liquid embolizer, which can be used safely and efficiently in certain situations to treat acute GI bleed. Some caution, however, is advised to achieve good results.
Clinical Findings/Procedure Details: Acute GI bleed has been treated successfully via superselective catheterization with microcatheter and embolization with Onyx® liquid embolizer at our institution in recent years. The clinical presentation and angiographic findings of selected cases are shown. The use of Onyx® as the preferred embolizer (versus coils or other embolic materials) is discussed. Preparation and delivery of this embolizer are demonstrated in detail for educational purposes.
Conclusion: Superselective embolization for acute GI bleed is a well-accepted treatment option in recent years due to its minimal risks. When coils or other embolic materials are not indicated or cannot be deployed safely, Onyx® liquid embolizer should be considered as an appropriate life-saving tool to stop the bleeding. Familiarity with this liquid embolizer is crucial in Interventional Radiology.

P-93

Percutaneous varicocele embolization: minimally invasive treatment of male infertility

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[1]Radiology, HUC, Coimbra, Portugal, [2]Radiology, Porto Hospital, Porto, Portugal.

Learning objectives:
Brief thematic review on the subject percutaneous embolization of varicocele grade II to IV, with illustration of the technique, enumeration of the complications and analysis of the obtained therapeutic effects.
Background: The authors retrospectively assessed 50 cases of percutaneous embolization of clinically detectable varicoceles, performed at the HUC, in the period between January 2009 and January 2011.
Clinical Findings/Procedure Details: The varicocele consists of varicose dilation of pampiniform plexus and spermatic vein and may present with pain, testicular atrophy and male infertility. It affects 15% of men, being present in 40% of the infertile male population. Usually unilateral and more frequent on the left side, it may be bilateral (9%) and present on the right (1-2%). The indications for treatment are symptomatic varicoceles, adolescents with a decrease in testicular volume and infertile adults with multiple alterations in semen. Through the clinical evaluation and semen analysis, when available, the authors demonstrate the good results in terms of efficacy and safety.
Conclusion: Percutaneous varicocele embolization is a minimally invasive technique of interventional radiology without the need for general anesthesia or stitches/scars, providing a rapid recovery of the patient, with a short hospital stay and therapeutic results similar to surgery.

P-94

Endovascular treatment of a ruptured pulmonary artery aneurysm (PAA) in a patient with Behçet's disease (BD) using the amplatzer vascular plug (AVP)

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[1]Department of Radiology, Azienda Ospedaliera G. Salvini, Garbagnate Milanese, Italy, [2]Radiology, University of Insubria, Varese, Italy.

PAA is the leading cause of mortality related to BD. We describe a case of spontaneous rupture of a PAA that, due to inadequacy of medical therapy and the disadvantages of surgical intervention, has been successfully treated with AVP 4.

P-95

Coil embolization in the treatment of retroperitoneal hematoma from a lumbar artery pseudoaneurysm resulting from IVC filter placement

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[1]Department of Radiology, Bryn Mawr Hospital, Bryn Mawr, PA, United States of America, [2]Radiology, Paoli Hospital/Bryn Mawr Hospital, Paoli, PA, United States of America.

Venacaval filter with caval wall penetration leading to a retroperitoneal hematoma. Pseudoaneurysm and active extravasation from a lumbar artery detected during arterial phase CT imaging. Successful treatment with coil embolization.

P-96

Embolization with Onyx liquid embolic agent of a ruptured splenic artery aneurysm. A case report

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[1]Interventional Radiology, Hospital de Navarra, Pamplona, Spain, [2]Emergency Department, Hospital de Navarra, Pamplona, Spain.

We report a 47-year-old man with abdominal pain and hemodynamic instability due to splenic aneurysm ruptured. The patient was successfully treated by urgent embolization with Onyx, avoiding splenectomy while maintaining the organs circulation.

P-97

Pre-Fontan coil embolization to occlude aortopulmonary collateral arteries in a single ventricle patient: use of Guglielmi detachable coils (GDC)

***T. Sonomura**[1], M. Nakai[1], N. Kawai[1], M. Sawa[1], A. Ikoma[1], H. Minamiguchi[1], K. Kishi[1], T. Suenaga[2], T. Takeuchi[2], H. Suzuki[2], N. Yoshikawa[2], S. Uchita[3], Y. Okamura[3], M. Sato[1];*
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A 2-year-11-month-old girl with tricuspid atresia underwent successful coil embolization using GDC, which is the safest type of coil because there is no risk of unexpected release, to occlude aortopulmonary collateral arteries before Fontan operation.

P-98

Back door embolisation via the plantar arch of a traumatic arteriovenous fistula of the posterior tibial artery and vein

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A 25-year-old male presented with traumatic AV fistula of the posterior tibial artery (PTA) and vein. Standard "front door" embolisation was performed via PTA. "Back door" embolisation was performed retrogradely via ATA and plantar arch with a microcatheter.

P-99

Endovascular treatment of a large neck arterio-venous malformation (AVM) with temporary flow reduction technique and transarterial cyanoacrylate embolization

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A case of endovascular treatment of a large neck AVM with temporary flow reduction technique through the use of a balloon occlusion catheter displaced in the internal jugular vein and subsequent transarterial cyanoacrylate embolization of the superior thyroid artery.

P-100

A case of duodenal arteriovenous malformation treated with onyx

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A 42-year-old man who presented acute gastrointestinal hemorrhage caused by a duodenal arteriovenous malformation (AVM) was treated with onyx. Literature of duodenal AVM is reviewed.

P-101

Gastroduodenal artery pseudoaneurysm with proximal small bowel obstruction following colonoscopy: case report of a rare complication

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Perforation and haemorrhage are the frequently reported serious complications of colonoscopy. The formation of gastroduodenal artery pseudoaneurysm and an accompanying intramural duodenal haematoma causing secondary duodenal obstruction is an unheard complication of diagnostic colonoscopy. Therapeutic occlusion by embolisation averted catastrophic haemorrhage.

P-102

Pseudoaneurysm treatment of deep artery of the penis by direct percutaneous injection of non-adhesive liquid embolic agent (Onyx) in a case of high-flow priapism

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[1]S.O.D. Radiologia Interventistica, Azienda Ospedaliera Universitaria Pisana, Pisa, Italy, [2]Department of Radiology, Carrara City Hospital, Carrara, Italy, [3]Department of Oncology, Transplants and Advanced Technolgies in Medicine, University of Pisa, Pisa, Italy.

High-flow priapism in a 47-year-old male with pseudoaneurysm of left deep artery of the penis and perilesional arterio-cavernous fistulas treated by direct percutaneous injection of Onyx under ultrasound and fluoroscopic guidance. We obtained occlusion of pseudoaneurysm and perilesional fistulas.

P-103

Bilateral vesical artery embolization for the treatment of radiation cystitis

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We present one case of radiation-induced hemorrhagic cystitis which successfully controlled by bilateral superselective embolization of vesical arteries using 350-500 µm polyvinyl alcohol particles. There was no recurrence of hematuria at follow-up of 3 years and no complication was observed.

P-104

Successful closure of a broncho-pleural fistula with an amplatzer vascular plug

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We report a case of a 67-year-old patient that developed a broncho-pleural fistula after a left side pneumonectomy for a T1b NSCLC. An amplatzer vascular plug was successfully deployed and excluded the fistula.

P-105

Endovascular embolization of traumatic pseudoaneurysm of left deep artery of the penis by non-adhesive liquid embolic agent (Onyx) in a case of high-flow priapism

A. Lunardi[1], *T. Torri*[2], *I. Bargellini*[1], *S. Vannucci*[1], *E. Bozzi*[1], *M. Barattini*[1], *R. Cioni*[1];
[1]S.O.D. Radiologia Interventistica, Azienda Ospedaliera Universitaria Pisana, Pisa, Italy, [2]Department of Radiology, Carrara City Hospital, Carrara, Italy.

Late embolization (1 year after the onset of trauma) of large traumatic pseudoaneurysm of left deep artery of the penis by non-adhesive embolic agent (Onyx). We obtain occlusion of pseudoaneurysm and perilesional artero-cavernous fistulas with a good recovery of erectile function.

P-106

Endovascular treatment of a real inferior gluteal artery aneurysm associated with a pelvic arteriovenous malformation

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We report on a rare case of a real inferior gluteal artery aneurysm associated with a large pelvic arteriovenous malformation. The aneurysm was successfully treated by embolization using the combination of coils and amplatzer vascular plugs.

P-107

Microsphere spleen embolization in a case of thrombocytopenia

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A previously liver transplanted patient with cirrhosis relapse presented thrombocytopenia and hypersplenism. Treatment consisted of embolization of the superior half of the spleen utilizing microspheres and gelfoam. Platelet count raised from 29.000 mm3 to 137.000 mm3 in a three-month period.

P-108

Isolation technique on transcatheter coil embolization for gastrointestinal hemorrhage in an angiographically unvisualized right hepatic arterial branch

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A patient developed a shock due to gastrointestinal hemorrhage two weeks after pancreaticoduodenectomy for pancreatic cancer. Initial endoscopic sclerotherapy was not possible. We treated this patient using an isolation technique for transcatheter coil embolization of an angiographically unvisualized right hepatic artery.

P-109

Combined thrombin injection and coil embolization of pseudoaneurysm arising from gastroduodenal artery stump after pylorus preserving pancreaticoduodenectomy

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We report a case of pseudoaneurysm arising from the stump of the gastroduodenal artery after pylorus preserving pancreaticoduodenectomy (PPPD) which was successfully treated with combined thrombin injection and coil embolization with simultaneous balloon occlusion of the common hepatic artery.

P-110

William syndrome: a rare genetic disease with a rare manifestation of multiple pulmonary arteriovenous malformations

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33-year-old female with William syndrome presenting sudden dyspnea and hypoxia not correctable with oxygen therapy. Bilateral pulmonary arteriovenous malformations were diagnosed with angio-CT, then embolized with detachable microcoils. Rapid improvement of SpO_2.

P-111

Pulmonary artery pseudoaneurysm secondary to fungal infection and treatment with amplatzer plugs

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[1]Radiology, Sheffield Teaching Hospitals NHS Trust, Sheffield, United Kingdom, [2]Vascular Surgery, Sheffield Vascular Institute, Northern General Hospital, Sheffield, United Kingdom.

Pulmonary artery pseudoaneurysms may result in life threatening haemoptysis but are fortunately uncommon. We describe a case of large pulmonary artery pseuodoaneurysm secondary to fungal infection in an immuno-compromised patient, which was successfully treated percutaneously using amplatzer embolisation plugs.

P-112

Congenital and acquired renal AVMs: curative embolization with Onyx

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Renal arteriovenous malformations (AVMs) are rare lesions, and may be acquired or congenital. Congenital arteriovenous malformations of the kidney are rare causes of severe hematuria especially in young patients. The renal AVMs was cured by superselective endovascular embolization with Onyx.

P-113

Intercostal artery embolization for intrathoracic drainage tube bleeding

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Active bleeding 10 days after performance of intrathoracic drainage. Emergency intervention was performed and the intercostal artery which had active bleeding can be seen during retrograde angiography from the chest tube. Then, embolization was performed and bleeding stopped.

P-114

Endovascular management of multiple pulmonary artery aneurysms in a patient with Behçet's disease: case report

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Interventional Radiology, National Hospital of Sri Lanka, Colombo, Sri Lanka.

Young male with Behçet's disease presented with two rapidly enlarging pulmonary artery aneurysms. Under local anaesthesia, superselective catheterisation of the feeding vessels with Amplatzer PDA delivery system and 064'' guiding catheter was performed. Successful occlusion of each vessel was achieved with vascular plugs.

P-115

Endovascular treatment of a peripheral pulmonary artery pseudo-aneurysm in a patient with complex congenital heart disease

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[1]Radiology, Gartnavel General Hospital, Glasgow, United Kingdom, [2]Interventional Radiology Unit, Gartnavel General Hospital, Glasgow, United Kingdom.

We describe the endovascular treatment of a peripheral pulmonary artery pseudo-aneurysm in a patient with pulmonary atresia and an abnormal communicating vessel between the aortic arch and the pulmonary trunk.

P-116

Amazing ruptured hepatic pseudoaneurysm

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Interventional Radiology, Hospital Infanta Leonor, Madrid, Spain.

A big hepatic pseudoaneurysm was embolized using a pump-assisted injection method. Flow of 4 ml/sec over 3 seconds was employed and provoked an amazing rupture. We embolized the branch quickly with no complications.

P-117

Endovascular strategy for the treatment of a pulmonary arteriovenous malformation

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Department of Clinical Science and Bioimaging - Section of Radiology, University G. D'Annunzio - SS. Annunziata Hospital, Chieti, Italy.

After a traumatic event, a 16-year-old man had a chest X-ray that documented a pulmonary arteriovenous malformation as incidental finding. CT-angiography confirmed it; we chose to embolize afferent artery using amplatzer vascular plug.

P-118

Embolization of a type II endoleak via octopus graft after TAAA repair

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[1]Department of Radiology, University Medical Center Regensburg, Regensburg, Germany, [2]Radiology, Krankenhaus Barmherzige Brüder, Regensburg, Germany.

We present a 37-year-old woman with a type II endoleak after hybrid repair of a TAAA. The feeding vessel (left gastric artery) was catheterized via the octopus graft and the leak was successfully embolized with 0.3ml Onyx-34.

P-119

Selective venous embolisation therapy for intractable post-partum haemorrhage

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[1]Radiology, Colchester Hospital University Foundation NHS Trust, Colchester, United Kingdom, [2]Obstetrics and Gynaecology, Colchester Hospital University Foundation NHS Trust, Colchester, United Kingdom.

We discuss the treatment of a 32-year-old patient who developed postpartum haemorrhage. Bleeding continued despite hysterectomy, bilateral internal iliac artery ligation and right internal iliac vein ligation. The haemorrhage stopped after selective left internal iliac vein embolisation.

P-120

Transarterial treatment in penetrating cranio-cerebral injuries

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Orbitocranial penetrating injuries are relatively rare. We present the case of a patient arrived at the hospital with a knife stuck in the skull. The patient was managed conservatively: transarterial embolization of the injured arteries and removal of the blade.

P-121

Renal artery aneurysm successfully embolized using double microcatheter single vascular access technique and new PenumbraTM detachable coils

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[1]Interventional Radiology, SS. Annunziata Hospital ASL TA, Taranto, Italy, [2]University of Bari, Institute of Cardiology, Bari, Italy.

A wide-neck renal artery aneurysm was successfully embolized using double microcatheter single vascular access technique to reduce risk of coil migration. New PenumbraTM .020" detachable coils were used because of their increased thrombogenic power and their length up to 60cm.

P-122

Successful embolization of multiple bleeding angiomyolipomas with high-flow A-V fistula in a horseshoe kidney

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[1]Interventional Radiology, SS. Annunziata Hospital ASL TA, Taranto, Italy, [2]University of Bari, Institute of Cardiology, Bari, Italy.

A 33-year-old woman, affected by tuberous sclerosis and with a horseshoe kidney, underwent successful embolization of multiple bleeding angiomyolipomas with high-flow artero-venous fistula. PVA particles with detachable coils and n-BCA were used by superselective microcatheterism.

P-123

Selective embolisation of an arteriobiliary fistula caused by laparoscopic cholecystectomy

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[1]Radiology, Clinical Emergency Hospital, Bucharest, Romania, [2]Surgery, Clinical Emergency Hospital, Bucharest, Romania.

We report the case of a 22-year-old male presented with massive hemobilia three months after laparoscopic cholecystectomy. The arteriography revealed an arteriobiliary fistula successfully treated by selective hepatic embolisation and is symptom free after 2 months.

P-124

Endovascular treatment of a persistent sciatic artery aneurysm

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We present a case of an acute presentation of a large aneurysm arising from a persistent sciatic artery successfully treated by endovascular techniques to exclude the aneurysm as well as optimise the native femoral circulation.

P-125

Short bowel syndrome as a rare complication of gel foam embolization

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Lower gastrointestinal bleeding due to post-traumatic ileocolic artery aneurysm is usually treated with gel foam embolization after selective cannulation. Rarely, long segment bowel necrosis may occur as a complication of gel foam embolization.

P-126

A case of traumatic hemorrhage from external auditory canal: successful treatment by embolization with N-butyl-2-cyanoacrylate

N. Sakamoto, *M. Yamaguchi, T. Okada, K. Idoguchi, K. Sugimura, K. Sugimoto;*
Radiology and Center for Endovascular Therapy, Kobe University Hospital, Kobe, Japan.

We present a case of 82-year-old man with uncontrollable hemorrhage from external auditory canal caused by deep auricular artery injury concomitant with mandibular condyle dislocation fracture. Emergent angiography revealed extravasation and selective embolization was successfully performed with NBCA.

P-127

Treatment of hypersplenism by partial splenic embolization using Onyx

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Department of Radiology, University Medical Center Regensburg, Regensburg, Germany.

We present a 52-year-old man with severe thrombocytopenia secondary to hypersplenism who was successfully treated by partial splenic embolization using liquid embolic agent Onyx. The platelet count increased within 24 hours after embolotherapy.

EVAR and TEVAR

P-128

Factors influencing mortality after endovascular repair of ruptured abdominal aortic aneurysms: a meta-analysis and meta-regression analysis

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Purpose: To determine factors that may influence the peri-operative mortality after endovascular repair of ruptured abdominal aortic aneurysms (RAAAs).
Material and Methods: A MEDLINE and EMBASE database search (February 2010) was performed. All English-language publications quoting mortality figures after endovascular repair of RAAAs were included, systematically reviewed and meta-analysed. A meta-regression analysis was subsequently performed to determine the impact on mortality of the following 6 factors: anaesthesia; endograft configuration; haemodynamic instability; use of intra-aortic occlusion balloon; conversion to open repair; and post-operative development of abdominal compartment syndrome.
Results: 46 studies with 1397 patients met the inclusion criteria. There was significant within-study heterogeneity and peri-operative mortality ranged between 0 and 54%, whereas the pooled mortality after endovascular repair was 24.3% (95% CI: 20.7 to 28.3%). There was evidence of publication bias suggesting the mortality may have been underestimated. Of the 6 prognostic variables, meta-regression showed only bifurcated approach to have a statistically significant (negative) association with mortality (p=0.023). Conversion to open repair showed a trend for higher mortality but was not statistically significant (p=0.067).
Conclusion: Endovascular repair of RAAAs is associated with acceptable mortality rates. Patients having a bifurcated endograft were less likely to die. This may be due to some surgeons opting for a bifurcated approach in patients with better hemodynamic condition. Further studies will be needed to clarify this issue.

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Reducing the risk of spinal cord ischaemia following endovascular repair of thoracoabdominal aneurysms: "the sac perfusion branch"

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WITHDRAWN

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Emergency repair of acute catastrophes of the descending thoracic aorta: a single center experience

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Purpose: A number of acute catastrophes of descending thoracic aorta (ACDTA) may be treated by endoluminal exclusion. This technique offers an attractive alternative to high-risk open repair. We report our experience treating ACDTA by open descending thoracic aorta repair (DTAR) and endovascular technique (TEVAR).
Material and Methods: Between April 2001 and January 2010, 76 patients underwent TEVAR and 24 patients underwent DTAR for ACDTA. Indications for endovascular intervention were traumatic aortic tear (n=27), acute type B dissection (n=19), ruptured degenerative aneurysm (n=19), intramural hematoma (n=3), penetrating ulcer (n=3), penetrating injury (n=3), and embolizing lesion (n=2). Indications for open repair were ruptured degenerative aneurysm (n=22), acute type B dissection (n=1), and penetrating ulcer (n=1). A variety of stent-grafts were used including TAG excluder (N=41), aortic cuffs (n=25), custom-made devices (n=8), and Talent (n=1). All open repairs were performed using an interposition graft.
Results: Mean age was 58.5 years. In-hospital mortality occurred in 37 patients (TEVAR n=21, 28% vs DTAR n=16, 67%, P=0.0012). The incidence of post-operative myocardial infarction, acute renal failure, stroke, and paraplegia/paresis were similar between the two groups (TEVAR 5%, 12%, 8%, 8% vs DTAR 13%, 13%, 9%, 13%, P>0.05). The major respiratory complications and other complications were higher in the DTAR group (TEVAR 16%, 20% vs DTAR 48%, 83%, P<0.05). Median follow-up is 12 months (range 0-83). Predictors of patient mortality included patient age and patients with DTAR vs TEVAR.
Conclusion: Most patients presenting with ACDTA can be successfully treated with TEVAR with diminished risks of mortality and major complications.
Disclosure: Dr. Eskandari serves as a paid consultant for Harvard Clinical Research, Medtronic, and Abbott Vascular. Dr. Morasch receives honoraria for serving as training course director for W. L. Gore & Associates, Inc. and as consultant for King Pharmaceuticals.

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Early results of percutaneous treatment of abdominal aortic aneurysms using Ovation stent graft with manual compression of the femoral approaches

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Purpose: To present the performance data on the use of Ovation (Trivascular) stent-graft in patients with abdominal aortic aneurysm (AAA) and complicated necks or small diameter vascular access.
Material and Methods: Between November and December 2010, 12 patients (9 men and 3 women, mean age 73.5±5.7), with AAA complicated proximal neck and/or severe iliac artery angulation/tortuosity with small diameter, were enrolled in the study. The mean AAA diameter was 55.3±6.9 mm. All procedures were performed using a total percutaneous approach with a 12 Fr access for the main body and a 10 Fr for the contralateral branch. Heparin was administered before the procedure to obtain an ACT 250s. At the end of procedures an adequate Protamine dose was administered to prevent bleedings. Post-procedural haemostasis at the puncture site was performed in all cases with manual compression. All patients performed an angio-CT control at 1 month follow up.
Results: The graft was successfully implanted in all patients. Total percutaneous approach was successful in all cases. No aneurysm-related rupture or death occurred. Only one patient presented a type 2 endoleak at the final angiography, successfully treated during the procedure with coil embolization. All patients were discharged at post-operative day 1. No early complications were recorded. Angio-CT controls at 1 month have shown the correct placement of the aortic stent grafts with no complications.
Conclusion: The Ovation stent-graft allows a total percutaneous treatment of AAA with complex proximal neck anatomy, angulated and/or narrow iliac arteries, with good short-term clinical outcomes.

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The accuracy of CT central luminal line (CLL) measurements in quantifying stent-graft migration

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Purpose: To evaluate the accuracy of central luminal line (CLL) measurements in quantifying stent-graft migration. The bias of the CLL technique together with its repeatability and reproducibility was assessed.
Material and Methods: Stent-grafts were deployed in plastic aortic phantoms at fixed locations from two side-branches. Each phantom was then filled with iodinated contrast and 2mm MDCT performed. Each stent graft was then displaced caudally; the new location determined and again subjected to a CT scan. This created a series of 15 cases with known stent-graft migration. CLLs were used to measure stent-graft position on the CT scans and calculate migration (3 observers). In vivo stent-graft migration was then evaluated in a similar manner using the 1st post-operative and latest CT scans from 10 patients (2 observers). CLL measurements were performed independently and were repeated on a separate occasion.
Results: Using the phantoms the mean difference in CLL migration between the actual and observed measurements was -0.02mm (95% limits of agreement: -2.58mm to 2.61mm). The coefficient of repeatability was 3.77mm and the 95% limits of agreement between observers were -1.17mm and 0.92mm. Clinically, CLLs generated a repeatability coefficient of 3.14mm (within observers) and 95% limits of agreement of -2.75mm to 3.27mm (between observers). When assessing for clinical migration 62 (97%) of the paired calculations were within ≤4mm.
Conclusion: Bias from CLL determined migration is small and not statistically significant from zero. Measurement variability within and between observers is relatively small but not insignificant; it should be feasible to detect changes in stent-graft position which are ≥4mm.

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Clinical factors increasing radiation doses to patients during abdominal stent-graft implantation

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Purpose: The aim of the study was to document the radiation doses of EVAR and to discuss potential reasons for prolongation of radiological procedures. Because of the increasing complexity of endovascular interventions that need exposure to ionizing radiation, concern has grown regarding X-ray exposure to both patients and operator.
Material and Methods: Dose-area product (DAP) ($Gycm^2$) and air kerma (AK) (Gy) obtained during EVAR from 92 patients were analysed retrospectively in regards to body mass index (BMI), angulations of aneurysm neck, length of aneurysm neck and occurrence of tortuosity of iliac arteries.
Results: Total AK for fluoroscopy differed significantly between normal BMI (373 mGy) and BMI 25-29.9 (1125 mGy) or BMI >30 (1085 mGy). Iliac artery tortuosities >45° and short aneurysm necks caused higher doses of total AK (1097 mGy and 1228 mGy, respectively) than iliac artery tortuosities <45° and long aneurysm necks (605 mGy and 720 mGy, respectively). In 39 of the analysed patients (42.4%) AK was between 1 and 2 Gy and for 7 patients (7.6%) it exceeded 2 Gy. For the rest 46 patients (50%) radiation dose was lower than 0.5 Gy.
Conclusion: The main factors contributing to a high radiation dose being acquired by patients during EVAR are: BMI >25, tortuosity of iliac arteries >45° and short aneurysm necks. The patient, who must take a conscious decision of the surgery (and sign the informed consent) should be informed about possible complications that can lead to receive a high dose of radiation.

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Long-term follow-up of patients after endovascular stent-graft treatment of acute complicated type B aortic dissection: changes in aortic morphology in relation to clinical outcome

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Purpose: To study long-term follow-up regarding morphological changes of the aorta after thoracic endovascular aortic repair (TEVAR) for acute complicated type B aortic dissections, related to clinical outcome.
Material and Methods: During the period 1999-2009, 60 patients were treated with TEVAR for acute complicated type B aortic dissection at Uppsala University Hospital. Early (1-3 months) and late (>5 years) post-operative evaluation of aortic morphology with special emphasis on false lumen thrombosis and changes in aortic diameter was done with computed tomography. Changes in aortic morphology were compared to clinical outcome.
Results: Three-year survival was 90% and five-year survival was 87%. Freedom from re-intervention at five years was 65%. Data concerning the change of aortic morphology is being analyzed at present time and the results will be ready for presentation at the time for CIRSE 2011.
Conclusion: Patients with acute complicated type B aortic dissection can be treated with stent grafts with excellent survival compared to previously published results. The analysis of aortic remodeling after stent-graft implantation will hopefully elucidate the findings in the clinical outcome.

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Endovascular repair of inflammatory abdominal aortic aneurysms: a 15-year single-centre experience

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Purpose: To report our experience with endovascular repair of inflammatory abdominal aortic aneurysms (IAAAs).
Material and Methods: The records of 8 patients who underwent endovascular repair for an IAAA in our unit over the last 15 years were retrospectively reviewed. All patients were male with a median age of 56.5 years (range 53-78) and a median sac maximum diameter of 55 mm (range 47-56). Hydronephrosis was present in 4. A bifurcated device had been implanted in 5 cases (1 Excluder, 1 Endologix, 2 Anaconda, 1 hybrid combination of Anaconda and reversed Unifit)

and a tube endograft in 3 (1 Endofit, 2 custom-made). Five patients received corticosteroids, 3 colchicine and 1 tamoxifen.
Results: All endovascular procedures were technically and clinically successful. There was no perioperative mortality or morbidity. During a median follow-up of 37 months (range 1-84), two type II endoleaks had been encountered, there was no need for reinterventions and there were no aneurysm-related deaths. One patient died 8 years after endovascular repair from unrelated causes. Follow-up imaging documented a reduction in aneurysm diameter of a median of 9.1 mm (range 0-18). All 4 patients with pre-procedural periaortic fibrosis and hydronephrosis improved after endovascular repair. All these patients received adjuvant medical treatment.
Conclusion: Endovascular repair appears to be a safe and effective option for IAAAs. Aneurysm exclusion, particularly when combined with additional medical therapy, seems to be associated with reduction of aneurysm size and regression or stabilization of the inflammatory process.

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Performance of chimney grafts in urgent aortic arch pathologies

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WITHDRAWN

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Abdominal chimney grafts for aneurysms with short neck: are they increasing the EVAR population?

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WITHDRAWN

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Abdominal aortic aneurysms with severe neck and iliac angulations: endovascular treatment with the Aorfix stent-graft

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Purpose: The aim of the study was to evaluate the use of the Aorfix stent-graft for abdominal aortic aneurysms (AAA) with severe neck and iliac angulations.
Material and Methods: From June 2008 to January 2011, 53 patients underwent implantation of the Aorfix stent-graft for abdominal aortic aneurysm repair; 24 (22M,2F; mean age 69 years) had the aneurysm with severe neck (70-90º) and iliac (90-110º) angulations. In 26 cases the neck length was shorter than 1.5cm. Patients were followed up to evaluate safety and effectiveness of this device for such challenging aneurysms.
Results: All procedures were performed under spinal anesthesia. In four cases there were technical issues with cannulation of the contralateral leg. In two cases sandwich technique with the use of Fluency stentgrafts was performed to preserve hypogastric arteries, in other one two Wallstents were implanted into stent-graft legs to avoid external compression. There were two type I endoleaks treated with implantation of aortic cuff. One patient died on 1[st] postoperative day due to bowel ischaemia. During follow-up no deaths, graft migration or disintegration, secondary endoleak or aneurysm growth were observed. All prostheses remain patent.
Conclusion: Early data with the Aorfix stent-graft show favorable results. The flexible design allows safe aneurysm exclusion in patients with complex infrarenal AAA anatomy.

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Thoracic abdominal endovascular aneurysm repair (TEVAR) in the management of acute aortic syndrome (AAS). An early experience with de-branching, chimney techniques and multilayer stenting

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Purpose: 33 TEVAR were performed for 31 patients (13 females:18 males) over a period of 36 months of which six were emergencies. The mean age was 64.6 years. 26 patients were ASA grade III or more.
Material and Methods: Risk factors were hypertension (n=20), hypercholesterolaemia (n= 17), smoking (n=14) and ischaemic heart disease (n=9). 17 procedures were for thoracic abdominal aneurysms type three, 7 thoraco-abdominal aneurysms type four, 4 aortic dissection Type B, 1 infantile adult aortic coarctation and 2 spontaneous supra visceral aortic ruptures. Seven patients underwent a one-/two-stage hybrid debranching of visceral vessels followed by TEVAR. Fourteen patients underwent chimney or Snorkel endografting of subclavian or renal vessels. Two patients underwent multilayered stenting for thoraco-abdominal aneurysms with visceral involvement. One patient had a CPS stent for infantile adult coarctation.
Results: Primary endpoints were 6% mortalities within 30 days for the two acute emergencies of which one was a HIV patient with syphilitic aneurysm. 30-day morbidity was one acute tubular necrosis and one lower respiratory tract infection. Aneurysm free survival time was 19 months. No patients developed aneurysm rupture, paraplegia or stroke. Four cases of endoleak were witnessed; however, no aneurysm expansion was experienced. Two patients required re-intervention for graft migration.
Conclusion: We display from our experience that minimal invasive techniques with TEVAR and debranching, chimney, snorkel and multilayered stent grafting of visceral vessels are safe, prudent and economically viable. The development of multilayered stenting technique looks ever promising for future management of complex aortic pathologies.

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Para millennium high risk AAA saga: a clinical dilemma but not a major concern for the endovascular specialist!

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Purpose: Between 1996 and 2009, of 2868 patients referred with AAA disease, 575 have had AAA repair, performed by one specialist vascular team and two general surgery teams.
Material and Methods: From 1996 to 2009 our mean patient age has risen by an average of 0.5% per annum from 71 years in 1996 to 78 years in 2009 (p=0.023). There has been a concomitant significant rise in SVS co-morbidity score (P<0.001), Kertai-probability index (P<0.01), SVS anatomical score (P<0.01) and the Australasian endovascular aneurysm repair risk assessment (ERA) model (P<0.05) when comparing 1998 to 2009. The percentage of endovascular repairs has increased from 0 to 91% and despite an increase in complexity and a percentage increase of Pararenal repair of <1% in 1996 to 31% in 2009, there has been a consistent drop in peri-operative mortality and morbidity rates. Elective operative mortality prior to the establishment of a specialist deliberate practice volume centre and prior

to the introduction of endovascular techniques in 2002 was 15.7% per annum compared to 1.8% since 2002 (P<0.0001).
Results: Freedom from major adverse events (MACE) has increased over the last decade from 28% to 78% (p=0.0009, h=0.32 [95%CI=0.17 to 0.61]). Cox proportional hazards ratio showed that age, gender, SVS co-morbidity score, Kertai-probability index, SVS anatomical score and ERA Model score did not influence 5-year aneurysm-related survival or freedom from MACE.
Conclusion: Procedural innovation, minimally invasive technologies and enhanced understanding of the management of high-risk factors have led to substantial upturn in aneurysm survival rates and a profound recuperation of both quality of life and cost-effectiveness.

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A 10-year single centre experience of endovascular stent graft repair for traumatic thoracic aortic injuries

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Purpose: To evaluate the long-term success of endovascular stent graft insertion for traumatic thoracic aortic injuries. We present our 10-year results in a level I trauma centre.
Material and Methods: Data from 23 consecutive patients with acute traumatic thoracic aortic injuries who were treated with endovascular stent graft insertion, between October 2001 – January 2011 were prospectively analysed. Demographic information along with injury features, insertion technique and complications during and following insertion were recorded. Patients followed up with computed tomography and chest radiographs at regular intervals. Average follow up has been 47 months.
Results: All patients underwent technically successful endovascular repair. Two patients required carotid-carotid bypass and another required a chimney carotid stent during the procedure. No patients required conversion to open repair. Paraplegia rate was zero, although two patients had cerebral infarcts. Complications included one incident of stent migration, one stent graft collapse and two avulsed iliac arteries. There were two type I endoleaks treated at the time of insertion.
Conclusion: Traumatic aortic injury is potentially life threatening with a high mortality if untreated. These patients often present with multiple coexisting injuries complicating open surgical repair and increasing risk of mortality. Endovascular repair of traumatic thoracic aortic injuries is an effective and feasible alternative to surgery, with low mortality and morbidity. It is now emerging as the procedure of choice with long-term durability.

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Repositionable EVAR: the early European experience with the Gore C3 delivery system

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Purpose: Recently, a new repositionable delivery system for the Gore Excluder Stent Graft has become available. The new Gore C3 delivery system enables controlled initial release of the graft coupled with the ability to reconstrain and reposition it for level and rotation. This should improve the operator's confidence with the device, especially in challenging infrarenal necks.
Material and Methods: To assess the advantages of the Gore C3 Delivery System, a registry has been initiated at twelve sites throughout Europe. This registry is designed to capture the actual application of the Excluder in all cases treated with the new delivery system. The information generated in this registry will be standardized across all the sites and will be both qualitative and quantitative for 200 patients. Data collected include patient demographics, relevant medical history, risk scores, morphological data, device components used, repositioning data and procedural outcomes. The patients will be followed for 10 years to characterize the long-term viability of the Gore Excluder Device.
Results: At the time of submission over 60 patients have been treated at these twelve sites. Data collection is ongoing and we expect to be able to present a significantly larger experience at the meeting. Documentation of this early experience should provide an accurate assessment of this novel delivery system.
Conclusion: We will briefly present the elements of the new delivery system, our direct clinical experience at Liverpool, and a summary of the European registry experience with the Gore C3 Delivery System.
Disclosure: DR R McWilliams has received lecture fees from Gore.

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Exclusion of thoracic aortic aneurysm using a recapturable/repositionable Amplatzer thoracic graft: preclinical evaluation in a large swine model

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Purpose: The Amplatzer thoracic graft (ATG) features low-profile delivery, repositionability, recapturability and integration into the aortic wall. The purpose of this study was to evaluate the exclusion of aneurysms in a swine model with ATG.
Material and Methods: Thoracic aortic aneurysms (TAA) were surgically created in 18 swines (58.2-87.6 kg) using a fusiform Dacron graft. ATG is a self-expanding tubular prosthesis consisting of two nitinol and two polyester layers of braid. The graft was mounted into a delivery catheter with a lock mechanism allowing full recapture and reposition of the graft during implant. The graft was deployed via 12 F sheath. Animals were followed up at 1 week, 1 month, 3 months and 6 months, and afterwards euthanized for pathology examination.
Results: Graft implantation was technically successful in all 18 cases. Recapture and reposition of the graft were tried at ten implants without any issues. Aneurysm exclusion rates were 83.3% after implant, 94.4% at 1 week, and 100% at 1 month, 3 months and 6 months. All implanted grafts remained stable in the implanted position throughout the course of the study. Pathology demonstrated generally optimal healing of the grafted aorta and aneurysm characterized by inclusion of the graft in organized, maturing and stable neointima. All the aneurysms were filled by organized thrombus.
Conclusion: Endovascular exclusion of TAA was achieved using a novel metal/fabric hybrid graft in an animal model. The ATG offers the advantages of low-profile introduction, reposition/recapturability and incorporation into aortic wall with neointimal coverage of the graft surface for aneurysm exclusion.
Disclosure: Employee of AGA Medical Corporation

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Open repair versus endovascular treatment in elective and emergency surgery of infrarenal aortic aneurysms: 6 years of single center experience

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Purpose: Endovascular treatment (EVAR) of abdominal aortic aneurysm (AAA) is an increasingly used method in morphological suitable aneurysms alternatively to open surgery (OR). We demonstrate and compare our results in a center of maximum care for elective and emergency patients undergoing endovascular and open surgery.
Material and Methods: A retrospective SAP and PACS database analysis was performed for AAA-patients treated by open and endovascular surgery from 01/01/2004 to 31/12/2009 to compare the early and late results of both methods.
Results: 379 patients with AAA were treated by EVAR (n = 199) or OR (n = 180). The proportion of EVAR increased from 32% (04/05) to 53% (08/09). Among the electively treated patients (n = 330), 163 endovascular and 167 open surgeries were performed. The 30-day mortality after EVAR was 0% compared to 2.3% after OR. Major complications (including MI, dialysis, postoperative bleeding and dissection, stroke) occurred perioperatively with 6.6% after OR more often (4.4% EVAR). A follow-up was performed in 77.9% of the patients (mean follow-up, 26.4 months). In the medium-term follow-up, major complications were recorded with 7.2% for OR and 12.9% after EVAR (including EL I, III, V). In 49 ruptured AAA-patients, 32 were treated by open repair and 17 by EVAR with a hospital mortality of 47 and 24%. Major complications occurred in six patients each.
Conclusion: Technical innovations and clinical experience have increased the possibilities of endovascular AAA-treatment. The excellent early results after EVAR, however, are lowered by the higher rate of secondary complications. For ruptured AAA-patients, EVAR is an important addition to the methods of treatment.

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Rates and complexity of secondary intervention following EVAR

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Purpose: To assess the rate and complexity of secondary intervention following EVAR procedures performed over an eleven-year period at a single centre.
Material and Methods: Retrospective review of case notes and imaging from a prospectively maintained database, detailing EVAR procedures performed between 1998 and 2008 at the Royal Bournemouth Hospital. Secondary intervention defined as surgical or endovascular procedure for managing a complication of EVAR.
Results: During the study period a total of 235 EVAR procedures were performed, with 47 secondary interventions in 44 patients. Complete follow-up data are available in over 90%. During 1998-2003, covering the EVAR 1 trial recruitment period, 120 EVAR procedures were performed, with secondary intervention rates of 9.6% at two years, and 16.8% at four years. Interventions included 6 open conversions, and 8 endovascular procedures for type 1 or type 3 endoleaks.
From 2004 to 2006, 59 EVAR procedures were performed, with secondary intervention rates of 17.5% at two years, and 29.0% at four years. Over 80% were for limb complications or type 2 endoleaks.
In 2007-2008, 56 EVAR procedures were performed with a secondary intervention rate of 3.8% at two years.
Conclusion: Recent fall in the rates of secondary intervention and changes in the severity of complications are likely to reflect technological improvements in stent-grafts, increased operator experience, and changing management of complications.
The need for secondary interventions is a significant problem for EVAR. Cost effectiveness studies often use the EVAR 1 trial intervention rate of 20%. A lower rate will have implications on decision making for individual patients, and general service provision.

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Short-term results with the Powerlink stent-graft at two UK centres

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Purpose: To assess initial results using the Powerlink EVAR system at two UK centres.
Material and Methods: The Powerlink stent-graft is a unibody system, which requires surgical access in only one groin, and is designed to use the aortic bifurcation for anatomical fixation. Retrospective review of imaging and notes for Powerlink device deployment and follow-up at two UK centres - Royal Bournemouth Hospital and Watford General Hospital - assessing initial technical success, short-term complications and secondary interventions.
Results: 33 Powerlink stent-graft procedures performed over the past two years, with neck diameters up to 32 mm, neck lengths ranging from 15 to 60 mm and neck angulation up to 50 degrees. 100% procedural technical success. Additional proximal stents required in two cases for sealing type 1 endoleaks. Initial CT follow-up was available in all patients, with six-month or one-year follow-up in 18 patients. All stent-grafts are patent with no evidence of stent graft migration in any of the study patients. One patient has a type 1 endoleak. There have been two secondary interventions. One was for thrombosis of a limb extended through to the EIA, 2 weeks after the EVAR procedure (before initial CT). This was successfully managed with thrombolysis and support stent deployment. The second was a proximal extension cuff placed endovascularly for a type 1 endoleak at six months. No surgical secondary intervention has been required to date.
Conclusion: Good initial results with the Powerlink system, which represents an alternative to other bifurcated stent-grafts, relying on fixation at the bifurcation, not in the aneurysm neck.

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Trans-caval endoleak embolization (TCEE) of type I and II endoleaks occurring after endovascular abdominal aortic aneurysm repair (EVAR)

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Purpose: To investigate the feasibility and efficacy of trans-caval endoleak embolization (TCEE) of type I and II endoleaks occurring after endovascular abdominal aortic aneurysm repair (EVAR).

Material and Methods: Fourteen patients (6 men, 8 women; mean age 71.6 ± 7.9, range 69-85) with type Ia, II and Ia-II endoleaks and aneurysm sac growth following EVAR were treated by TCEE. In all patients the aneurysm sac was adherent to the inferior vena cava. Type I endoleaks were embolised using coils, while type II endoleaks were embolised with a combination of coils, Glubran 2 acrylic glue and thrombin. Follow-up was performed by computed tomography angiography (CTA) at 1, 6, 12 and 18 months after the procedure.
Results: TCEE was technically successful in all patients (100%). Intrasac pressure dropped from a mean of 63.6 ± 15.2 mmHg (range: 43-89) to a mean of 7.8 ± 2.3 mmHg (range: 5-12). Mean time of fluoroscopy was 15.4 ± 4.1 minutes (range: 10-22). During a mean 9.9 ± 4.5-month (range: 6-18) follow-up period, no aneurysm-related deaths, further increases in aneurysm sac diameter or endoleak recurrences were observed.
Conclusion: TCEE of type I and II endoleaks associated with aneurysm sac enlargement is a safe, effective and feasible procedure. This technique does not require high operational skills and can be performed by all endovascular specialists without the need of CT guidance.

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Embolization of internal iliac artery aneurysms with occluded internal iliac ostia after abdominal aortic aneurysm repair through femoral-internal iliac collaterals

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Purpose: To report retrograde embolization via hypogastric-femoral pathways of internal iliac artery aneurysms (IIAA), which are unaccessible by standard antegrade approach because of previous aortic aneurysm repair.
Material and Methods: Between August 2001 and April 2010 this procedure was attempted in four male patients (mean age 71 years, SD 9.5 years) with symptomatic, expanding IIAAs (mean diameter 10.05 cm, SD 4.98 cm) after abdominal aortic aneurysm repair (2 patients after bifurcated endoprosthesis, 2 patients after aortobiiliacal bypass). The access and the embolization material used varied according to the requirements of the specific case and the availability of newer embolic agents.
Results: All four patients underwent successful retrograde transfemoral embolization of the internal iliac aneurysms without complications. At CTA follow-up the IIAAs did not show any contrast uptake in two patients. In one patient an endoleak type II persisted but the aneurysm showed no further growth. Finally, in the patient with an extremely large IIAA causing hydronephrosis preoperative embolization facilitated safe aneurysmorrhaphy with successful ureteral release. At follow-up (mean 40 months, from 4 to 102 months) the maximal diameter of the aneurysm remained stable (16 cm and 4.7 cm) in two patients and diminished (from 7.5 cm to 6.7 cm and from 12 cm to 7.7 cm) in two patients.
Conclusion: In patients with an expanding internal iliac artery aneurysm despite the obstructed iliac artery, ostium embolization of the feeding internal iliac artery branches was feasible via the hypogastric-femoral collateral pathway.

P-149

Pictorial review of complications following fenestrated endovascular aortic aneurysm repair (FEVAR)

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Learning objectives: To describe both the early and late occurring complications following fenestrated endovascular aortic aneurysm repair (FEVAR). To define what the vascular specialist needs to know to ensure timely identification, management and prevention of such complications and to optimise successful management of juxta- and supra-renal AAAs. Illustrated case guide of a series of complications and potential management strategies with highlighted teaching points.
Background: Endovascular repair of aneurysms with hostile aortic necks is becoming an ever more viable option. Worldwide, there are reports of over 1000 patients successfully treated for non-infrarenal AAA by FEVAR. With these more challenging techniques and devices comes new complications, we aim to highlight complications relating to the use of fenestrated stent-grafts for the treatment of AAAs.
Clinical Findings/Procedure Details: From a series of over 70 FEVAR procedures performed primarily in a single institution, an illustrated case guide of complications, management strategies and outcomes will be presented. Cases include: target vessel compromise, device migration, limb occlusion and dislocation and component fracture. Avoidance strategies will be discussed including the roles of radiological surveillance, preoperative planning and device selection.
Conclusion: FEVAR has the potential for more serious and potentially catastrophic complications. Despite this, complications are less frequent than for conventional stent-grafts and in most cases can be effectively managed by endovascular reintervention. With little long-term follow-up data on FEVAR the true natural history of its complications is still not known as are the true requirements for IR in maintaining procedural success.

P-150

Contrast-enhanced ultrasound versus CT angiography for the detection of endoleak in patients post-EVAR: an evidence-based radiology approach

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Learning objectives: To assess the role of contrast-enhanced ultrasound (CEUS) for EVAR surveillance and endoleak detection using an evidence-based radiology approach.
Background: Endoleak occurs in up to 20% of patients and is a serious complication, associated with increased risk of aneurysm rupture. Regular surveillance is mandatory for early detection of complications. CT angiography (CTA) is the current gold standard imaging modality for EVAR surveillance. This carries risks of cumulative exposure to ionising radiation, nephrotoxic contrast media and high costs. Recent studies have shown that sonographic contrast agents can increase the capability of ultrasound to detect endoleaks whilst avoiding the inherent risks of CTA.
Clinical Findings/Procedure Details: The centre for evidence-based medicine approach was adopted to perform an evidence-based review of the literature. This entails four steps: to formulate an answerable question using the PICO format, to search the primary

and secondary literature, to identify papers with the highest level of evidence and critically appraise them, to form conclusions, and apply to daily practice. This yielded eleven relevant articles, including one systematic review (level 2A) and eight prospective cohort studies (level 2B). These papers were critically appraised.
Conclusion: CEUS is highly sensitive (0.98) for the detection of endoleak in EVAR patients (level 2A evidence). Although its exact role in EVAR follow-up is still unclear, CEUS offers promise as a safe and sensitive screening tool which should be integrated into patient surveillance.

P-151

Endovascular treatment of ruptured abdominal aortic aneurysms: aorto-uni-iliac or bifurcated endograft?

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Learning objectives: To evaluate safety, technical and clinical success rate of positioning endovascular endografts (EG) in ruptured abdominal aneurysms.
Background: Patients with a ruptured abdominal aortic aneurysm confirmed by contrast-enhanced computed-tomography-angiography were eligible for the analysis. Out of a group of 67 patients, 42 patients (62.7%) were treated with endograft. Thirteen patients (30.9%) received an aorto-uni-iliac endograft (group A), and 29 a bifurcated endograft (group B). Patients were divided for comparative analysis according to the configuration of the endograft implanted.
Clinical Findings/Procedure Details: Primary technical success rate was 100%; primary clinical success rate was 95% (40/42). There were 2 intra-operative deaths (4.7%) related to intractable shock. No patient required conversion to open repair. Overall, a total of 12 patients (28.5%) died within 30 days. Hospitalization death rate was 30.9% (13/42). Hospital mortality was statistically higher in group A; type of endograft and intensive care unit admission were the only independent predictors of hospital mortality.
Conclusion: In our experience, an higher mortality rate for the aorto-uni-iliac configuration was observed; shock at admission was confirmed the most important factor for postoperative survival.

P-152

Percutaneous contrast enhanced ultrasound (CEUS)-guided thrombin injection for endoleaks after endovascular repair of abdominal aortic aneurysm: a pictorial review

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Learning objectives: Our purpose is to describe the technique of percutaneous contrast enhanced ultrasound (CEUS)-guided thrombin injection for endoleaks after endovascular repair of abdominal aortic aneurysm, to illustrate the radiological findings and procedure, and to provide some examples with CT correlation.
Background: Endoleaks are the most common complication of placed endovascular stented grafts. Patients with endoleak should either be closely followed or be treated. Endoleaks type II are generally treated by embolization; however, it is not always technically possible and percutaneous thrombin injection is a good method. CT is the preferred modality for evaluation of the graft and for guiding percutaneous embolizations in some endoleaks. Percutaneous contrast enhanced ultrasound (CEUS)-guided thrombin injection in appropriate patients is a good option, and it allows continuous visualization and real-time monitoring of the thrombus formation.
Clinical Findings/Procedure Details: An accurate baseline US and color Doppler exploration is always performed prior to contrast-enhanced study (Pulse inversion, Toshiba). Immediately after intravenous administration of the contrast agent (Sonovue), the harmonic mode is switched on, and the percutaneous thrombin injection is guided. A continuous visualization of the thrombus formation in real time is allowed with this non-ionizing technique.
Conclusion: Endoleaks are well-recognized complications of aortic endovascular stented grafts. Contrast enhanced ultrasound has emerged as an alternative imaging technique in the diagnosis of endoleaks and for guiding percutaneous embolizations, being as accurate as CT, and it allows continuous visualization of the thrombus formation.

P-153

Hybrid procedures for complex thoracic aortic pathology

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Learning objectives: To review the indications on the use of hybrid techniques in patients with thoracic aortic pathology. To give an overview on the imaging findings regarding hybrid procedures for complex thoracic aortic pathology.
Background: Endovascular repair of complex thoracic aortic pathology is emerging as the preferred treatment strategy in certain patients, as increasing data suggest that endovascular repair may be performed with lower peri-operative morbidity and mortality rates and similar midterm survival, when compared with standard open repair. However, because of anatomic constraints related to required endograft seal zones, a significant number of patients are excluded from standard endovascular repair. Hybrid techniques with open surgical supra-aortic extra-anatomical bypasses provide a suitable proximal landing zone. Simultaneous or staged thoracic endovascular stent grafting can then be safely performed. Usually, these hybrid treatments combine surgical debranching of one or more supra-aortic vessels by transposition or supraaortic bypass, with endovascular stentgraft placement into the thoracic aorta to exclude the aneurysm.
Clinical Findings/Procedure Details: We discuss which patients are potential candidates for thoracic aortic hybrid repair and demonstrate how multidetector computed tomography (CT) with two-dimensional (2D) multiplanar reformation (MPR) and three-dimensional (3D) rendering is relevant in preoperative planning and postoperative assessment. A selected subset of cases of thoracic aortic disease treated with hybrid techniques is presented, including successful outcomes and complications.
Conclusion: Knowledge of endovascular techniques, including hybrid repair, of complex aortic diseases is crucial for radiologists to provide the referring clinician information to determine appropriate clinical care. MDCT, including vascular reformations, is the diagnostic test choice for treatment assessment.

P-154

Indications and planning for fenestrated and branched endografts

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Learning objectives: To review the indications on the use of fenestrated and branched stent-grafts in patients with thoracoabdominal aortic aneurysms (TAAA). To give an overview on the imaging findings regarding branched and fenestrated prostheses.
Background: Unfavorable anatomy of the proximal aortic neck of an infrarenal abdominal aortic aneurysm (AAA) is the most common factor precluding patients from an endovascular treatment

option. The use of fenestrated or branched devices allows the extension of the sealing and fixation portions of the graft into a more stable aorta, while simultaneously maintaining branch vessel patency. Fenestrated and branched aortic endografts clearly reduces the surgical impact on the patient, compared to open and hybrid repair alternatives.
Clinical Findings/Procedure Details: We discuss which patients are potential candidates for fenestrated and/or branched stent-grafts and demonstrate how multidetector computed tomography (CT) with two-dimensional (2D) multiplanar reformation (MPR) and three-dimensional (3D) rendering is relevant in preoperative planning and postoperative assessment. A selected subset of cases of thoracoabdominal aortic aneurysms (TAAA) treated with fenestrated and/or branched stent-grafts is presented, including successful outcomes and complications.
Conclusion: Endovascular treatment with fenestrated and/or branched stent-grafts is a new therapeutic option with encouraging results for patients considered unfit for conventional open repair or standard endovascular repair. MDCT, including vascular reformations, is the diagnostic test choice for treatment assessment.

P-155

Endovascular stent grafting for various aortic diseases: indications, imaging work-up, technical considerations, and management of complications

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Learning objectives: 1. To learn indications for endovascular stent grafting based on pathogenesis of aortic diseases. 2. To learn appropriate imaging work-up before endovascular stent grafting. 3. To learn selection of appropriate stent-grafting techniques suitable for each pathogenesis. 4. To learn possible complications related to endovascular stent-grafting and their management.
Background: Most aortic aneurysms that are commonly treated with endovascular stent grafting are atherosclerosis in origin. However, recently, this procedure has been increasingly performed for the treatment of aortic diseases due to a variety of causes. Aortic diseases can be divided into the following three groups based on their pathogenesis and indications for stent grafting; 1. good indication, 2. controversial indication, and 3. poor indication. Knowledge of indications for stent grafting and selection of stent-grafting techniques suitable for each pathogenesis are mandatory to obtain excellent long-term results.
Clinical Findings/Procedure Details: Content 1. Indications for stent grafting based on pathogenesis Good indication - Atherosclerotic aneurysm - Iatrogenic disease - Traumatic injury - Penetrating atherosclerotic ulcer - Intramural hematoma - Inflammatory AAA Controversial indication - Infected aneurysm - Vasculitis-related aneurysm - Aortic dissection Poor indication - Marfan syndrome - Behçet disease - Ehlers-Danlos syndrome 2. Imaging work-up before stent grafting 3. Technical considerations in specific pathogenesis 4. Results of stent grafting for various aortic diseases 5. Complications related to stent grafting and their management
Conclusion: Endovascular stent grafting is an effective treatment for aortic disease due to a variety of causes. However, selecting patients suitable for endovascular treatment, choosing the stent-graft devices, and planning the intervention are mandatory to obtain excellent long-term results, and to reduce potential complications.

P-156

Chimneys, snorkels and periscopes: options for endovascular repair of complex abdominal aortic aneurysms

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Learning objectives: Endovascular treatment of aortic aneurysms with infra-renal neck length <10mm is associated with a high risk of type 1 endoleaks. Such patients are therefore usually offered open repair, despite its higher mortality. We present our experience with the chimney technique – a technique for renal and visceral revascularization allowing complete endovascular treatment of juxta/supra-renal aneurysms, using off-the-shelf devices. We used this technique in high-risk patients in whom either anatomy or urgency prevented the use of a custom-made fenestrated device.
Background: Between November 2008 and February 2011, 14 patients fulfilled the above criteria and were treated using the chimney technique as 'compassionate' cases.
Clinical Findings/Procedure Details: Immediate intra-operative technical success was achieved in all cases. There were 2 in-hospital deaths. During a mean 9-month follow-up (range 1-24), one patient developed a type 1 endoleak through the gutter between the chimney stent-graft and the main stent-graft. This was successfully treated using coil embolisation. The remaining 11 patients have no type 1 endoleaks and all their target vessels remain patent at their last follow-up.
Conclusion: The results of a fully endovascular repair of juxta- and supra-renal aneurysms using off-the-shelf stent-grafts are promising. It could be used as a planned procedure in patients with short infra-renal necks or as a rescue procedure in cases with unplanned covering of a vital visceral vessel. Although long-term results need to be awaited before this technique can be recommended routinely, it remains the only alternative for poor surgical candidates with juxta/supra-renal aneurysms in the emergency situation.

P-157

Juxtarenal aortic aneurysm: easy treatment for a complex aneurysm with multilayer stent

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An old man with a juxtarenal AAA was treated by deploying an uncovered multilayer stent. CT after 1, 3, 9 months showed excellent patency of the stent, with a normal perfusion of the viscera and a correct shrinkage.

P-158

Chimney graft for the treatment of a symptomatic aortic anastomotic pseudoaneurysm

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An octogenarian high risk surgical patient with a symptomatic aortic anastomotic pseudoaneurysm following an aorto-femoral bypass with dacron prosthesis was successfully treated with the Chimney graft technique to left and right renal arteries.

P-159

Endovascular aneurysm repair using a reverse chimney technique in a patient with Marfan syndrome and contained ruptured chronic type B dissection

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A Marfan patient presented with contained juxtarenal ruptured type B dissection. EVAR was performed in modified chimney technique to preserve flow into the left renal artery. Follow-up showed thrombosis of the false lumen and excellent perfusion of the left kidney.

P-160

Prophylactic TEVAR placement prior to removal of pedicle screw impinging on thoracic aorta

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Aortic injury following posterior spinal instrumentation can present acutely or chronically with pseudoaneursym formation. In our case CT angiography demonstrated a screw apparently within aortic lumen. We demonstrate an effective combined procedure with prophylactic TEVAR placement prior to pedicle screw removal.

P-161

Double-chimney technology treating secondary type I endoleak after endovascular repair for complicated thoracic aortic dissection

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Endovascular repair continues to pose a formidable technical challenge in aortic arch pathologies. With the first experience in double-chimney technique, we simultaneously preserved the innominate artery and the left common carotid artery for total reconstruction of the aortic arch.

P-162

Aortoduodenal fistula after surgical bypass: endovascular treatment of nearly fatal haemorrhage

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We are presenting a case of nearly fatal haemorrhage after incidental aortoduodenal fistula formation. Patient had surgically treated AAA with goretex bypass several years ago. He presented with massive haemorrhage into duodenum, and was successfully treated with bifurcational aortic endoprosthesis.

P-163

Contained rupture of a penetrating atherosclerotic aortic ulcer involving the origin of the celiac trunk treated by the cardiatis multilayer stent in a symptomatic patient

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A symptomatic contained rupture of a penetrating atherosclerotic aortic ulcer involving the origin of the celiac trunk successfully treated by cardiatis multilayer stent. Furthermore, the flow diverter stent preserves the main visceral vessels patency avoiding a high risk surgical intervention.

P-164

Stent-graft for a large innominate aneurysm

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The author successfully treated a patient with a large true aneurysm of the innominate artery by endovascular stent-graft exclusion via the right carotid artery approach, who was followed up for a year with stable status.

P-165

EVAR in a patient with horseshoe kidney

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EVAR has become an attractive method of treatment, especially for patients with unusual abdomen anatomy. We report a case of a 65-year-old male with horseshoe kidney which was successfully treated with endovascular aortic aneurysm repair.

P-166

Hybrid open and endovascular repair of a true left subclavian artery aneurysm without proximal neck

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Patient with a true left subclavian artery aneurysm incidentally found after a CT. Follow-up angioCT showed enlargement of the aneurysm to 4.3cm of diameter. Hybrid repair with carotid-carotid-left subclavian bypass and stent-graft of the arch and descending aorta was performed.

P-167

Transcatheter embolization of type II endoleak after EVAR

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Patient presented with a previous EVAR and coil embolization of left hypogastric aneurysm. Follow-up CT: type II endoleak (inferior mesenteric artery-IMA). Transcatheter coil embolization via superior mesenteric artery (arc of Riolan) of IMA was performed with complete treatment of the endoleak.

P-168

Endovascular repair of abdominal aortic aneurysm after renal transplantation

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Male patient with previous renal allo-graft transplantation in the right common iliac artery presenting with an abdominal aortic aneurysm was treated with endovascular repair using minimal enhanced contrast medium; post-operative follow-up with maintenance of renal-allograft function.

P-169

Endovascular management of stent-graft thrombosis in a case of traumatic thoracic aortic injury

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A 25-year-old man underwent two stent grafting for traumatic injury of thoracic isthmus. After one year, CT angiography documents distal concentric thrombosis in the stent-graft. We perform the insertion of third graft.

P-170

Endovascular repair of a ruptured abdominal aortic aneurysm in a patient with a horseshoe kidney

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WITHDRAWN

P-171

Collateral between the thyrocervical trunk and the bronchial artery, a source of type II endoleak after endovascular repair of a thoracic pseudoaneurysm: treatment with Onyx

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We report the management of a type II endoleak arising from a thyrocervical trunk-bronchial artery collateral in a patient with a stent graft, deployed for treatment of a thoracic pseudoaneurysm. We report the use of Onyx at this unusual anatomical location.

P-172

Treatment of a thoracoabdominal aortic aneurysm using a cardiatis multilayer stent

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A patient previously treated with surgical substitution of aortic arch and infrarenal abdominal aorta developed a thoracoabdominal aneurysm and was treated using a cardiatis multilayer stent. At 9-month follow-up, the aneurismal sac is reduced and the surrounding vessels are patent.

P-173

Iliac paraanastomotic pseudoaneurysm treated using a cardiatis multilayer stent

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A patient previously treated with surgical substitution of the abdominal aorta developed a paraanastomotic iliac pseudoaneurysm and was treated using a cardiatis multilayer stent. At 3-month there was no opacification of the pseudoaneurysm and the ipogastric artery was patent.

P-174

Endovascular treatment of descending thoracic aortic aneurysm in Takayasu arteritis: case report

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We report a case with an aneurysm of descending thoracic aorta due to Takayasu arteritis. To our knowledge, this is the first reported case treated with stent graft implantation to cover the aortic aneurysm in Takayasu arteritis.

P-175

CT- and fluoroscopy-guided percutaneous transabdominal embolization of type II endoleak

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In this case report, we demonstrate percutaneous transabdominal embolization of type II endoleak with a large sac located anterior aspect of the stent-graft in a 75-year-old male.

P-176

Endovascular treatment of iatrogenic ruptured thoracic aortic pseudoaneurysm after an open vertebral biopsy: case report

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We are presenting a patient with an iatrogenic ruptured thoracic aortic pseudoaneurysm after an open vertebral biopsy which was treated successfully with aortic stent-graft.

P-177

Kissing stent placement for blunt traumatic abdominal aortic obstruction

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We present a case of a 60-year-old man with blunt traumatic abdominal aortic dissection causing severe obstruction. Self expanding bare stent placement with the kissing technique was successfully performed to reconstruct aorto-bi-iliac obstruction.

P-178

Idiopathic growing fat-containing lesion within the aneurysm sac after endovascular stent graft repair of an abdominal aortic aneurysm

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Fat within an aneurysm sac is rare, having never been previously described. In our presented case, a growing fatty lesion is seen within the aneurysm sac after endovascular stent graft repair of an abdominal aortic aneurysm. The etiology is unknown.

P-179

Failed TEVAR and final hourglass shape of the stent-graft due to the embracing of a 10-mm migrated nitinol stent

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TEVAR of a chronic type B dissection, 7cm descending thoracic aneurysm and abdominal aorta true lumen occlusion that was recanalized with a 10mm self-expandable stent. By stent-graft deployment we dragged the stent into the thoracic aorta.

Experimental work in IR

P-180

Improved function of circulating angiogenetic cells is evident in type 1 diabetic-islet transplanted patients

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Purpose: In type 1 diabetic patients, endothelial dysfunction is commonly present; a reversal of endothelial dysfunction was previously described after pancreas transplant. Circulating angiogenic cells (CACs) are vascular-committed bone-marrow derived cells that are dysfunctional in type 1 diabetes (T1D). We studied if restoration of endogenous beta cells function with islet transplantation is associated with better CACs function.
Material and Methods: Patients underwent endothelial dilatation assessment through ultrasound technique. We studied with US (Philips-ATL IU-22) the right brachial arteries of 14 insulin independent percutaneous islet-transplanted patients (ITA) , 18 type 1 diabetic untransplanted patients (T1D) and 14 healthy controls (C). Mean antero-posterior diameter increase of the right brachial artery after local ischemia (brachial compression) and after sublingual nitrates was evaluated to assess endothelial dependent dilation (EED) and independent dilatation (nitrate induced, NDD). Moreover, these parameters were correlated with Hba1c.
Results: T1D showed a lower EDD compared to healthy controls (T1D=4.1±1.4 vs. C=8.6±0.6%, p=0.0001,). Interestingly, ITA showed a normal EDD being statistically higher compared to T1D group (ITA=16.4±2.3%, p=0.0007 vs. T1D). EDD negatively correlated with HbA1c (R=-0.40, p=0.01). On the contrary, no differences in NDD were found in the three groups studied (T1D=17.3±3.0, C=23.6±4.5 and ITA=19.2±3.5%; ns).
Conclusion: Diabetic patients showed a lower percentage of EDD compared with healthy controls, while after islet transplantation a fully recovery of endothelial function was evident. On the contrary, no differences in NDD were found in the three groups studied confirming the hypothesis that the defect of CACs may reflect into a macroscopic alteration of endothelial function in patients.

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Targeted endovascular temporary vessel occlusion with a reverse thermo-sensitive polymer for bloodless partial nephrectomy: comparison to standard surgical clamping techniques

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Purpose: To determine if reversible blood flow interruption to a randomly chosen target region of the kidney can be provided with the injection of a thermoplastic polymer through an angiographic catheter to facilitate its resection without compromising the blood flow to the remaining kidney or adding risks beyond those encountered by the use of hilar clamping.
Material and Methods: 15 pigs underwent partial nephrectomy after blood flow interruption by vascular cross clamping (n=6) or injection of a reversible thermosensitive polymer (Lumagel™) into

a segmental artery. 5 animals were euthanized following surgery (3 x open and 2 x laparoscopic resection), 10 (open resection) after 6 weeks of survival. Blood specimen was obtained throughout, a repeat angiogram and a complete necropsy at six weeks.
Results: Selective renal ischemia was achieved in all cases. Surgical resection time averaged 11 minutes (range 10-13) and 23.3 (range 9-40) in the open and laparoscopic groups, respectively. Estimated blood loss was negligible with the exception of one case where an accessory renal artery was originally overlooked. Reversal of the polymer to liquid state was consistent angiographically and visually in all cases. Time to complete flow return averaged 7 and 2.5 minutes for Lumagel™ and arterial clamping, respectively. Angiographic analysis at six weeks did not demonstrate any evidence of vascular injury. Laboratory data and necropsies showed no differences between animals undergoing vascular clamping or polymer injection.
Conclusion: Lumagel™ was as effective as vascular clamping in producing a bloodless operative field for partial nephrectomy while maintaining flow to the uninvolved portion of the affected kidney.
Disclosure: Sebastian Flacke is a consultant for Pluromed Inc. James A Benn and Peter N. Madras disclose a financial interest in Pluromed, Inc. This work was supported by NIH SBIR Grant: 1R43DK079481-01

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First multimodal embolization particles visible on X-ray/computed tomography and magnetic resonance imaging

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Purpose: Most commercially available, particulate embolization materials are not visible in any imaging modality. A direct detection of embolization material would be desirable for prevention of material misplacement, for direct therapy control as well as follow-up imaging and for assurance of visibility in hybrid (X-ray/MRI) angiography setups at all times. Therefore, we created an embolization particle visible in X-ray/CT and MRI.
Material and Methods: X-ray visible iodine was combined with MRI visible iron in a macroparticle (diameter 60-200µm). A core consisting of copolymerized monomer MAOETIB [2-methacryloyloxyethyl (2,3,5-triiodobenzoate)] was coated with paramagnetic iron oxide nanoparticles. After ex-vivo examinations, including SNR measurements (n=5), its ability to embolize tissue was tested in an established tumor embolization model in six rabbits. X-ray fluoroscopy, CT and MR imaging were performed on clinical scanners before, during and after application of particles to the catheterized renal artery. Histology was prepared.
Results: The particles provided a clear image contrast in fluoroscopy, CT (SNR: 13 ±2.5) and MRI (SNR: 35 ±10). Successful kidney embolization was confirmed by angiography. Particles residing within the renal parenchyma were found in corresponding areas in MRI and CT. Dynamic imaging during embolization provided real-time detection of embolization particles inflow within fluoroscopy, CT and MRI. Histology showed residing particles and associated thrombosis in renal arteries.
Conclusion: Novel multimodal visible embolization particles being visible in X-ray/CT and MRI were developed and successfully tested in an animal model. Potential impact on embolization therapy is large.

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Multimodal visibility (angiography, CT and MRI) of embolization particles for liver embolization: a feasibility study

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Purpose: To evaluate multimodal visibility of embolization particles on angiography, CT and MRI in a porcine liver model.
Material and Methods: The livers of four pigs were embolized with two different sizes (100 micrometer +/- 25 micrometer; 700 micrometer +/-50 micrometer) of modified embolization particles (Embozene™ Microspheres) embedded with a) different density of radiopaque material (intensity A, B, and C, with increasing intensity from A to C for the 100microm size and intensity A and C for the 700 micrometer size) and unloaded Embozene™ particles as control group, and b) magnetic substance for MRI visibility. During the embolization procedure, no contrast agent was added to the embolic agent. Prior to the embolization and immediately after embolization, MRI and CT were performed. Subjective and objective (determination of the SNR - signal to noise ratio) particle visibility was evaluated on angiography, CT and MRI.
Results: For the 100 micrometer particle size, the angiographic visibility was good for group B and C, whereas the unloaded particles of the control group were not visible. Also, CT visibility was excellent for the groups B and C loaded, which were loaded with the highest intensity of radiopaque material. The control group was not visible. MRI visibility was excellent and comparable for groups A, B and C, whereas the control group was not visible. The 700 micrometer particles had a lesser angiographic visibility, most likely caused by an overall lower number of particles than in the 100 micrometer groups. CT visibility was good for group C, whereas group A was only slightly visible. On MRI, groups A and C had an excellent visibility. The control group was visible neither on CT nor on MRI.
Conclusion: Modification of the current available Embozene™ particles was successful with multimodal visibility on angiography, CT and MRI in a porcine liver model.
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Δ(k2-k5)Plasmin (TAL6003) is an effective and safe direct acting thrombolytic as compared to rtPA: implications for stroke therapy

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Purpose: Bleeding complications limit the use of rtPA for the treatment of thrombo-embolic stroke in the clinic. Because of this, a safer thrombolytic agent is desirable. Δ(K2-K5)Plasmin (TAL6003) is a novel thrombolytic that is a recombinant form of naturally occurring plasmin where kringle 1 is spliced directly to the serine protease domain preserving both fibrin- and α2-antiplasmin binding functions.
Material and Methods: Efficacy of TAL6003 to lyse clots from

humans, canine and rats was tested in vitro. The efficacy of TAL6003 to lyse a thrombus in vivo was tested in a beagle dog femoral artery thrombosis model. And the safety of TAL6003 with respect to intracerebral hemorrhage transformation was tested in a middle cerebral artery occlusion (MCAo) model in spontaneously hypertensive rats (SHR).
Results: TAL6003 lysed clots from humans, canines and rats with nearly identical kinetics. TAL6003 (1.25 mg/kg) and rtPA (0.5 mg/kg) treatment significantly reduced the size of an arterial thrombus in the dog arterial thrombosis model as opposed to vehicle treatment (thrombus wt.: 171±20 mg 7±5 mg, and 53±10 mg, for vehicle, rtPA and TAL6003, respectively; p<0.01). TAL6003 (0.15, 0.5, 1.5 and 5 mg/kg) infusion starting after 6 hours of MCAo in the SHR and immediately before reflow induced no increase in severity or frequency of hemorrhagic transformation compared to saline or vehicle. In contrast, rtPA (10 and 30 mg/kg) induced more extensive intracerebral hemorrhage. TAL6003-treated rats displayed improvement in behavior.
Conclusion: These data suggest that TAL6003 is as efficacious as and safer than rtPA for ischemic stroke.
Disclosure: I am an employee of Talecis Biotherapeutics

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Accuracy of fluoroscopic needle guidance using trajectory overlay from C-arm CT

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Purpose: To evaluate error in needle tip location when using fluoroscopic guidance combined with trajectory overlay from C-arm CT.
Material and Methods: C-arm CT images of anthropomorphic phantom (Model 057, CIRS) were acquired with a flat panel detector (Innova 4100 GE Healthcare). 5 trajectories were defined using a software dedicated to needle guidance. Each trajectory corresponds to a different target point inside the phantom. Then trajectories were overlaid in real time on top of fluoroscopic images. Two experienced interventional radiologists, inserted needles according to the predefined trajectories. The "lesions" defined as target points were not visible under fluoroscopy, to ensure that the needle guidance relied exclusively on the trajectory that was overlaid on top of fluoroscopy. After each needle insertion of the needle, a C-arm CT image was acquired with the needle in place. Error was defined as 3D distance between the target and the real needle location.
Results: All punctures were achieved in less than 1 minute and during the first attempt. The error in needle tip location was 1.4±O.7 mm (mean ±DS) overall. It was not different for the two operators with errors of 1.2±0.6 mm and 1.5±0.9 mm, respectively. In all the measurements performed, the minimal and maximum errors were 0.4 mm and 3.2 mm, respectively. Evaluation of the accuracy in clinical experience with fluoroscopic guidance combined with trajectory overlay from C-arm CT for puncture of bone lesions during cementoplasty or thermal ablation will be presented.
Conclusion: Accuracy of needle placement using needle guidance software on 3D C-arm CT is high.
Disclosure: Mr Yves Trousset is a GE Healthcare employee

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In vivo comparative study of cryoplasty in a rabbit iliac artery model: histological outcomes following single or double balloon inflation

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Purpose: To in vivo investigate the histological response after single or double cryoplasty therapy in a rabbit iliac artery model.
Material and Methods: In total, 40 New Zealand White rabbits underwent percutaneous transluminal angioplasty of the iliac artery using either PolarCath balloon or a conventional angioplasty balloon of equal diameter. Arterial injury, inflammatory response and smooth muscle cells (SMC) apoptosis using the TUNEL (Terminal deoxynucleotidyl transferase dUTP Nick End Labeling) immunohistochemical assay were analyzed. Rabbits were divided between single or double balloon inflation and histological results were compared between cryoplasty and control angioplasty both at 30 minutes and 72 hours.
Results: Arterial injury and wall inflammation scores were low and similar between cryoplasty and control groups after single and double balloon inflation. Compared to conventional balloon angioplasty, Polarcath cryoplasty demonstrated superior SMC apoptosis after single inflation at 30 minutes [12.0±1.2 cells/(0.025mm)2 vs 7.0±1.5 cells/(0.025 mm)2, P=0.002], single inflation at 72 hours[9.0 ± 1.0 cells/ (0.025 mm)^2 vs 5.4±1.4 cells/(0.025 mm)^2, P=0.001],double inflation at 30 minutes [11.6±1.5 cells/(0.025 mm)^2 vs 6.8 ± 1.4 cells/(0.025 mm)^2, P=0.001] and double inflation at 72 hours [9.2±0.8 cells/(0.025 mm)^2 vs 5.0 ±0.7 cells/ (0.025 mm)^2, P=0.001]. There were no significant differences in apoptosis between single and double cryoplasty application at 30 minutes and 72 hours.
Conclusion: Cryoplasty demonstrated superior rates of SMC apoptosis at 30 minutes and 72 hours and was associated with relatively low arterial injury and inflammation scores. An immediate second PolarCath inflation did not achieve superior apoptosis.

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Mechanisms of doxorubicin toxicity on liver after TACE with doxorubicin-loaded microspheres in pigs

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Purpose: Doxorubicin has a toxicity which is not well known in chemoembolization application. We evaluated the mechanisms of hepatotoxicity of doxorubicin-loaded microspheres (DoxMS) by histology and DNA-microarray technique [Blomme, Toxicology Letters, 2009].
Material and Methods: Hepatic arteries of two pigs were embolized with 1 mL of DoxMS (25mg) or BlandMS. Histopathological effects were evaluated at 1W. RNAs were extracted from embolized areas (n=3/pig) and hybridized onto Agilent porcine microarrays. Genes showing significantly different expression (p<0.01) between two groups were listed and classified by biological process.
Results: At 1W after embolization, DoxMS caused important tissue damages (vascular necrosis in 51% of embolized vessels, parenchymal necrosis in 38%), whereas BlandMS caused no tissue damage. At the necrosis margin, repair process started with inflammation

and tissue remodeling. The gene expression analysis highlighted pathways associated with histological reactions: Damages: DoxMS up-regulated genes vs BlandMS (n=353) were significantly related to (1) cell death, (2) apoptosis (genes revealing DNA damages), and (3) metabolism of doxorubicin (Multidrug resistance gene MDR5). DoxMS down-regulated genes (n=120) were mainly related to hepatic functions: enzymes of lipid and carbohydrate metabolisms. Repair: Among up-regulated genes, clusters of genes proved the liver healing and regeneration. They related to (1) cell proliferation (CTGF, GDF15 and HGS growth factors), (2) tissue remodelling (MMPs and several collagen types), (3) inflammatory reaction (IL6, IL8, CCL2, CCL20, CXCL2, CXCL14) and (4) angiogenesis (HIF1a pathway).
Conclusion: DoxMS caused (1) hepatic function alteration through cell death and apoptosis pathways, and (2) an inflammatory repair process started at 1W with a cell proliferation, tissue remodelling and angiogenesis.

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VEGF and bFGF transfected VX2 tumors necrotize spontaneously much less than classical VX2 since they have a higher intratumoral vascular density

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Purpose: We have recently demonstrated (Pascale, et al, SIR 2011) that upregulation of VEGF in VX2 cells increased the tumor volume and reduced necrosis, while upregulation of bFGF reduced the tumor necrosis but had no effect on tumor volume. In this work we searched for difference between the intra tumoral and the peritumoral MVD of these two transfected tumors vs classical VX2 tumors that could explain the differences observed in terms of necrosis extent.
Material and Methods: Two VX2 cell line transfected with rabbit VEGF or bFGF cDNAs were multiplied in culture before grafting. White New Zealand rabbits were implanted into leg muscle with VEGF-VX2 (n=5), bFGF-VX2 (n=5), classical VX2 tumors (VX2-Control) (n=8). Animals were sacrificed at D21. Mean vascular density (MVD, vessels/mm^2) was quantified by counting CD31 stained vessels into the tumor core (Intra-MVD) and on the tumor edges (Peri-MVD). Necrosis was evaluated on digital images of HES-stained tumors.
Results: Intra-MVD was significantly higher in VEGF-VX2 group (102±43) and in bFGF-VX2 group (66±35), vs VX2-control (38±37) ($p<0.0001$ MW each). Peri-MVD was not different between VEGF-VX2, bFGF-VX2 and VX2-control groups (77±30, 78±31 and 95±47, respectively) (p=0,3462,KW, NS).
Conclusion: Transfection of VEGF or bFGF in VX2 cells increased the intra-tumoral vessel density, but not the peri-tumoral one. This supports the hypothesis that intra-tumoral vessels are insufficient in classical non-transfected VX2 tumors to prevent their necrosis. The two transfected tumors could be proposed as models for evaluating small-size drug eluting microspheres in terms of intra-tumoral penetration and antitumoral efficacy.

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7.0T MR detects atherosclerotic plaques in ApoE-/- mouse carotid artery by specific immunomagnetic probe

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Purpose: To synthesize the anti-mouse matrix metalloproteinase-9 immunomagnetic nanoparticlesï¼ˆAb-SPIOï¼‰chemically; then, to investigate the possibility of Ab-SPIO specific probe as a marker of atherosclerotic plaques detected with 7.0T magnetic resonance imaging system in mice model.
Material and Methods: Superparamagnetic iron oxide (SPIO) was prepared by chemical coprecipitation and coated with meso-2,3-dimercaptosuccinic acid (HOOCCH(SH)-CH(SH)-COOH) or DMSA]. The anti-mouse matrix metalloproteinase-9 immunomagnetic nanoparticles (Ab-SPIO) are synthesized by grafting anti-mouse matrix metalloproteinase-9 antibodies on the surface of DMSA-coating using the linker of EDC (1-ethyl-3-[3-dimethylaminopropyl] carbodiimide hydrochloride).The conjugation amount of the antibodies and the activity of Ab-SPIO were evaluated by enzyme-linked immunosorbent assay (ELISA). A model of atherosclerosis was established by ligating the ApoE-/- mice left carotid artery and feeding with high lipid diet. The mice models were injected with Ab-SPIO through the tail vein. MR imaging was performed 0, 4, 6, 24 and 48 h after the injection and then histological (Perl's Prussian blue staining and immunohistochemistry) study was done.
Results: The optical density (OD) from ELISA increases with increase in the quality of antibodies. Six hours after the injection of Ab-SPIO, the injured vessels showed signal intensity loss on T2WI most obviously, corresponding to Perl's Prussian blue staining-positive particles under the endomembrane revealed by histopathological study. Also, immunohistochemistry showed appreciable MMP-9 staining under the endomembrane.
Conclusion: The anti-mouse matrix metalloproteinase-9 immunomagnetc nanoparticles (Ab-SPIO) can be chemically synthesized by EDC; the conjugation activity and stability still remain. It is possible to use Ab-SPIO specific particles as a marker of atherosclerotic plaques detected with 7.0T magnetic resonance imaging system in mice carotid artery.
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In vivo comparison of radiofrequency ablation with saturated saline preinjection and renal artery occlusion in canine kidneys

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Purpose: To compare the ablation zone after radiofrequency ablation (RFA) with saturated saline preinjection and renal artery occlusion in canine kidneys.
Material and Methods: RFA wad induced in the exposed kidneys of 6 anesthetized mongrel dogs. Eight ablation zones were induced using a 1-cm tip internally cooled needle electrode in 3 groups: RFA (Base group), RFA with 0.5 mL saturated saline preinjection (SS group), and RFA with renal artery occlusion (Occlusion group). Ablation zone diameters were measured along transverse and longitudinal sections of the needle axis, and volumes were calculated. Temperature, applied voltage, current, and impedance during RFA were recorded automatically.
Results: RFA zone volume was greatest in the SS group (1.33 ± 0.34 cm^3), followed by the Occlusion group (1.07 ± 0.38 cm^3) and then the Base group (0.62 ± 0.09 cm^3). Volumes for the SS and Occlusion groups were significantly larger than those for the Base group ($p = 0.001$ and $p = 0.012$). There was no significant difference in volumes between the SS and Occlusion groups ($p = 0.178$). The variation in the volumes for the SS and Occlusion groups was greater than that for the Base group. The tissue impedance decrease and current increase of the SS group were significantly greater than those of the Occlusion and Base groups ($p < 0.001$).

Conclusion: Both saturated saline preinjection and renal arterial occlusion are effective for expanding the ablation zone. RFA with saturated saline preinjection may result in a slightly larger ablation zone compared with RFA with renal arterial occlusion

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Comparative study of anti-tumor effects of suspension and emulsion of miriplatin-lipiodol using a VX2 liver tumor model

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Purpose: Miriplatin (formerly SM-11355), which is a fat-soluble platinum complex, has the capability to be suspended in lipiodol. In this work, we studied the anti-tumor effect of suspension and emulsion of miriplatin-lipidol for transarterial chemoembolization.
Material and Methods: A total of 30 Japanese white rabbits were randomly assigned to ten groups at 2 weeks of VX2 tumor transplantation to the liver. We prepared four types of mixture: a suspension of lipiodol (0.1 ml/kg) and miriplatin (2 mg/kg) (ML), an emulsion of miriplatin dissolved with lipiodol and contrast medium (MLC) or saline (MLS), and saline alone (S). Ratios between ML and contrast media/saline volumes were 1:1/4, 1:1/2, 1:1 and 2:1, respectively. To evaluate the usefulness of the anti-tumor effect, sequential change of the plasma platinum concentration within the first 24 h, as well as the tissue/tumor platinum concentrations at 1 week was measured after intra-arterial infusion of these mixtures. In addition, the reduction rate of the VX2 tumor was calculated among ten therapeutic groups after 1 week of intra-arterial infusion on the basis of 0.3 Tesla MR images.
Results: On comparison of the total plasma platinum concentration and the tissue/tumor platinum concentrations, there were no significant differences among these groups. On the other hand, the tumor reduction rate tended to be higher in groups MLC and MLS (group MLC = group MLS > group ML > group S). In terms of emulsion ratios of ML and saline/contrast medium, both combinations at the emulsion ratio of 1:1/2 and 1:1 showed a slightly higher rate in tumor reduction.
Conclusion: We suggest that an emulsion rather than a suspension of miriplatin-lipiodol may be more effective for clinical use.

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Autologous endothelialization of a bioprosthetic valve for the treatment of chronic deep venous insufficiency

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Purpose: To demonstrate the feasibility of seeding bioprosthetic venous valves with autologous endothelial progenitor cells (EPC) to reduce thrombosis and intimal hyperplasia (IH) after percutaneous implantation.
Material and Methods: EPC were evaluated in vitro as a source of autologous seeding for SIS endothelialization. EPC were isolated from whole blood of adult domestic sheep. In vitro cell adhesion and proliferation of ovine EPC on a porcine small intestinal submucosa (SIS) was compared to collagen I-coated tissue culture wells. Conditions for seeding SIS with ovine EPC were optimized with a concentration of 300,000 cells/cm^2 and incubation for 48 h in a minimal ovine serum media. Endothelialization was evaluated by immunofluorescent staining, DNA quantification, functional assays, and quantitative real-time polymerase chain reaction (PCR).
Results: Immunofluorescent staining of actin on the SIS after seeding with these conditions revealed a confluent layer of EPC. DNA quantification via Picogreen assay indicated no significant difference in the number of cells on the SIS versus control after 48 h. Tissue factor pathway inhibitor functional assay resulted in no significant difference between EPC on SIS and the control coated tissue culture wells. Quantitative PCR indicated an increase in the gene expression for thrombomodulin for EPC grown on SIS compared to the collagen I control. This increase in thrombomodulin should correspond to an increase in the generation of activated protein C (APC) leading to a less thrombogenic implant surface.
Conclusion: EPC are a viable source for autologous seeding of bioprosthetic venous valves and are likely to limit thrombosis and IH due to increased APC activity.

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Gelatin microspheres: correlation between embolic effect/ degradability and cross-linkage/particle size

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Purpose: To evaluate embolic effect and degradability of gelatin microspheres (GMSs) using a variety of degrees of cross-linkage and particle sizes in embolization of rabbit's renal arteries.
Material and Methods: 6 types of GMSs were used as follows; 3 types of cross-linkage and 2 types of particle sizes. 36 rabbits (N=6 in each group) were used for renal artery embolization. Renal angiography was performed before and after embolization of right renal artery. Follow-up renal angiography was performed 2 days (N=2), 5 days (N=2), or 15 days (N=2) after embolization in each group, and then kidneys were removed for histopathological evaluation. Vascular areas of the angiography were measured by Image J and the reperfusion rate was calculated. In renal specimens residual GMSs were checked and the degree of degradation was classified according to 4-grade scale.
Results: Mean amount of large and small particle-sized GMSs injected were 15.7 mg and 35.3 mg, respectively. Tissue necrosis was confirmed in each group; however, no difference was observed among these groups. Renal reperfusion was observed more often among small GMSs than among large GMSs. Renal reperfusion was also observed more often among low cross-linked GMSs than among high cross-linked GMS. In histopathological specimens large GMSs were confirmed in the lobar artery and small GMSs were confirmed in the lobular artery. Low cross-linked GMSs completely degraded 15 days after embolization. In contrast, high cross-linked GMSs were observed 15 days after embolization.
Conclusion: The degree of cross-linkage and particle size affected degradability and reperfusion of GMSs; however, they did not affect embolic effects or tissue necrosis.

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Combination of MRI visible iron-platinum (FePt) nanoparticles and resonant markers for catheter localization and guidance in 1.5T MRI

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Purpose: In order to plan and perform MRI-guided cardiovascular interventions, catheters and catheter tips must be reliably differentiated and visualised. A method, combining FePt nanoparticles causing signal voids for catheter markers and a resonant marker for tip localization, is proposed.
Material and Methods: Six markers, each consisting of 11µL solvent

with 2.5% w/v in-house synthesised FePt nanoparticles and nail polish, were applied to a 5F-catheter (Somatex Pro-Tex Sidewinder-II) using a micropipette. For tip localization, a saddle-coil, built of enamelled copper-wire and a non-magnetic SMD-capacitor, was tuned to 63.8 MHz using a spectrum analyzer (HAMEG HM5014-2), then glued to the tip. Real-time imaging (FGRE, TR/TE 3.2-13.5/8.7-18.9ms, Matrix 256*256, FOV 250x250mm^2, SL 5mm, FA 20-75°) of the catheter in a phantom (a plastic box containing 0.9% saline solution) was conducted in a clinical 1.5T scanner (GE Signa HDx) with 8-channel head coil.

Results: The resonant tip marker (bright) showed high device-to-background contrast during imaging with low flip-angles (<45° good/<75° visible) for various orientations in respect to B_0. The ellipsoid-shaped susceptibility artefacts (black) caused by the nanoparticles showed good-size signal voids (long-axis: 3-6mm) during real-time imaging, increasing with TE. Good visualization and differentiation between tip and other markers was easily achieved (TR/TE 3.2/8.7 FA 25°).

Conclusion: We demonstrated FePt nanoparticles and a resonant tip marker as suitable and reliable for device localization in MRI. However, attaching markers to the device surface is no option for clinical evaluation. As a next step, miniaturization of resonant markers and incorporation of these and the nanoparticles (higher concentration) into device material will be evaluated.

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The use of chitosan gel as an embolic agent in experimental aneurysm models of rabbits: a focus on angiographic and histopathologic findings

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Purpose: To evaluate the feasibility of endovascular treatment of experimental aneurysms in rabbits using chitosan gel as a new embolic agent, in the hope of overcoming anatomic and biological limitations of Guglielmi detachable coils.

Material and Methods: As the first step, activated clotting times (ACTs) were compared between the pure blood group and the chitosan gel-blood mixture group in 17 patient's blood in vitro study. As a main experiment, an aneurysm was created in the proximal common carotid artery in 13 rabbits and embolized with chitosan gel in 10 rabbits (3 controls with non-embolized aneurysms and 10 embolized aneurysms). These were evaluated by serial follow-up intravenous digital subtraction angiography (IV-DSA) on 1 week (n=13), on 2 weeks (n=12), on 4 weeks (n=10) and on 6 weeks (n=8) after embolization. Then histopathologic evaluation was carried out on 3 days (n=2), 1 week (n=1), 2 weeks (n=1), 3 weeks (n=1), 4 weeks (n=2), 6 weeks (n=1), and 8 weeks (n=1) after embolization.

Results: In vitro study: ACT were measured 52.0+/-13.2 seconds in the chitosan gel-blood mixture groups and 120.3+/-25.1 seconds in the pure blood groups. In animal study, occlusion ratio of aneurysms in IV-DSA was more than 75% decreased aneurysm size in 7 rabbits (70%), 75%-50% decrease in 2 rabbits (20%), and less than 50% decrease in 1 rabbit (10%). Histopathologic findings showed well-organization thrombus and neointima formation in the aneurysmal sac.

Conclusion: Endovascular exclusion of aneurysms in rabbits was feasible, chitosan gel as a new embolic agent might be an alternative material for overcoming limitations of Guglielmi detachable coils.

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A novel stent designed for the treatment of tracheal traumatisms: preliminary study in an animal model

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Purpose: The aim of this study was to evaluate a novel metallic stent designed to decrease hyperplasic tissue in-growth in the minimally invasive treatment of tracheal traumatism.

Material and Methods: 5 rabbits were used for this study. A tracheal traumatism model was created through a cervical approach by making an incision covering 25% of the tracheal circumference. A modified Taewoong Medical (Niti-S tracheobronchial Full Covered stent) stent was then deployed. A PTFE segment was used to modify both stent ends. The stent was deployed under fluoroscopic control, making sure that the tracheal lesion was covered by the mid part of the stent. Hemodynamic and ventilatory parameters including heart rate (HR), respiratory rate (RR), tidal volume (TV), SpO_2, CO_2 and positive end expiratory pressure (PEEP) were registered prior to creating the traumatism (phase I), during lesion creation (phase II) and after stent deployment (phase III).

Results: An increased HR and TV and decreased SpO_2 was seen in all animals during phase II. All these parameters returned to baseline values during phase III. During the 8 weeks of follow-up completed to date, no respiratory disorders, subcutaneous emphysema development or hyperplasic tissue growth inside the trachea have been seen.

Conclusion: In this preliminary study, covered metallic stent deployment was useful in the management of tracheal traumatism in the absence of stent-induced obstructive hyperplasia. This approach could allow a more conservative therapy for tracheal trauma, albeit a longer follow-up time is needed.

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In the rodent model, does an additional hepatic artery ligation have any benefit for compensatory liver regeneration than portal vein ligation alone?

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Purpose: Preoperative embolization of ipsilateral portal vein has been performed in many centers expecting compensatory regeneration of remnant liver. Animal models of portal vein embolization were well established. Furthermore, additional hepatic artery embolization to portal vein embolization has been introduced in several animal experiments. We compared portal vein ligation (PVL) and additional hepatic artery ligation (HAL) in this study.

Material and Methods: 20 rats underwent ligation of portal vein, influenced to medial and left lateral lobe. Each 5 of them was sacrificed at 24hr, 72hr, 120hr, and 168hr after operation. Portal veins of the other 20 rats were ligated and 48hr later, we tied up the hepatic artery supplied to medial and left lateral lobe, and sacrificed them at 24hr, 72hr, 120hr, and 168hr after. ALT, AST, total bilirubin, ALP, gamma GT, albumin, PT, INR were checked with blood sample. Using excised liver on rat specimen, we performed immunohistochemical analysis about proliferating cell nuclear antigen (PCNA). We compared serum and tissue marker of liver regeneration, synthetic and other functions in each group.

Results: Mean expression of PCNA in the rats sacrificed at 24hr, 72hr, 120hr, 168hr in PVL group was 162.2, 149.9, 176.3, 166.8, respectively. Those of additional HAL group were 137.8, 139.2, 144.6, 122.4. ALT/AST were elevated at HAL group at 120hr. Albumin was decreased and PT prolonged at HAL group at 72hr, 120hr, and 168hr.
Conclusion: There was no benefit in additional HAL compared to PVL alone for compensatory liver regeneration in this study.

GI tract intervention

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Percutaneous wirsungostomy and subsequent wirsungolitholapaxy in acute obstructive calculous pancreatitis

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Purpose: The percutaneous management of acute obstructive pancreatitis is described and the new technique of pancreatic duct stone evacuation is introduced.
Material and Methods: The percutaneous wirsungostomy is performed to 31-year-old female patient with acute pancreatitis, due to pancreatic duct obstruction by multiple stones. The percutaneous transhepatic access and then drainage of pancreatic duct was performed under combined real-time ultrasound-fluoroscopy control using guidewire technique. Wirsungolitholapaxy (stones evacuation into the duodenum) was performed after the pancreatic duct distal portion balloon dilatation, performing the pushing actions by 8,5 CH diameter catheter with cut tip and partially inflated balloon under real-time fluoroscopy guidance. The procedure was performed under the conscious sedation.
Results: Wirsungostomy enabled to eliminate clinic of acute pancreatitis in 2 days. Consequently, 3 procedures performed during 1 month enabled to evacuate stones from distal pancreatic duct and restore its patency completely. The pancreatic duct anomaly - presence of 2 ducts (Wirsung and Santorini), both of them joining directly duodenum - was revealed. Duct anomaly was revealed on wirsungolitholapaxy procedure; the presence of second duct (it turned out to be a Wirsung duct) was revealed only after balloon dilatation and stone evacuation in duodenum.
Conclusion: Percutaneous wirsungostomy is an effective treatment option of acute obstructive pancreatitis, enabling to perform safely multiple (if needed) wirsungolitholapaxy procedures. Wirsungolitholapaxy after preliminary performed wirsungostomy should be suggested as an effective and safe low-invasive treatment option in cases of acute (wirsung duct stone generated) obstructive pancreatitis; it may provide possibility to avoid the traumatic surgery.

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Exacerbated chronic mesenteric ischemia: technical success rate of percutaneous stenting and clinical outcome

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Purpose: To evaluate technical success of percutaneous stenting and clinical outcome of patients with exacerbated chronic mesenteric ischemia (eCMI).
Material and Methods: The radiological information system database was used to identify all patients with mesenteric ischemia in whom percutaneous stenting of splanchnic arteries was attempted between 2006 and 2011. eCMI was diagnosed if the patient presented typical symptoms of chronic mesenteric ischemia (CMI) and in addition to new onset of persistent abdominal pain, peritoneal signs, gastrointestinal bleeding and/or shock. Acute mesenteric ischemia (AMI) was diagnosed if patients presented typical symptoms of AMI but lacked a history of CMI. Technical success was defined as patency of treated arteries with residual stenosis of 30% or less. 30-day mortality and morbidity (renal, liver, heart failure, heart attack, pneumonia/ARDS, SIRS/sepsis, stroke and death) were determined.
Results: Stenting was carried out in 21, 11 and 14 patients with CMI, eCMI and AMI, respectively. Results of the eCMI-subgroup are as following: stenting was performed in nine patients primarily and in two secondarily after laparotomy. Technical success was achieved in twelve out of 14 arteries (86%). 30-day mortality was 27% (three of eleven patients) and morbidity 36% (four of eleven patients). Two patients died of cardiopulmonary failure and one of heart attack. Another patient suffered from pneumonia/ARDS postinterventionally. 30-day mortality of the CMI- and AMI-subgroup was 5% and 64%, respectively.
Conclusion: Percutaneous stenting for the treatment of eCMI can be carried out with high technical success rate and was associated with acceptable mortality and morbidity in our study population.

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Acute mesenteric ischemia: technical success rate of percutaneous stenting and clinical outcome

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Purpose: To evaluate technical success of percutaneous stenting and clinical outcome of patients with acute mesenteric ischemia (AMI).
Material and Methods: The radiological information system database was used to identify all patients with AMI in whom percutaneous stenting of splanchnic arteries was attempted between 2006 and 2011. Technical success was defined as patency of treated arteries with residual stenosis of 30% or less. 30-day mortality and morbidity (renal, liver, heart failure, heart attack, pneumonia/ARDS, SIRS/sepsis, stroke and death) were determined.
Results: Percutaneous stenting was attempted in 14 patients with AMI, whereas it was carried out in nine patients primarily and in five secondarily after laparotomy. Technical success was achieved in 13 out of 14 arteries (93%). 30-day mortality was 64% (nine of 14 patients) and morbidity 79% (eleven of 14 patients). Five patients died of septic multiple organ failure, two of heart failure and one each of stroke or pulmonary failure. Two further patients developed severe sepsis. Laparatomy was performed in eleven patients. In nine of them bowel was resected (jejunum (n=1), right hemicolon including terminal ileum (n=4), transverse colon (n=1), left hemicolon (n=2), entire colon (n=1)).
Conclusion: Though high technical success rate of minimal-invasive percutaneous revascularization in our study population, AMI was associated with high mortality and morbidity.

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Buried bumpers: a radiological management technique

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Purpose: Buried bumper syndrome is an uncommon complication of feeding gastrostomy catheter insertion, in which the internal flange or "bumper" of the gastrostomy tube erodes through gastric mucosa and may migrate along the gastrostomy track. Typical presenting problems are tube blockage, abdominal pain, leakage

of feed around the tube, abscess formation, gastric haemorrhage or perforation. Various endoscopic and surgical techniques have been described to facilitate removal. I describe a fluoroscopic technique, allowing synchronous insertion of a replacement tube, and discuss the correct follow-up management.

Material and Methods: 13 patients with buried bumper were treated by a push-pull technique between 2003 and 2010. Radiology reports, images and clinical records were reviewed for indications, technique, success, complications and current feeding method.

Results: All patients had neurological conditions. 14/15 procedures in 13 patients were successful. In 3/7 cases where replacement button gastrostomies were inserted they re-buried. In 5 cases balloon or loop catheters were used without problems. 1 gastrostomy was not replaced. 5 patients have died with median survival of 691 days (11-820). 1 patient with failed removal after previous endoscopic bumper removal and replacement died at 11 days of septic complications following placement of a second gastrostomy. 12/13 patients remained gastrostomy dependant. Otherwise, no technique-specific complications of removal were seen.

Conclusion: Buried bumpers occur in patient with underlying neurological conditions after prolonged use of button gastrostomies. The push-pull dilatation technique has a good success rate. Replacement with another bumper catheter is contra-indicated.

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Percutaneous radiologic gastrostomy: one shot double anchor technique

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Purpose: To evaluate the feasibility, safety, and effectiveness of percutaneous radiologic gastrostomy (PRG) with a single 17-Gauge Chiba-needle puncture technique with the use of a gastropexy in the same puncture tract.

Material and Methods: From January 2008 to December 2010, 123 patients underwent PRG. Stomach was punctured with a 17-Gauge Chiba-needle. The Cope suture anchor was deployed into stomach lumens, with a metallic guide-wire, through the 17-Gauge Chiba-needle. A 10-Fr dilator tip was cut and fixed to a Silk-0 suture thread. Then the 10-Fr dilator was loaded over the guide-wire and pusher into the stomach and the dilator tip was released into the stomach lumen as a second anchor. Finally, 12-Fr diameter locking loop catheter was inserted and the anchor threads were fixed.

Results: All 123 patients successfully underwent PRG. Only a single puncture attempt was required in all patients. The average procedure time was 8 minutes. Three patients (2,4%) had major complications: hemorrhage (n=2) and pneumoperitoneum (n=1). Post-procedure-related mortality at 30 days was 1,6% (n=2).

Conclusion: PRG with the use of one shot double anchor technique gastropexy is feasible, safe, and effective and permits to secure the device in a more safely way.

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Radiologic placement of gastroduodenal stents for the treatment of malignant gastroduodenal obstruction: a comparison of the results according to the stent types

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Purpose: To evaluate and compare the effectiveness of radiologic placement of gastroduodenal stents for the treatment of malignant gastroduodenal obstruction according to the stent types.

Material and Methods: From July 2001 to April 2010, 88 radiologic placement of gastroduodenal stents were attempted in 64 patients (M:F, 44:20; mean age, 65.9 years) with malignant gastroduodenal obstructions. Stent types were classified as uncovered stent (Group I), partially covered stent (Group II) and covered stent (Group III). The technical and clinical success, complication rates and stent patency rates were evaluated and compared according to the stent types. The follow-up period was 1~760 days (mean, 61.8 ± 96.1 days).

Results: Radiologic stent placement was technically successful in 82 of 88 cases (93.2%). Clinical success rates were 90.3% in Group I (28/31), 91.4% in Group II (32/35) and 93.8% in Group III (15/16). During follow-up, total complication rates according to stent types were 25.8% (Group I), 31.4% (Group II) and 31.3% (Group III). The primary stent patency rates according to stent types (Group I/II/III) were (81.9/88.0/92.9) at 1 month, (68.3/55.2/66.3) at 3 months, (34.1/31.6/33.2) at 6 months and (34.1/21.1/33.2) at 12 months. There were no statistically significant differences in the clinical success rates, total complication rates and primary stent patency rates among the three stent types.

Conclusion: The radiologic placement of gastroduodenal stents for the treatment of malignant gastroduodenal obstruction is feasible and safe and provides acceptable clinical results. Additional studies are desirable for the collection of more reliable data.

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Percutaneous abscess drainage in patients with Crohn's disease: reduction of severe postoperative septic complications

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Purpose: Severe postoperative intra-abdominal septic complications (IASC) such as an anastomotic leak, intra-abdominal abscess, and fistula are significantly associated with the presence of spontaneous intra-abdominal abscess at the time of laparotomy in patients with Crohn's disease (CD). The purpose of this study was to compare the incidence of severe postoperative IASC in patients undergoing intestinal resections with and without preoperative percutaneous abscess drainage (PAD) before definitive surgery.

Material and Methods: Using a prospective surgical database, we searched for patients with CD and spontaneous intra-abdominal abscesses who underwent intestinal resection at our hospital from May 2005 to February 2009. Postoperative IASC were defined as anastomotic leaks, abscess, and fistula within 1 month after surgery. We compared the incidence of postoperative IASC in patients with (group I) and without (group II) preoperative PAD (Fisher's exact test).

Results: We identified 25 patients (15 men, 10 women; mean age, 31 years) with spontaneous intra-abdominal abscesses. PAD was performed in 12 of 25 patients (48%), with an average of 37 days before surgery (range, 6–83 days). The overall rate of postoperative IASC was 48% (12 of 25 patients). In group I, postoperative IASC occurred in 3 of 12 patients (25%). In group II, postoperative IASC were assessed in 9 of 13 patients (69%). The differences between these two groups were considered to be statistically significant ($p = 0.04$).

Conclusion: PAD of intra-abdominal abscesses before surgery could significantly reduce the occurrence of severe postoperative IASC in patients with CD.

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Percutaneous gastrostomy in patients with pharyngoesophageal obstruction

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Purpose: Percutaneous nonendoscopic gastrostomy is commonly performed with gastric insufflation using a nasogastric tube. However, in patients with pharyngeal or esophageal obstruction, insertion of a nasogastric tube is impossible. We retrospectively investigated the clinical procedural performance of percutaneous radiologic gastrostomy using a combination of sonographic and fluoroscopic guidance without nasogastric tubing.
Material and Methods: Between 2001 and 2010, 89 patients underwent percutaneous radiologic gastrostomy because endoscopic procedures were contraindicated. In 17 patients of them, nasogastric tubing was impossible due to pharyngeal or esophageal obstruction (hypopharyngeal cancer 8, cervical esophageal cancer 7, oral cancer 2). The stomach was percutaneously punctured using a fine needle under sonographic guidance and inflated through the needle. Following gastric insufflation, a gastrostomy tube, Ultrathane Friction-Lock Russell Malecot gastrostomy set (COOK), was placed using a single or two gastropexy T-fasteners, Cope gastrointestinal suture anchor set (COOK), under fluoroscopic guidance.
Results: Percutaneous radiologic gastrostomy without nasogastric tubing was technically successful in all cases. No major complications were observed during the procedure. There were no procedure-related deaths. In one patient, the gastrostomy tube was removed due to stoma infection on the 10th postprocedural day.
Conclusion: Percutaneous radiologic gastrostomy using a combination of sonographic and fluoroscopic guidance without nasogastric tubing is a practical and safe procedure in patients with pharyngoesophageal obstruction.

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Combined transcatheter embolisation and medical treatment as a replacement therapy for surgery, in low-operative risk patients with endoscopically unmanageable massive bleeding from gastric-duodenal ulcers

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Purpose: To assess the usefulness of endovascular therapy as a second step management in endoscopically unmanageable low risk patients with massive bleeding from a peptic ulcer.
Material and Methods: A retrospective study of 22 consecutive embolization procedures in endoscopically unmanageable, hemodynamically unstable patients, referred from 2004 to 2010. Different techniques and embolization materials were used. Mean follow-up was 7 months. Endoscopy was performed for 12 patients 5 to 9 months after embolization to assess healing of the ulcer.
Results: Gastric ulcer was noted in 7 patients, bulbar duodenal ulcer in 13 patients and postbulbar duodenal ulcer in 2 patients. The technical success rate was 100%. The rebleeding rate was 9%, and 30-day mortality rate is 4%. No major complications were reported. Follow-up endoscopy revealed healing of the ulcer in 10 of the 12 patients (83%).
Conclusion: Angio-embolization is safe and effective for controlling life-threatening endoscopically unmanageable, bleeding from gastroduodenal ulcers especially in low risk patients. Whenever combined with proper medical therapy it allows ulcer healing without the need for higher risk laparotomy in most of the patients.

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Concerning the incidence of stomach wall dissection during CT-guided gastrostomy in morbidly obese patients with previous gastric by-pass surgery: are there any denominators?

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Purpose: To find out whether there are any denominators, concerning the presence of stomach wall dissection, during CT-guided gastrostomy, in superobese patients after bariatric surgery.
Material and Methods: We retrospectively reviewed 30 patients (23 women), mean age 38±8 years, previously submitted to CT-guided gastrostomy, due to complications after bariatric surgery. The patients underwent gastrostomy in a mean period of 19 (range 1-54) months after gastric by-pass surgery. Access to the stomach remnant was achieved by the silastic ring, placed during surgery, attaching the remnant to the abdominal wall. The incidence of mucosal detachment was correlated with: stomach wall thickness at entry point, number of needle passes, angle of approach between needle and stomach wall and the distance between needle entry point and the silastic ring. Prism 4 (GraphPad Software, Inc.) statistical software was employed for calculations.
Results: Technical success of gastrostomy tube placement was 29/30 (97%). The incidence of stomach wall dissection was 20/30 (67%). The mean stomach wall thickness at entry site and the mean number of needle passes were 8±3 mm and 3 (range1-9), respectively. The mean angle between needle and stomach wall and the mean ring-needle distance were 35±25º and 16±11 mm, respectively. Gastrostomy tube was removed after 9±5 months. Binary logistic regression analysis found that the number of needle passes ($p=0.041$) and stomach wall thickness at entry site ($p=0.023$) were predictive factors of significantly higher presence of stomach wall dissection.
Conclusion: There was a high incidence of stomach wall dissection in our patients. Its incidence was statistically higher in patients with thick-walled stomach and more initial needle pass attempts.

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Gastrointestinal bleeding in 110 patients: which role for interventional radiology in the treatment planning and embolization efficacy?

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Purpose: To evaluate the role of interventional radiology in the multidisciplinary approach to gastrointestinal bleeding.
Material and Methods: Between 2005 and 2010, 110 patients (46 females; mean age 55.6 yr) underwent celiac-mesenteric arteriography (IADSA) for gastrointestinal bleeding (55/110 hematemesis, 53/110 melena, 2/110 both). Angio-CT (38/110), endoscopy (52/110) or both (20/110) were obtained prior to IADSA and demonstrated active bleeding in all patients. Risk factors, CT and endoscopic findings were compared with treatment efficacy (Chi-square test). Survival rates were calculated with Kaplan Meier method and compared with Logrank test.
Results: In 65/110 patients, active bleeding was demonstrated at IADSA: all patients underwent transcatheter embolization. Bleeding was related to neoplasm (16/65), surgical or endoscopic complications (13/65), post-traumatic injury (6/65), pseudoaneurysms of pancreatic-duodenal arcade (8/65), diverticulitis (5/65) and other causes (14). Primary technical success (immediate complete hemostasis) was achieved in 64/65 patients (98,4%). Eight patients (12,3%)

were re-treated within 48 hours because of bleeding relapse. In all 8 patients the second embolization obtained definitive treatment. Overall, 88 branches were embolized: 68/88 celiac-trunk branches (45/68 from GDA), 14/88 SMA branches, 6/88 IMA branches. The embolization material used was gelfoam/PVA (34/64 procedures), microcoils (20/64), gelfoam and microcoils (6/64), stentgraft (2/64), intentional dissection (2/64). No complication occurred during embolization or within 50 days of follow up. In 45/110 patients no active bleeding was demonstrated at IADSA. The survival rate of this group was comparable with the embolized group.
Conclusion: Transcatheter embolization was effective in achieving hemostasis in acute gastrointestinal bleeding. Patients without active bleeding at IADSA benefit from medical treatment.

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Successful drainage and ethanol injection of multiple and very large hydatid liver cysts

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Purpose: Percutaneous treatment of very large (>6 cm) hydatid liver cysts (HLC) with ethanol injection is considered unsafe and substantially ineffective. We present the results of a 6-year experience with treatment by aspiration and injection of ethanol of a series of patients with multiple and very large HLC.
Material and Methods: Between June 2004 and January 2011, 9 patients (6 males, 3 females; age range: 38 - 78, median: 55) with 18 HLCs (diameter range: 6.0 - 15.0 cm; mean: 8.5 cm) were admitted at our institution. 1 patient had 5 cysts, 4 patients 2 cysts and 5 patients 1 cyst. 13 cysts were unilocular (type 1-2), 5 cysts were septated or multivesiculated (type 3). 7 patients were treated percutaneously and 2 under laparotomy. Follow-up was performed by US every 3 months and abdominal-CT every 12 months.
Results: No major complication was reported. At last US examination during the follow-up, 11/ 18 cysts (61.1%) showed a solid pattern (a hypo- or hyper-echoic solid mass) and 7 cysts (38.8%) showed a fluid-mixed pattern. A substantial shrinkage was observed in all cyst with decrease in size ranging from 30 to 80% of the pre-treatment volume. In no patient lung recurrence at chest X-ray or abdominal spreading of the disease at CT was reported.
Conclusion: In our experience, "open" and "percutaneous" aspiration and ethanol injection of very large HLC can be safely performed and showed a high long-term efficacy.

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Is there a role for prophylactic gastroduodenal artery embolization in the management of patients with active upper GI haemorrhage?

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Purpose: There is a subset of patients, many of whom are high risk surgical candidates, in whom endoscopy fails to arrest upper gastrointestinal haemorrhage. Our interventional department is referred to these patients in order to try and arrest the bleeding either by identifying bleeding points with computer tomography angiography or by catheter angiography. We can then perform targeted embolization or prophylactic gastroduodenal artery (GDA) embolization. We wanted to determine whether prophylactic GDA embolization was as effective in reducing re-bleed rates in comparison to targeted embolization.
Material and Methods: We retrospectively collected all the pertinent data from a secure PACS database, electronic medical records and interventional radiology database for all patients who had catheter mesenteric angiograms (CMAs) from May 2008 to November 2010 for UGI haemorrhage.
Results: 52 CMAs on 50 patients were performed over a two-and-half year period for UGI haemorrhage. A total of 22 angiograms identified a site of haemorrhage which was embolized (2/22 re-bled) and of the remaining 30 angiograms no site of haemorrhage was identified. In 21/30 angiograms where no site of haemorhage was identified, patients underwent prophylactic GDA embolization (3/21 re-bled). In the remaining 9/30 patients no embolization was performed. There was no statistical significance in the re-bleeding rate between targeted embolization and blind prophylactic GDA embolization (p=0.6640).
Conclusion: Prophylactic embolization of the GDA in unstable patients with upper GI haemorrhage with refractory bleeding despite endoscopic treatment appears to be an effective treatment with low re-intervention rates comparable to those patients where the site of haemorrhage is identified and embolized.

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The role of primary percutaneous drainage in the management of acute necrotising pancreatitis: an evidence-based radiology review

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Learning objectives: To review the principles used to perform an evidence-based radiology review of available literature and to apply these principles to assess the benefits of primary percutaneous catheter drainage of acute necrotising pancreatitis over surgery, with regard to patient outcomes.
Background: The incidence of pancreatitis in the United States is approximately 185,000 per year. Acute necrotising pancreatitis complicates roughly 20% of these patients. Traditionally management options were conservative treatment plus/minus open necrosectomy. Therapeutic strategies are evolving to involve percutaneous drainage, endoscopic drainage and minimally invasive surgery. Our goal was to appraise the available literature and assess whether or not primary percutaneous drainage decreases morbidity or mortality in this patient group.
Clinical Findings/Procedure Details: Using the McMaster principles developed in Canada, we formulated a specific clinical question in the standardised patient-intervention-comparison-outcome (PICO) format. For the purpose of our clinical review the question was as follows: in patients with acute necrotising pancreatitis, does percutaneous drainage as a primary intervention reduce morbidity and mortality when compared with open necrosectomy? We proceeded to carry out a comprehensive literature search and appraisal of relevant articles found.
Conclusion: While the majority of the evidence available is of a low level we did elucidate the following: roughly 1/3 of patients will require no further intervention after percutaneous catheter drainage. Percutaneous drainage in conjunction with minimally invasive techniques decreases major complications by up to 29%. No significant difference in the mortality rate.

P-212

Radiological management of the complications of laparoscopic band surgery

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Learning objectives: To recognise the common complications following laparoscopic band placement for patients with obesity. To discuss the reasons why these complications may occur. To describe the role of the radiologist in the management and treatment of these complications with a view to avoiding further surgery.
Background: Laparoscopic band placement is a common procedure in the treatment of obesity. There is an approximate reported 10-15% failure rate of these devices. We have reviewed our 6-year experience in the follow up of complications in nearly 5,000 band adjustments. We will describe the role of the radiologist in the management of common complications.
Clinical Findings/Procedure Details: Complications that should be recognised and treated by the radiologist are as follows: 1. Excessive band restriction. 2. Pouch dilatation. 3. Oesophageal dilatation/dysmotility. 4. Food bolus impaction. 5. Port site angulation/mobility. 6. Port site infection. 7. Intra-abdominal sepsis/collections.
Conclusion: The radiologist plays an integral role in the follow up and management of patients who have undergone laparoscopic band placement. The recognition of complications is vital to avoid subsequent patient morbidity and repeat surgical procedures. Many patients can be effectively treated by the attending radiologist for the majority of common complications as demonstrated in this poster.

P-213

Sharp recanalization of the esophageal occlusion using transjugular access set. Report of two cases

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Two patients were treated after unsuccessful attempts of endoscopic recanalization of the totally occluded esophagus. Sharp recanalization was performed using transjugular access set (Angiodynamics, Gothia, Billdal, Sweden). Successful recanalization was followed by balloon dilation and stent placement, allowing normal swallowing.

P-214

Liver collection of cerebro-spinal fluid: a case report

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A 22-year-old man prompted to the emergency with abdominal pain. He previously experienced head trauma and peritoneal shunt was necessary. Ce-MDCT revealed a liver fluid collection and a percutaneous drainage was achieved. Lab test showed cerebro-spinal fluid composition.

P-215

The complexity of a rectal bleed: anatomic evaluation and management

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Elderly patient presents with hypotension and GI bleed that required intervention. The source of the patients bleed was from a perforating deep rectal artery. This patient's complex anatomy is an excellent learning tool in evaluating and treating cases like this.

Gynaecological intervention (incl. UFE)

P-216

Effect of uterine fibroid embolization (UFE) on ovarian reserve: early results of a randomized control trial comparing two embolic agents

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WITHDRAWN

P-217

Spontaneous, successful and finished pregnancies with live births following uterine fibroid embolization

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Purpose: Evaluate the safety, morbidity and rate of spontaneous, successful and finished pregnancies following uterine fibroid embolization (UFE).
Material and Methods: UFE performed in 1001 patients (112 wanted to conceive). None of the patients could get a successful pregnancy at the time of embolization. UFE was performed, by single femoral approach with a C_2F_5 catheter and Polyvinyl alcohol (PVA) particles 300m, 500m and 700m and Embozene microspheres 500m and 700m.
Results: From the 112 patients who wanted to conceive, 59 (62.7%) had spontaneous pregnancies (age 22-43 years, mean 36.2). Time between UFE and conception ranged 2-26 months (mean 10.7). There are 52 finished pregnancies with 44 successful life births (84.6%), 6 spontaneous abortions (11.5%), 1 induced abortion and 1 stillbirth at 36 weeks; 4 pre-term gestations (9.9%) that lasted 33 and 34 weeks in 2 patients and 36 weeks in 2 patients. The gestation of the remaining 40 women ranged 37-41 weeks (mean 38.2). There were 2 cases of placenta previa (4.5%), 5 low birth weights (11.4%). The weight of the remaining 39 newborns ranged 2.610 kg-4.900 kg (mean 3.088). There were 29 cesarean sections (65.9%) and 15 vaginal deliveries. All the babies born presented no significant neonatal problems. In the remaining 7 patients with ongoing pregnancies the evolution has been normal and are waiting for term.
Conclusion: Spontaneous pregnancies after UFE are safe with low morbidity. There is high rate of spontaneous pregnancies (62.7%) and successful pregnancy with live birth (84.6%) after UFE.

P-218

Percentage of fibroid infarction after uterine artery embolization predicts clinical outcome: long-term results of a prospective cohort study

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Purpose: To prospectively evaluate the impact of residual uterine fibroid perfusion after uterine artery embolization (UAE) on clinical long-term outcome.
Material and Methods: 115 consecutive patients underwent UAE between 07/2001 and 06/2004. Contrast-enhanced MRI was performed within 48-72h after UAE in all pts. Percentage of fibroid infarction was assessed on a scale from 0 to 100% (10% increments). Patients were divided into three groups according to infarction rate (I: 100%, n= 60; II: 90-99%, n=32; and III: 0-89%, n=23). Clinical outcome (change in menorrhagia and bulk symptoms and overall satisfaction) was documented. Frequency of re-interventions for treatment failure (surgery, repeat UAE) was assessed and compared using Kaplan-Meier-analysis (KMA) and associated Log-rank-test (LRT).
Results: Ninety/115 (81%) patients completed follow-up after a median of 7.2 years (range 5.1-9.7 years) with 42/60 (70%) in group I, 29/32 (91%) in group II and 22/23 (96%) in group III. Only 55% of patients in group II had no re-intervention (p<0.001). KMA showed no significant difference in the cumulative rate of re-intervention between group I and II with a survival free from re-intervention of 93% in both groups. Patients without re-intervention improved with respect to menorrhagia (I: 88%; II: 100%, III: 80%) and bulk symptoms (I: 84%; II: 89%, III: 91%) and were satisfied with the results of treatment (I: 89%; II: 100%, III: 91%).
Conclusion: Infarction rate of fibroids at early contrast-enhanced MRI after UAE is strongly associated with clinical outcome. Clinical failure with a high frequency of re-interventions occurring within 2 years after UAE is seen in patients with devascularization below 90% of fibroid load.

P-219

Uterine artery embolization for large fibroids: a comparative study in patients with and without pretreatment gonadotropin-releasing hormone agonists

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Purpose: To evaluate the effectiveness of pretreatment with gonadotropin-releasing hormone (GnRH) agonist before uterine artery embolization (UAE) for large fibroids.
Material and Methods: A total of 40 patients with large fibroids (≥10cm) diagnosed by magnetic resonance imaging (MRI) were enrolled. The maximum diameter of the fibroids was 10.0–16.3 cm (mean, 11.9 cm). Among the 40 patients, 28 (control group) underwent UAE without pretreatment with GnRH agonists, and 12 (GnRH group) received a GnRH agonist (3.75 mg leuprolide acetate, administered subcutaneously once a month) 1–5 times (mean, 2.7 times) before UAE. The patients were assessed for the extent of volume reduction of fibroids after hormonal treatment in the GnRH group. In both groups, necrosis of large fibroids and fibroid volumes were assessed by MRI 3-months after UAE. The primary embolic agent was non-spherical polyvinyl alcohol.
Results: Thirty-nine out of 40 patients (97.5%) showed complete necrosis of large fibroids after UAE. When GnRH agonists were administered before UAE, the average rate of fibroid volume reduction rate was 36.3% (range, 10.3-68.9%). Follow-up MRI performed 3 months after UAE showed a 58.2% (45.0-79.0%) volume reduction rate of predominant fibroids in the GnRH group, which was significantly higher than the volume reduction rate of 35.0% (6.9-60.3%) noted in the control group (p < 0.001).
One patient (8.3%) in the GnRH group had a fibroid that became endocavitary with vaginal discharge but was managed conservatively. In the control group, five patients (17.9%) had fibroids that became endocavitary with severe cramping pain and vaginal discharge; one of them underwent partial hysteroscopic resection.
Conclusion: Pretreatment with a GnRH agonist before UAE was effective for patients with large fibroids.
Three months after UAE, the GnRH group showed more significant volume reduction of fibroids than the control group.

P-220

Prophylactic uterine artery balloon occlusion in women at high risk of major peripartum haemorrhage can cause fetal compromise

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Purpose: The evidence for efficacy of pre-delivery prophylactic pelvic arterial balloon occlusion to reduce peripartum haemorrhage (PPH) is weak and addresses only maternal outcomes. We present our experience of prophylactic bilateral uterine artery (UA) balloon occlusion in a sequential cohort of women at high risk of PPH. We address both fetal and maternal outcomes.
Material and Methods: Women with ultrasound- or MRI-detected placenta praevia, accreta or with a history of previous caesarean section (CS) and an anterior low-lying placenta were included in a prospective observational study. Standard angioplasty balloons were placed (uninflated) in the UAs bilaterally prior to transfer to the obstetric theatre for delivery by CS. The balloons were inflated following delivery and cord clamping. Estimated blood loss, transfusion requirements, transfer times, fetal pH and maternal and fetal complications were recorded.
Results: 13 women were included in the study with UA balloons inflated in 11. Balloon occlusion was associated with low mean intraoperative blood loss (880ml) and transfusion requirement (180ml) with no hysterectomies or maternal intensive care unit (ICU) admissions. Mean fetal pH was low (7.2, range 6.90-7.44) and fetal bradycardia was noted in two women following balloon placement. The most rapid transfer achievable was 28 minutes from onset of fetal distress to delivery. One infant was admitted to neonatal ICU but all were healthy at discharge.
Conclusion: In women at high risk, UA balloon occlusion may reduce PPH. However, balloon placement can also cause fetal compromise, possibly due to UA spasm. Fetal risks could be mitigated by eliminating the requirement for transfer.

P-221

Complications after uterine artery embolization in the treatment of postpartum hemorrhage: multivariate analysis of predictive factors for major complication

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Purpose: To evaluate the complications after uterine artery embolization (UAE) for treatment of postpartum hemorrhage (PPH) and to determine predictive factors associated with major complication.

Material and Methods: Between March 2004 and January 2011, two hundred twenty-eight patients (age range 22-41 years; mean 33) underwent UAE for PPH. A retrospective analysis was performed to evaluate the clinical success rate, complications, requirement of additional treatment, and mortality. Multiple covariates including demographic data, causes of PPH, mode of delivery, preembolization hemodynamic stability, blood transfusion, and embolization characteristics were included in multivariate analyses to determine predictive factors for major complication.
Results: Uterine artery embolization was successful in 206 patients (90.4%). The major complications occurred in 26 patients (11.8%) including hemorrhagic complication (n=11), extremity paresthesia (n=9), pelvic abscess (n=3), post-embolization syndrome (n=2), and transfusion-related complication (n=1). Twenty-one patients were improved with conservative management within 3 months after the embolization. Three patients with pelvic abscess and one patient with subarachnoidal hemorrhage were successfully treated with percutaneous drainage and surgical evacuation, respectively. One patient died of ischemic multiorgan failure 9 days after the embolization. In multivariate analysis, predictive factors for major complications were hemodynamic instability before UAE (P<0.05, OR 3.655, 95% CI 1.038-12.870) and embolization of pelvic artery other than uterine artery (P<0.01, OR 1.556, 95% CI 1.134-2.136).
Conclusion: Major complications after UAE for PPH are not uncommon but mostly resolved with conservative management. Hemodynamic instability and embolization of pelvic artery other than uterine artery are independently associated with major complication.

P-222

Utero-ovarian anastomoses in uterine fibroid embolization: their presence could influence the results and complications?

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Purpose: Our group has studied retrospectively all our angiographies done by our series of women treated by means of embolization of their fibroids since 8 years ago, comparing two groups (with and without utero-ovarian anastomoses).
Material and Methods: Since December 2002 to February 2011, consecutively, we have performed EAU in 202 patients, with an average age of 42 years (range: 28-53 y). Angiographies have been studied, searching for the presence of anastomoses between the uterine arteries and the arterial ovarian plexus (UOA). It has been classified according to Razavi et. al into different groups. Amenorrhea ratio and long-term results have been statistically analyzed.
Results: Technical success was 98%. Cumulative rates of symptom control were 96% at 1 year, 87% at 3 years and 84% at 5 or more years. We recorded 104 women with UOA, bilateral presentation in 38 cases and unilateral in 68. Type III of Razavi's classification was the most common anastomoses type (89 arteries), following type Ia: 22, and type Ib: 18. No type II was observed. Amenorrhea was present in 27 women at 5th year (13.5% , with only 3% in women <45 years). Clinical failure in 10 cases (5%). Bilateral and/or unilateral presence of UOA has no statistically significant influence (p>0.05) either in the results or in the complications.
Conclusion: Reintervention rates, clinical failure and amenorrhea ratio were not influenced by the presence or absence of UOA.

P-223

Treatment of symptomatic high-flow female varicocele with balloon-occluded retrograde transvenous foam sclerotherapy (B-ORTFS) using sodium-tetradecyl-sulphate foam

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Purpose: To assess the efficacy of balloon-occluded retrograde transvenous foam sclerotherapy (B-ORTFS) in high-flow pelvic varicocele using 3% sodium-tetradecyl-sulphate (STS) foam.
Material and Methods: A retrospective study was conducted in 12 patients (mean age: 35.2 years; range: 23-46) with pelvic congestion syndrome (PCS) with atypical high-flow venous collaterals treated by B-ORTFS between June 2005 and May 2008 at our Department. PCS was diagnosed by physical and transvaginal color-Doppler US examination, while high-flow venous collaterals were detected at selective ovarian venography. B-ORTFD was performed by injection of 3% STS foam into the pelvic varices after balloon-occlusion of the major venous vessels to which high-flow venous collaterals were tributary. Follow-up was performed at 1, 3, 6 and 12 months by physical and transvaginal color-Doppler US examination and by a questionnaire-based assessment of pain using a symptom severity score.
Results: The procedure was technically successful in all patients (100%). After the injection of 3% STS foam, 3 (25.0%) patients presented a colic-like pain with spontaneous resolution after 5 minutes. During follow-up, no recurrences of PCS were detected. A significant improvement of symptoms (Student's t test, P<0.01) was observed in follow-up period.
Conclusion: B-ORTFS of high-flow female varicocele using 3% STS foam is a safe and effective procedure that should be taken into consideration as an alternative to other endovascular and surgical options.

P-224

Is uterine artery embolization with 700-µm microspheres effective for the treatment of symptomatic pure adenomyosis?

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Purpose: To evaluate the clinical and imaging response of patients undergoing uterine artery embolization (UAE) for the treatment of symptomatic adenomyosis.
Material and Methods: Fourteen consecutive patients (38-56y, mean 47.64y) with symptomatic pure adenomyosis (menorrhagia, pain) non-responding to conservative treatment underwent bilateral UAE using Embozene® microspheres 700 µm. The diagnosis of adenomyosis was based on MRI criteria: diffuse or focal broadening/enlargement of the junctional zone on T2-WI (thickness >12mm) and punctate high intensity myometrial foci. The MR images obtained before and after UAE (1st, 3rd, 6th and 12th month) were evaluated for changes regarding uterine volume (length × width × height × 0.523), as well as the percentage of reduction rate in uterine size. The latter was calculated as follows: [volumepre-UAE – volumepost-UAE]/volumepre-UAE] × 100 (%). Patients' clinical status was also evaluated at corresponding intervals.
Results: All patients demonstrated clinical improvement at the scheduled follow-up period. A significant decrease in the mean uterine volume, corresponding to a mean reduction percentage rate of 17.67%, 14,4%, 29,74% and 34,09% (1st, 3rd, 6th and 12th month,

respectively) was shown. With the exception of a partial parturition of a necrotized adenomyoma, no other complications were noted.
Conclusion: UAE is a promising non-surgical alternative for patients with symptomatic adenomyosis. Short- and mid-term results of UAE using microspheres 700 µm are encouraging and demonstrate a satisfactory clinical improvement even if association with imaging findings is not so impressive.

P-225

Imaging appearances following uterine artery embolisation for adenomyosis

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Learning objectives: To outline the imaging appearances found during follow-up post-uterine artery embolisation (UAE) for adenomyosis. We plan to detail imaging methods and highlight salient radiological findings.
Background: UAE is increasingly utilised with a promising risk-benefit profile and good short-term outcomes in the treatment of adenomyosis. Imaging appearances found during follow-up, particularly those of ultrasound, could give cause for concern for the unprepared. For all centres considering embarking on delivery of this service, it is essential to gain knowledge of these features.
Clinical Findings/Procedure Details: In our practice, routine preprocedure imaging, for both fibroids and adenomyosis, consists of an initial pelvic ultrasound scan followed by an MRI scan, including gadolinium enhancement and angiogram (MRA), to detail arterial anatomy and assess extrapelvic uterine supply. Follow-up imaging consists of an ultrasound scan at one month and an MRI scan at 3 months. The ultrasound, in particular, can have a disconcerting appearance, on occasion mimicking a necrotic infected abscess centred on the uterine cavity, which needs careful clinical correlation. MRI appearances are often more reassuring. The MRI scan at 3 months (which can be brought forward if there are significant clinical concerns) is performed to assess treatment efficacy and to identify potential or late complications.
Conclusion: The growing influence of interventional radiology is rapidly pushing the available treatment envelope. The sharing of experience is essential to aid its safe development. This presentation outlines the imaging modalities used and the typical findings seen following UAE for adenomyosis and highlights the need for careful clinical correlation.

P-226

A combined intrauterine and cervical pregnancy after in vitro fertilization-embryo transfer: ultrasound-guided potassium chloride injection and bilateral uterine artery embolization

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Cervical pregnancy is a rare form of ectopic pregnancy. We present an unusual case of both viable cervical and intrauterine pregnancy after in vitro fertilization (IVF), managed with expectation of spontaneous cervical expulsion, in order to preserve the viable intrauterine pregnancy.

P-227

Percutaneous treatment of severe angiomatosis of uterine wall

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Patient presented with severe angiomatosis of uterine wall with intermittent bleeding and pain. Percutaneous injection of sclerosing agent under US-guidance was performed few times directly inside venous dilated vessels of uterine wall. Remission of symptoms and uterus volumetric reduction was achieved.

P-228

Balloon occlusion of the internal iliac arteries during caesarean section for placenta percreta: a case series

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Placenta percreta is a rare condition, often resulting in severe haemorrhage. We present 12 consecutive patients, who underwent multidisciplinary planed caesarean section involving prophylactic placement of internal iliac occlusion balloon catheters. Endovascular technique and peroperative transfusional needs will be discussed.

P-229

Successful uterine artery embolization in intractable postpartum hemorrhage using a novel embolic agent: Onyx

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We report the first case of severe postpartum uterine hemorrhage successfully treated with embolization using a new embolic material "Onyx"(used for the treatment of cerebral vascular malformations), after prior failure of treatment with standard agents.

P-230

Fibroid embolization in an amenorrheic woman with type-2 Mayer-Rokitansky-Kuster-Hauser syndrome (MRKH-2)

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Leiomyomata are common in women with normal uteri, but there are only 16 reported cases of fibroids in the rudimentary uterus of MRKH-2. This is the only described case treated with fibroid embolisation with symptomatic and imaging resolution on follow-up.

Imaging

P-231

Role of multidetector-row CT in assessing the source of arterial hemorrhage in patients with pelvic vascular trauma: comparison with angiography

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Purpose: We investigated the role of MDCT in identifying active bleeding in polytrauma patients with pelvic vascular injuries with or without associated fractures of the pelvis.
Material and Methods: 90 patients with blunt pelvic trauma and a drop in haematocrit underwent MDCT and angiography. Conventional radiography of the pelvis was performed at the admission followed by whole-body MDCT without and with contrast triphasic study to identify any injuries. MDCT images were transferred to a workstation to assess pelvic fractures, site of haematoma, active extravasation of contrast, vascular injuries and associated traumatic lesions. An aortogram was performed before selective and superselective catheterization of the hypogastric arteries and their branches for embolization. Results related to identify the source of bleeding at MDCT were compared with sites of bleeding or vascular injury identified by selective pelvic angiography.
Results: MDCT allowed us to identify pelvic bleeding in 83\\90 patients. Injured arteries were identified on MDCT in 75\\90 cases. Angiography confirmed the site of bleeding detected on MDCT and identified a second arterial hemorrhage in one patient. There was no agreement between MDCT and angiography in one patient. MDCT showed a PPV of 100% in identifying the injured arteries.
Conclusion: Arterial hemorrhage is a serious problem associated with pelvic fracture, and remains the leading cause of death. MDCT provides diagnostic information and it is able to identify pelvic bleeding. The presence of contrast extravasation indicates an injury of a specific artery. Urgent angiography and transcatheter embolization are effective methods for controlling arterial bleeding in pelvic injuries.

P-232

Single dose gadobenate dimeglumine for comprehensive MR angiography of the lower limbs with dynamic calf, 3-station bolus chase and high resolution extended phase infra-inguinal imaging: initial experience & comparison to historical control blood pool contrast agent imaging

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Purpose: Contrast-enhanced MRA is the modality of choice for assessing peripheral arterial disease. With developments in percutaneous angioplasty and open surgery to small crural vessels, there is increasing demand for high image quality, particularly in the run-off vessels. However, due to rapid distribution of conventional extracellular contrast from the arterial bed, there is an inherently narrow window for image acquisition. This can lead to "venous contamination". This problem has been largely overcome by blood pool contrast agents which have a prolonged intravascular half-life, most notably gadofosveset. This agent is no longer available in the European Union. The aim of this study was to adopt "extended phase" imaging using conventional gadobenate dimeglumine to achieve high-resolution images comparable to gadogosveset.
Material and Methods: The imaging of 20 patients scanned with gadobenate was compared to a control group of 20 scanned with gadofosveset, including claudicant and critical ischaemic patients. The dynamic, bolus chase and high-resolution images were scored on a Likert scale (from 1 to 5) by 2 radiologists. Observations were made at each of the 3 stations. Furthermore, contrast-to-noise ratio at the muscle, vein and arteries were studied with region of interest values. Mann-Whitney U statistical analysis was used.
Results: No significant difference in arterial quality was recorded between the high-resolution images. Infra-inguinal bolus chase images were higher quality ($p < 0.05$) for the gadobenate images as a result of reduced venous enhancement.
Conclusion: Extended phase imaging using conventional contrast provides image quality comparable to steady state.

P-233

Foot perfusion CT in patients with peripheral arterial occlusive disease (PAOD): a novel chance for treatment planning?

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Purpose: To prospectively assess the technical feasibility and reproducibility of a quantitative foot perfusion multidetector-row computed tomography (MDCT) technique in patients with PAOD.
Material and Methods: After institutional review board approval and informed patient consent were obtained, 10 patients with PAOD referred to our department to undergo a single-limb endovascular treatment were prospectively enrolled. All patients underwent dynamic foot 64-row-CT examinations before and after (within 72 hours) endovascular treatment, acquiring eight contiguous 5-mm reconstructed sections, with 60-second acquisition time, during injection of 50 mL of contrast medium (Iomeprol 400 mgI/mL, at 5 mL/sec). Data were analyzed by two experienced blinded readers using a dedicated software to calculate perfusion parameters, such as blood flow (BF), blood volume (BV), mean transit time (MTT), and permeability-surface area product (PS). Interobserver and intraobserver agreement of perfusion CT analysis of untreated foot were statistically assessed using intraclass correlation coefficient (ICC) and Blant-Altman analyses.
Results: A good interobserver and intraobserver agreement of perfusion CT analysis was obtained in all patients. All perfusion parameters obtained for untreated foot showed good agreement between the two repeated studies.
Conclusion: Foot perfusion CT is a feasible and reproducible technique. By providing the functional foot microvasculature, it could be a promising method to select the best treatment available for patients with PAOD; furthermore, in case of endovascular treatment, it could be useful to determine which and how many arteries should be recanalized in order to obtain the best result.

P-234

MR evaluation of hepatic lesions after radioembolization by unenhanced and dynamic contrast-enhanced MR imaging using Gd-BOPTA

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Purpose: To characterize hepatic lesions after radioembolization on unenhanced, dynamic contrast-enhanced and hepatobiliary phase (hp) MR imaging as a predictor for successful treatment.
Material and Methods: In 18 patients with primary or metastatic liver tumors, 24 lesions were analyzed by MR imaging (1.5 T) before

and up to 18 months after radioembolization on the basis of echo-planar (DWI), dynamic contrast-enhanced and hp imaging (flash 2d), after administration of Gd-BOPTA. Lesions were characterized retrospectively by two readers in consensus regarding lesion to liver contrast and dynamic enhancement. A lesion to liver ratio (LLR) was calculated based on signal intensity (SI) measurements. SI changes in different phases of dynamic imaging were detected for the liver as well as focal lesions.
Results: Embolized lesions (N=18) were characterized by a significant (p=0.012) increase of SI on late phase imaging combined with a decrease in arterial and portal venous phase. After 6 and 9 months, peak contrast decreased significantly (p=0.028). Non-treated lesions (N =6) demonstrated a significant higher dynamic range (wash-in and out) compared to embolized lesions (p=0.017). On hp imaging a significant increased contrast media uptake could be demonstrated compared to non-treated lesions (p=0,035). For DWI, only a tendency towards SI decrease was found 3 months after treatment with a significant lower signal after 9 months (p=0.004).
Conclusion: Dynamic perfusion changes with an increased uptake on late phase images characterize lesions after radioembolization. The liver-specific contrast agent Gd-BOPTA is a helpful diagnostic tool for the evaluation of radioembolized liver tumors and the detection of tumor recurrence.

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Diagnostic accuracy of CT angiography in the evaluation of lower limbs stenosis: comparison between visual score and quantitative analysis using a semi-automated 3D software

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Purpose: To assess the accuracy of a semi-automated 3D CT-angiography analysis software in the evaluation of lower limbs stenosis compared to standard reader evaluation, using conventional digital subtraction angiography (DSA) as standard of reference.
Material and Methods: 40 patients (31 men, 9 women; mean age 70.5 years;) with peripheral arterial occlusive disease underwent both conventional DSA and 64-slice CT-angiography (collimation: 0.625x64mm; 100ml @ 4ml/s Iomeprol 400mgI/ml, Iomeron 400, Bracco Italy). For each patient the vascular tree was divided into 8 segments from distal aorta to popliteal artery. Each district was evaluated in terms of significant stenosis (>70%) by two experienced vascular radiologists, on axial as well as 3D-CT images. Furthermore, a semi-automated quantitative evaluation of each district was also performed using a 3D-CTA software analysis (ADW 4.3 Volume Viewer 3 Autobone Xpress Pro). Reader and automated evaluations were statistically compared to DSA as gold standard.
Results: Both reader and automated evaluations obtained high statistical results when compared to DSA. Reader's performance was significantly higher to software in terms of sentitivity (98% vs 88%).
Conclusion: 3D analysis software should be feasible to identify significant vascular stenosis, but the role of radiologists should not be undetermined, allowing to improve diagnostic performance.

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Real-time monitoring of ablation defects during radiofrequency ablation of liver lesions using ultrasound-based tissue elastography: preliminary results

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Purpose: To evaluate the feasibility of real-time tissue elastography as a predictor of ablation size during radiofrequency ablation (RFA) of liver lesions.
Material and Methods: Based on promising results ex vivo, in this ongoing study, 5 liver lesions (HCC) of two patients were monitored during RFA using ultrasound. A novel tissue elastography as well as contrast-enhanced ultrasound (CEUS) were performed (1-5 MHz, LOGIQ E9, GE). As a proof of concept, ultrasound elastography of the ablated region was correlated with the devascularization using CEUS as well as post-procedural ablation defects in the contrast-enhanced CT.
Results: Changes in the elastography of the ablated region correlated with post-procedural ablation defects in the cCT. The colour-coded area of blue, denser necrosis, after RFA correlated with post-ablation defect without vascularization using CEUS and cCT.
Conclusion: After RFA, a marked rise in tissue density of the ablated region was documented using elastography. This indicates that elastography offers new diagnostic perspectives for an effective RFA procedure.

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Evaluation of hemodynamic changes using dynamic susceptibility contrast-enhanced (DSC) MRI in patients with MS and Zamboni's CCSVI

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Purpose: To evaluate cerebral hemodynamic changes using DSC-MRI in normal appearing white matter (NAWM) of multiple sclerosis (MS) patients with chronic cerebrospinal venous insufficiency (MS+CCSVI+), compared with MS patients without CCSVI (MS+CCSVI-) and healthy subjects (controls).
Material and Methods: From a series of MS patients enrolled by our institute and evaluated with color-Doppler-ultrasound (CDU) and phlebography, in order to establish the prevalence of CCSVI in MS we selected 42 patients: 32 satisfied the CDU criteria set by Zamboni et al. to diagnose CCSVI, 10 did not fall under those criteria. We evaluated a control group of 10 healthy subjects. Values of cerebral blood volume (CBV), cerebral blood flow (CBF) and mean transit time (MTT) were calculated in the semioval center, periventricular, frontal and peritrigonal NAWM. The perfusion data obtained in each area of NAWM were compared between the three groups.
Results: Decreased CBV was observed in MS+CCSVI+ patients in the semioval center (p<0.001), frontal (p=0.004) and peritrigonal NAWM (p=0.006), no differences were seen in the periventricular NAWM. MS+CCSVI+ patients showed reduction of CBF in all the NAWM (semioval center p<0.001; frontal p=0.01; peritrigonal p=0.008; periventricular p=0.008). Different MTT values were seen in the frontal NAWM (p=0.04), there were no differences in the remaining areas.
Conclusion: MS+CCSVI+ patients show CBF and CBV anomalies at multiple levels in the NAWM, both with respect to controls and MS+CCSVI-. Despite these data seemed to be very interesting, further studies are needed on a larger study group.

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Improved C-arm cone-beam CT imaging in the rabbit VX-2 liver tumor model by compensating for breathing motion: first results

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Purpose: The rabbit VX-2 liver tumor model has been used extensively for liver cancer research. C-arm cone-beam CT (CBCT) is an emerging imaging technique that has gained interest in interventional oncology. While pre-clinical imaging systems exist, translation to clinical applications can best be accomplished using a clinical system. The short ventilation cycle of 1-2 seconds causes motion artifacts in the 3D images. This work shows improved 3D image quality (IQ) using motion-compensated reconstruction.
Material and Methods: CBCT scans with 5, 10 or 20 seconds duration were acquired in 8 rabbit models (>1 year old, 3.8-4.2kg weight) with VX-2 liver tumors. The following steps are performed for motion compensation. 1) From the X-ray projections, a region of interest (ROI) containing the diaphragm is selected and a gradient filter is applied. 2) The diaphragm motion is estimated by cross-correlation analysis of the filtered ROIs and a caudo-cranial shift vector is derived. 3) Ribcage and diaphragm are semi-automatically segmented from a standard 3D reconstruction. A 3D motion vector is interpolated for every voxel by keeping the ribcage static and applying the detected motion to the diaphragm. 4) The motion-compensated reconstruction is obtained by applying the motion vector to every voxel during back-projection.
Results: Compared to standard CBCT reconstructions, the motion-compensated images show increased sharpness of the diaphragm, fewer streak artifacts, and improved delineation of tumor boundaries.
Conclusion: Motion compensation of the rabbit ventilation results in improved IQ and can enable use of clinical C-arm systems for pre-clinical imaging to facilitate translational imaging research.
Disclosure: DS, ML, NN, PE, AR and MG are full-time employees of Philips.

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Detection and characterization of cerebral metastases: comparison of contrast-enhanced T1-MPRAGE and SPACE in an intraindividual comparison

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Purpose: To compare the effectiveness of T1 contrast-enhanced MPRAGE and SPACE for detection and characterization of cerebral metastases.
Material and Methods: A total of 18 patients with first-revealed metastatic changes of the brain were examined with a 3T MRI system. T1 MPRAGE and SPACE were used as postcontrast sequences using 20 ml of Gd in a randomized order. The parameters were: TR/TE 1900/2.46 ms, voxel 1.0 x 1.0 x 1.0, bandwidth 170 Hz/Px for MRPAGE; and TR/TE 500/19 ms, voxel 1.0 x 1.0 x 1.0, bandwidth 574 Hz/Px for SPACE. Sequences were compared using quantitative and qualitative parameters. The number of metastatic lesions was counted and as secondary criterion the MR signal intensity increase, measured in the units of contrast/noise ratio (CNR), was assessed.
Results: In all cases, localization, form, and configuration and enhancement characteristics of metastases more than 5 mm in size were completely comparable on both sequences. In 10 patients, the SPACE sequence detected 4-19 additional metastases, all less than 5 mm. In none of the patients, MPRAGE was able to detect more metastases. In all patients, CNR was higher with the usage of SPACE, as compared to MPRAGE: if the size of the metastatic lesion was more than 5 mm – 4.2 ± 0.7 and 3.1 ± 0.3; if it was less than 5 mm – 3.6 ± 1.3 and 2.5 ± 0.5, respectively. Two patients with more SPACE-revealed metastases underwent a following gamma knife delineation.
Conclusion: Post-contrast SPACE proved to be more sensitive than MPRAGE in the detection of small metastases. In the qualitative and quantitative analysis, a better delineation based on a superior contrast and contrast to noise was observed.

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Low-dose contrast-enhanced 4D DSA for post-surgical evaluation of hepatic artery complications after liver transplantation

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Purpose: To evaluate low-dose contrast-enhanced 4D DSA by 320-slice computed tomography (CT) scanner for the detection of hepatic artery complications after liver transplantation.
Material and Methods:
A total of 18 patients underwent CT scanning by 320-slice scanner after liver transplantation. Contrast medium was infused at 6 mL/s, with a total dose of 50 mL. Images were generated by dynamic volume scanning and processed by 4D digital subtraction angiography (DSA) imaging software. The best images at the pure hepatic artery phase were selected for image reconstruction by volume rendering (VR), maximum intensity projection (MIP) and multi-planar reconstruction (MPR).
Results: The time of peak hepatic arterial enhancement was 20 s (range, 10–24.2 s); CT value at peak enhancement was 210 HU in one patient and 383 HU (range, 310–500 HU) in 17 patients. Anastomotic hepatic artery pseudoaneurysm (n = 2); mild (n = 3), moderate (n = 4), and severe (n = 1) anastomotic stenosis of the hepatic artery; and occluded anastomosis of the hepatic artery (n = 1) were detected. The following conditions were also detected: normal hepatic artery anastomosis (n = 7). Concomitant stenosis in hepatic arterial branches, hepatic-portal arteriovenous fistula, or patent small hepatic arterial branches (n = 4); unmatched diameter of donor and recipient arteries (n =3); grafted liver received blood supply from phrenic artery (n =3).
Conclusion: Low-dose contrast-enhanced 4D DSA imaging was able to obtain precise hepatic artery images at the pure hepatic artery phase. This technique is safe, noninvasive and precise when used to diagnose hepatic arterial complications after liver transplantation.

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Anomalous inferior vena cava associated with horseshoe kidney on MDCT

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Purpose: Anomalous inferior vena cava (IVC) in young patients is a risk factor for the development of deep venous thrombosis and the detection of the anomalies is important to place an IVC filter. The objective of our study is to evaluate the prevalence of the anomalous IVC associated with horseshoe kidney on MDCT.
Material and Methods: A total of 66 patients with horseshoe kidneys (Group A: 45 men, 21 women; mean age: 59.9 years) and 1,060 patients without horseshoe kidney (Group B: 530 men, 530 women; mean age: 63.1 years) were retrospectively evaluated for the prevalence and variation of anomalous IVC on contrast-enhanced MDCT. We used 16- or 64-MDCT scanner and reviewed axial CT images with 5 mm of reconstruction interval. The prevalence of anomalous IVC was compared for both groups using Chi-square test.
Results: Total anomalous IVCs were identified in 12 patients (1.1 %). Anomalous IVCs were identified in five patients (7.6%) of Group A: one preisthmic IVC with retrocaval ureter, two double IVCs posterior to the horseshoe kidneys, one left IVC posterior to the horseshoe kidney and one IVC with azygos continuation. Anomalous IVCs were identified in seven patients (0.66%) on Group B: four double IVCs, two left IVC and one IVC with azygos continuation with polysplenia and heterotaxy syndrome. Group A had higher prevalence of anomalous IVC than Group B ($P < 0.001$).
Conclusion: There was a significantly higher frequency of anomalous IVC in patients with horseshoe kidneys than in those without horseshoe kidney on MDCT. Anomalous IVC associated with horseshoe kidneys should be detected before vena caval intervention.

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Clinical application of diffusion weighted imaging and contrast-enhanced ultrasound in the diagnosis of ischemic-type biliary lesions after liver transplantation

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Purpose: To discuss the clinical application of DWI and CEUS on ischemic-type biliary lesions after orthotopic liver transplantation.
Material and Methods: 14 cases with ischemic-type biliary lesions after liver transplantation on bases of PTC or ERCP examination, pathology or clinical follow-up data were selected. All of 14 cases underwent CEUS, DWI and MRCP examination. The perfusion of hilar bile duct was dynamically observed on CEUS. The enhancement of the hilar bile duct wall was qualitatively graded as higher, equal, lower, or none. And the bile ducts signal of graft was also observed on DWI. Statistics analysis was also done between CEUS and DWI.
Results: The MRCP revealed 13 cases ITBL with the sensitivity of (92.3%, 13/14). MRCP mainly shows absent or thin bile signal at the level of hilar bile duct or hilar bile duct and intrahepatic small ducts, irregular stenosis and dilation. There were 11 cases show lower or none enhancement of hilar bile duct (78.6%, 11/14) on CEUS. The incidences of hyperintensity of bile duct of graft on DWI were (78.6%, 11/14), mainly located in hilar bile duct and intrahepatic small ducts (90.9%, 10/11). 3 cases showed higher or equal enhancement of hilar bile duct on CEUS and no hyperintensity of bile duct on DWI. There was no difference between the two examinations.
Conclusion: MRCP is a first choice, reliable and non-invasive way in the diagnosis of ITBL after liver transplantation. The combination of CEUS and DWI is the effective and supplementary method of MRCP in the diagnosis of ITBL after liver transplantation.

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Role of 3T MRI in the evaluation of the myocardial viability after coronary artery recanalization. A prospective study

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Purpose: To evaluate the capabilities of 3T MRI for the assessement of myocardial viability after coronary artery recanalization.
Material and Methods: 18 patients (14M and 4F) with coronary artery disease underwent an ECG synchronized breath-hold 3T MRI (Magnetom Verio, Siemens) with native as well as late and early contrast phase images. 15 patients had cardiac infarction, 3 noncoronary myocardial injury mainly myocarditis of different stages. In 7 patients after infarction stenting of the coronary arteries was done. The basic criteria to evaluate myocardial viability was quantification of postinfarcted cardiosclerosis in delayed postcontrast images as well as its extension into myocardial tissue. Myocardium affected less than 50% could be called viable. Locating myocardial blood supply areas with regard to coronary arteries vessels suggested their successful recanalization. The evaluation was performed by 2 separate radiologists in a consensus reading.
Results: 5 patients had no viable myocardium, most often in the LCA. 2 of them had transmural infarction, 3 patients had subendocardial myocardium affecting more than 60-80%. The presence of viable myocardium in the infarcted area has been revealed in 10 out of 15 patients. In two subjects subendocardial infarction affected less than 20%, in 7 patients 30-35% and in one 40-45%. 7 patients with viable myocardium underwent repeated endovascular treatment and stenting of the consecutive coronary artery branch. 3 patients underwent the primary stenting.
Conclusion: 3T delayed contrast-enhanced MRI is informative and safe diagnostics which allows assessing post ischemic myocardial changes and forecasting possible successfully coronary artery recanalization.

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Intravenous contrast-enhanced C-arm CT for assessing safety margins in radiofrequency ablation of liver tumors: a preliminary result

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Purpose: To assess the use of intravenous contrast-enhanced C-arm CT for the immediate assessment of safety margins after radiofrequency ablation (RFA) of liver tumors.
Material and Methods: We studied the cases of 10 patients (4 men, 6 women; mean age, 68.7 years) with liver tumors (7 hepatocellular carcinomas, 3 metastatic liver tumors; mean size, 16.4 mm [range, 8–20 mm]) who underwent RFA with a flat-detector C-arm angiography system, wherein a 17-G RFA needle was inserted under ultrasound and/or C-arm CT guidance. Intravenous contrast-enhanced C-arm CT images were acquired at 2 min after injecting a 90 mL bolus dose of iopamidol via the antecubital vein at the end of each session. Contrast-enhanced multidetector computed tomography (MDCT) was performed 3–7 days after each RFA session. Ablation margins were measured in 6 orthogonal directions using multiplanar images of both C-arm CT and MDCT, with the preprocedural MDCT images as the reference. The ablation margins obtained from both imaging techniques were statistically compared using a paired t test.
Results: All RFA procedures were technically successful. Of 60 total

ablation margins, 28 (46.6%) and 18 (30.0%) were found to be less than 5 mm with C-arm CT and MDCT, respectively. The sensitivity and specificity of C-arm CT for detecting insufficient ablation margin were 88.8% (16/18) and 78.6% (33/42), respectively. The mean ablation margins were not significantly different between C-arm CT (7.4 mm [95% CI; 5.4–9.6 mm]) and MDCT (7.5 mm [95% CI; 5.0–9.9]) (P = .623).
Conclusion: The efficacy of intravenous contrast-enhanced C-arm CT in assessing the safety margins after RFA of liver tumors is nearly equivalent to that of MDCT.

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Virtual unenhanced CT of the aorta: can the conventional unenhanced phase be discarded?

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Purpose: Dual energy CT permits the production of virtual unenhanced (VU) images from any phase of a CT examination where iodinated contrast medium has been administered. The purpose of this study was to examine the image quality achievable with VU images of the aorta and investigate whether they were sufficient to replace conventional unenhanced (CU) images.
Material and Methods: VU, CU and arterial phase images were acquired using a Siemens 128 slice second generation dual source multi-detector CT machine. Paired regions of interest (ROIs) were drawn at multiple points within the thoracic and abdominal aorta and Hounsfield units measured. Subjective assessment of VU image noise, quality and acceptability was performed by 2 independent expert readers.
Results: Between November 2009 and November 2010, 50 patients were examined. There was no significant difference in HU attenuation between the VU and CU images in the abdominal aorta (44.8 vs. 45.3 p=0.15); however, there was a significant difference in HU attenuation in the thoracic aorta (42.9 vs. 47.2 p<0.01). Subjective assessment showed that VU images of the abdominal aorta were an acceptable replacement for CU images in 88% of cases as compared to only 12% of cases in the thoracic aorta. There would have been a radiation dose reduction of 53% had the CU series not been performed.
Conclusion: VU images of the abdominal, but not the thoracic, aorta are of sufficient diagnostic quality to replace the CU series. This could lead to a significant reduction in radiation dose.

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Magnetic resonance imaging for optimized implantation and long-term monitoring of patients receiving a left atrial appendage occluder

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Purpose: Patients (pts) with atrial fibrillation (AF) often suffer from blood clots in the left atrial appendage (LAA), being the main cause of embolism and stroke. For pts without effective with oral anticoagulion, percutaneous transcatheter LAA occlusion systems have been invented as a promising alternative therapy. We report about cardiac magnetic resonance imaging (CMR) for device size selection and monitoring of LAA occlusion in AF pts.
Material and Methods: Pts scheduled for LAA occlusion received CMR before and after device implantation. Left atrial (LA) angiography, a 3D navigator and delayed enhancement sequences were applied. The size of the LA, LAA, and position and size of the occluder were measured.
Results: 10 pts (7m, age 71+/-10y) with AF received a LAA occluder system (Amplatzer, Golden Valley/MN, USA). 9/10 had a stroke, 1/10 a TIA. CMR (Siemens Espree 1.5T) showed an LA diameter 58.1+/-17.2mm, and LAA diameter 25.7+/-4.5mm before implantation. Manufacturing occluder diameters were 25.1+/-4.7mm, with a difference of 1.6+/-0.3mm compared to measured LAA. During follow-up (24+/-4weeks), there was no device dislocation or thrombotic formation detected by CMR. LA diameter was 54.1+/-7.6mm, LAA diameter 27.9+/-3.2mm, and occluder diameter 25.3+/-4.9mm. 9/10 occluders were leakproof, 1/10 was untight with a small contrast agent rim around the occluder.
Conclusion: CMR allows visualization of LAA and selection of optimal LAA occluder size. CMR is feasible in pts after LAA occluder implantation, and seems to be safe for evaluation of device position, size, and tightness. Therefore, CMR is a valuable tool for LAA occluder implantation, and should be routinely used for long-term monitoring.

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Iomeprolo 250 mg/ml vs iopamidolo 370 mg/ml in DSA study of lower limbs diabetic arteriopathy in patients with elevated serum creatinine value

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Learning objectives: Evaluate the differences in tolerability and diagnostic quality of DSA images produced by the injection of two different and differently concentrated iodate particles, with equal volumes, flows and acquisition techniques.
Background: To evaluate the possibility of performing diagnostic imaging of the lower peripheral vascular district with DSA using a low iodine concentration contrast media, although maintaining an high diagnostic power and ensuring greater patient comfort.
Clinical Findings/Procedure Details: 96 diabetic arteriopathic patients with high creatinine values (median 1.6 mg/dl) were evaluated between November 2009 and December 2010 by lower limbs DSA. All patients had renal premedication. They were divided into two groups: in the first one (48 patients) Iomeprolo 250 mg/ml was used, and in the other one (48 patients) Iopamidol 370 mg/ml. Tolerability [pain before and after injection of contrast medium was evaluated by Visual Analogue Scale (VAS)] and capability to produce diagnostic images for lower limbs DSA between the two iodate particles were evaluated.
Conclusion: The iomeprolo 250 mg/ml has a good tolerability expressed in terms of VAS, avoids motion artifacts, guaranties the same high contrast images. This gives us the opportunity to reduce the total volume of iodine injected and so to reduce the possible risk of alterations in renal function.

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Pictorial essay of upper extremity angiographic findings

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Learning objectives: Atherosclerosis of the upper extremities is distinctly less common in the upper extremities than in the lower extremities. The upper extremities are however, subjected to a wide variety of various pathologic conditions including aneurysmal disease, thromboembolism, vasospastic disorders, collagen vascular diseases, thoracic outlet syndromes, and traumatic injuries. The purpose of this educational display is to indicate situations in which upper extremity angiography is indicated. A secondary goal is to illustrate examples of each of these pathologic conditions. Interesting anatomic variants and pitfalls will be discussed along

with complications.
Background: Arterial disease is diagnosed less commonly in the upper extremity than in the lower extremity, so that interventionalists may be less familiar with the anatomy and possible pathological conditions that may occur. Unusual pathologies such as vasculitis, entrapment syndromes, and trauma constitute a higher proportion of cases than in the lower extremity. The anatomic variation combined with the unusual pathologic conditions makes upper extremity angiography technically and diagnostically challenging.
Clinical Findings/Procedure Details: There are frequent anatomic variations in the blood supply to the upper extremity and each hand angiogram is as unique as a thumbprint. The causes of upper extremity arterial disease include atherosclerosis, thromboembolism, thoracic outlet syndrome, trauma, dissection, vasculitis, vibration injury, Buerger's disease, and other miscellaneous conditions. A wide variety of techniques can be utilized to image upper extremity arterial disease including MRI, CTA, ultrasound, and conventional angiography.
Conclusion: This pictorial essay has summarized indications and techniques, anatomic variants, and findings of the more common and interesting upper extremity pathological conditions.

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Congenital anomalies involving the coronary sinus: ECG-gated 64-channel MDCT findings

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Learning objectives: 1. To understand the normal developmental process of coronary veins and coronary sinus. 2. To review the normal anatomy of the coronary veins and coronary sinus. 3. To provide a pictorial review of several cases of the congenital coronary sinus anomalies discovered incidentally.
Background: Normal venous development is a process of progression and regression of the three major paired venous systems, namely the vitelline, umbilical, and common cardinal veins. The faulty development may result in congenital anomalies.
Clinical Findings/Procedure Details: Coronary sinus anomalies have been classified into five types, including enlargement of the coronary sinus with/without a left-to-right shunt, absence of coronary sinus, atresia of the right atrial coronary sinus ostium, hypoplasia of the coronary sinus, and unroofed coronary sinus. The failure to recognize anomalies in which the coronary sinus is involved may cause a misinterpretation of cardiac catheterization findings, and may cause a troublesome hemodynamic alteration during cardiac surgery.
Conclusion: Congenital coronary sinus anomalies are rare and they can occur without any effect on cardiac function and without clinical symptoms or signs. This exhibit presents the normal developmental process and normal anatomy of the coronary sinus and several cases of the congenital coronary sinus anomalies discovered incidentally.

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CT arteriography of the upper extremities: indications, technique and limitations

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Learning objectives: To review clinical indications for CT arteriography of the upper extremity (UE-CTA). To discuss optimized image acquisition techniques for multidetector and dual source CT scanners. To illustrate key imaging findings for common differential diagnoses and impact on treatment planning.
Background: CTA is a powerful noninvasive vascular imaging modality. In the upper extremities, CTA is less frequently utilized than in the lower extremities, and the literature on its use is limited. UE-CTA provides fast assessment of the arterial system of the upper extremities and is an extremely helpful modality particularly for interventional radiologists and vascular surgeons.
Clinical Findings/Procedure Details: UE-CTA is used in our institution for post-traumatic evaluation, pre-operative planning of complex upper extremity reconstructions, atherosclerotic/embolic events, post-surgical or interventional follow-up and thoracic outlet compression syndromes as well as less frequently for collagen vascular diseases and hypothenar hammer syndrome. Images with a collimation of 0.6 mm are acquired from the aortic arch to the digits with the UE of interest extended above the patient's head during the administration of intravenous contrast material through a vein in the contralateral extremity. With this technique stenosis grading and detection of occlusions is reliable to the level of the wrist. At the level of the palmar arches only the detection of occlusions is possible. The digital arteries cannot be confidently assessed with UE-CTA.
Conclusion: CTA of the upper extremity is a powerful tool in our imaging arsenal for the evaluation of upper extremity arterial disease. Disease processes affecting primarily the hand remain the realm of catheter angiography.
Disclosure: KDH: Grant support, Siemens Medical Solutions, Malvern, PA

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Usefulness of CT during celiacography using 320-detector row CT before transcatheter arterial chemoembolization for hepatocellular carcinoma

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Learning objectives: To report the usefulness of CT during celiacography (CTCG) using 320-detector row CT (area-detector CT: ADCT) before transcatheter arterial chemoembolization (TACE) for hepatocellular carcinoma (HCC).
Background: Before TACE for HCC, it is important to detect tumors using CT during hepatic arteriography (CTHA) and CT during arterial portography (CTAP). Both are required for the correct diagnosis, because CTHA shows some false lesions such as arterioportal shunts and CTAP does not contain the information of tumor vascularity, but it spends time and effort to take both CTHA and CTAP. ADCT has prominent advantages for time and space resolution compared with conventional helical CT. Therefore, with CTCG using ADCT, we can obtain both CTHA-like imaging and CTAP-like imaging at one examination. Because CTCG individually scans CTHA-like imaging during early phase by arterial flow via hepatic artery and CTAP-like imaging during delayed phase by venous flow via splenic and portal veins.
Clinical Findings/Procedure Details: CTCG using ADCT scans with the following protocol. 50ml of iodinated contrast medium is injected from celiac trunk at a rate of 5ml/sec, and five-phase CT scans with delay times of every 10 seconds after the start of injection to 50 seconds. The first-phase CT images are like pure CTHA images, and the fourth- or fifth-phase CT images enhanced by splenic and portal venous flow with minimum influence of arterial flow are like CTAP images.
Conclusion: CTCG using ADCT substitutes for both CTHA and CTAP. Therefore, it provides us with sufficient information before TACE for HCC.

P-252

Klippel-Trenaunay-Weber syndrome: pathophysiology, imaging and intervention

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Learning objectives: To understand recent theories regarding the pathophysiology of Klippel-Trenaunay-Weber Syndrome (KTWS). To appreciate the radiological features of KTWS and, in particular, the important role of duplex ultrasound in the assessment of varicosities and magnetic resonance imaging in the assessment of arteriovenous malformations prior to percutaneous or surgical treatment.
Background: Klippel-Trenaunay-Weber syndrome (KTWS) is a congenital angiodysplasia characterised by a combination of: cutaneous haemangiomata, varicose veins and hypertrophy of bony and soft tissues. Arteriovenous malformations are also a feature of KTWS originally described by Parkes Weber.
Clinical Findings/Procedure Details: We outline current theories regarding the pathophysiology of KTWS. We describe the imaging features of KTWS, in particular the important role of duplex ultrasound and magnetic resonance angiography in planning percutaneous or surgical intervention. Venous malformations and varicosities may be treated in selected patients by percutaneous sclerotherapy and arteriovenous malformations by percutaneous embolisation. We describe the techniques employed with reference to cases treated at our institution.
Conclusion: Duplex ultrasound plays an important role in imaging varicosities in KTWS, in particular, prior to sclerotherapy and in assessing the deep veins which are often underfilled on venography. Magnetic resonance imaging is another important non-invasive tool in the assessment of varicosities and the deep venous system. It also has an instrumental role in the assessment of the degree of soft tissue and bony involvement of arteriovenous malformations and is an essential pre-requisite to percutaneous and surgical treatment.

P-253

Balloon occlusion brain SPECT: the role in assessment for cerebral artery sacrifice

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Learning objectives: To show the value and technique of simultaneous temporary balloon occlusion and brain SPECT in evaluating cerebral perfusion in oncology patients undergoing surgical artery sacrifice.
Background: Three patients presented with head and neck tumours that encased the arterial supply of the brain (1 carotid, 2 vertebral). These required radical resection with likely artery sacrifice. Preoperatively, the question of the neurological complication following resection arose despite non-invasive imaging showing a normal Circle of Willis. Simultaneous balloon occlusion of the involved artery and brain SPECT allowed objective analysis of regional cerebral perfusion. In our cases it suggested that the artery could be sacrificed without neurologic consequence.
Clinical Findings/Procedure Details: Using a standard cerebral angiogram approach the artery to be sacrificed was selectively cannulated and temporarily occluded with a balloon catheter for up to ten minutes. Simultaneously, technetium exametazime was injected and the patient was clinically assessed. Subsequent delayed phase cerebral SPECT imaging was performed. With visual and quantification analysis of the SPECT study, normal regional cerebral perfusion was demonstrated.
Conclusion: The ability to demonstrate neurological tolerance, with the use of brain SPECT, to temporary occlusion of the involved artery in these patients can provide additional objective evidence for safe surgical resection of cerebral arteries.

P-254

Popliteal artery stenosis: a review of intrinsic and extrinsic causes

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Learning objectives: Popliteal artery narrowing arises from entities both extrinsic and intrinsic and includes commonly and uncommonly encountered pathologies. While the clinical presentation may overlap, there is considerable variation in treatment and prognostic factors. Thus, appropriate imaging and analysis is crucial in correct diagnosis.
Background: Popliteal artery narrowing is a common cause of morbidity and mortality. Symptoms are related to decreased blood flow to the lower extremity and include insidious and acute symptoms related to limb claudication and ischemia, with the resultant limitations in ambulation, daily functioning and quality of life. Narrowing due to atherosclerotic disease is especially common among smokers, patients with diabetes, the elderly and those with other cardiovascular risk factors. Nevertheless, the etiology of popliteal artery narrowing is broad and a working knowledge of these causal entities is essential in proper patient management and care.
Clinical Findings/Procedure Details: We present cases of a number of popliteal fossa pathology/popliteal artery narrowing including intrinsic vascular as well as extrinsic musculoskeletal entities such as: atherosclerosis, popliteal artery aneurysm, soft tissue sarcoma, osteochondroma, cystic adventitial disease, abnormal muscle course/popliteal artery entrapment, Baker and gangion cysts, as well as non-occluding cases involving popliteal fossa lymphadenopathy, venous aneurysm/varicosities. We will also provide a literature review and discuss other reported pathologies.
Conclusion: Popliteal artery narrowing is a common clinical problem with a broad differential. We present several cases illustrating these various pathologies and stress that intelligent use and analysis of diagnostic imaging is crucial in differentiating between these entities.

P-255

Extremity DSA-flow/perfusion studies: a novel home-grown technique

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Learning objectives: Processing of the raw data obtained at digital substraction angiography can provide a colour-coded map of perfusion to the lower limb. This is a novel method for obtaining quantitative analysis of lower limb perfusion and may prove useful in guiding diagnostic, therapeutic and revascularisation decisions in peripheral vascular disease.
Background: In many areas of imaging we are moving beyond anatomic vessel study to physiologic end-organ perfusion, e.g. brain, tumour and cardiac studies. It is recognised that there is physiologic data contained within standard DSA data sets. Traditionally, apart from noting asymmetry of flow this has not been part of clinical practice. We investigated a technique to analyse and objectively measure functional elements of DSA acquisitions.
Clinical Findings/Procedure Details: Patients were imaged during

routine angiography practice. Standard access, catheters, contrast and acquisition techniques were applied. For each pixel of data time density curves were constructed for predefined lengths of vessel. Data were analysed for time to peak and rate rise and then was processed to colour-code for flow dynamics.
Conclusion: There is physiologic data already contained in standard DSA data sets that can be processed to deliver an objective measure of flow/perfusion. This has the potential to better define vascular stenotic/occlusive patient subgroups and may provide more individualised vascular study.

P-256

Angiography with 64 slices multidetector computed tomography for vascular interventional planning

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Learning objectives: To learn how to use multidetector computed tomography and its post-process capabilities in angiographic explorations for planning interventional endovascular procedures in the context of acute bleeding.
Background: In the context of acute hemorrhage, time is crucial and any measure in order to reduce duration of diagnosis and intervention is desirable because it drives to a prompt hemodynamic stabilization of the patient. Moreover, not only reducing time of procedure but also lowering volume of contrast material is needed, because this would prevent further renal damage in patients already at risk of hypovolemic renal failure associated with blood loss.
Clinical Findings/Procedure Details: Here, we present our experience applying 64-slice multidetector computed tomography, multiplanar reconstruction, maximum intensity projection and volume rendering images as primary imaging technique for tailoring the best vascular access, the precise anatomical location and the selection of the most appropriate catheter to catheterized the target bleeding vessel.
Conclusion: Anatomical variants and anatomical references can easily be noted as traffic signs that permit to avoid excessive contrast material administration and time-consuming procedures. The last is achieved through focusing on the bleeding vessels and providing with confidence about the target to embolize.

P-257

Appreciating critical imaging features in the appropriate triage of blunt splenic trauma

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Learning objectives: The objectives are to appreciate current imaging assessment of blunt splenic trauma and the limitations of traditional injury grading systems, to understand recent modifications of splenic injury grading and the implications for patient management and to appreciate imaging findings that predict those patients likely to benefit from management by the interventional radiologist.
Background: The spleen is the most commonly injured visceral organ in blunt abdominal trauma. Historically, the American Association for the Surgery of Trauma Grading System has been used to classify injury and direct management. Recent literature has found this to be a poor predictor of outcome and therefore unreliable. There is a current trend towards splenic preservation and convincing evidence suggests that the most important predictors of failure of non-operative management are the presence of active contrast extravasation (ACE) and splenic vascular injury (SVI). The Maryland shock and Trauma Centre have devised a CT staging system incorporating these elements. Current literature supports the use of angiography and embolization in patients with ACE and SVI.
Clinical Findings/Procedure Details: This exhibit illustrates the range of appearances of SVI and active bleeding and some of the imaging pitfalls. Appreciation of these imaging features helps to predict those likely to benefit from management by embolisation techniques and thereby enhance splenic preservation rates.
Conclusion: Identification of patients with blunt splenic trauma who are likely to fail non-operative management is vital in optimising care and reducing laparotomy rates. It is essential that SVI and active bleeding are identified and that the interventionalist is involved early to guide appropriate management.

P-258

Pictorial review of aortic root vascular pathology

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Learning objectives: To learn the most appropriate imaging modality/techniques and the imaging features of aortic root pathology. To revise the normal aortic root anatomy and imaging appearances. Various aortic root abnormalities will be described and presented with illustrative pictorial case studies.
Background: Anatomically the aortic root is the segment between the left ventricle and the ascending aorta. The components of the aortic root are the aortic annulus, the aortic valve leaflets, the coronary arteries and the sinus of Valsalva. Multidetector CT angiography is the preferred first line imaging modality for the majority of acute aortic root pathology as it is a sensitive and specific non-invasive test which provides detailed and fast volume coverage of the thoracic aorta in a single breath-hold.
Clinical Findings/Procedure Details: The aortic root pathologies can be subdivided anatomically according to whether they involve the aortic valve, the sinuses of valsalva or the aortic wall. Common acute aortic root wall abnormalities are caused by dissections, penetrating ulcers, intramural haematomas and aneurysms. Aortitis and infections are less commonly encountered causes. A detailed pictorial review of aortic root pathology is presented.
Conclusion: The vascular specialist should be familiar with the spectrum of aortic root pathology, especially that which may present acutely and the associated imaging features which are presented in this pictorial review.

P-259

Pictorial review of gastrointestinal complications following open aortic aneurysm repair

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Learning objectives: To learn and review the imaging and clinical features of a spectrum of acute gastrointestinal complications which may develop following open aortic aneurysm repair.
Background: Acute gastrointestinal complications are reported to develop in approximately 7-20% of patients following open aortic aneurysm repair. There is a high associated mortality rate of approximately 16-67%. Increased morbidity, length of hospital stay and increased costs are also associated with post-operative gastrointestinal complications. The diagnosis of a post-operative gastrointestinal complication is difficult for the surgeon to make without

imaging correlation. It is therefore of critical importance that the vascular radiologist is able to quickly and confidently recognise the spectrum of gastrointestinal complications which may occur.
Clinical Findings/Procedure Details: We pictorially present a wide spectrum of gastrointestinal complications which may develop post-operatively following aortic aneurysm repair. Specific post-operative complications include bowel ischaemia, paraprosthetic fistulation, bowel obstruction, direct bowel injury, omental infarction, intra-abdominal sepsis, ileus and peptic ulceration. The salient imaging and clinical features are presented with illustrative cases to aid learning.
Conclusion: Gastrointestinal complications following open aortic aneurysm repair are difficult to diagnose without imaging and are a cause of significant mortality and morbidity. It is important for the radiologist to be able to identify specific complications following aortic aneurysm repair which are presented with pictorial examples in this educational exhibit.

P-260

Communications between peripheral portal branches

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74-year-old female received percutaneous transhepatic portal vein embolization and this revealed obstruction of proximal portion of P8. However, peripheral branches of P8 were observed by selective portography of posterior branch. This finding suggests the existence of peripheral portal communications.

P-261

A case of cystic adventitial disease of the popliteal artery in a 7-year-old boy

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A 7-year-old Chinese boy presented with symptoms of left lower leg ischaemia at exercise. Doppler ultrasound and MRI showed cystic adventitial disease of the popliteal artery, an extremely rare condition in a pediatric population.

P-262

Tortuous cerebral veins in a patient with multiple cavernomas and osteogenesis imperfecta

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A 32-year-old patient with known clinical history of osteogenesis imperfecta presented with acute left sided hemianopsia caused by a chiasmal bleeding from a cavernoma. MR and DSA imaging revealed multiple CNS cavernomas and atypically convoluted superficial veins.

P-263

Persistent sciatic artery in a patient with intermittent claudication

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The authors present a case of persistent sciatic artery which was revealed by angiography in a patient with claudication. Sciatic artery is a rare embryonic anomaly in which primitive artery persists as a major blood supply of the lower extremity.

P-264

Conversion of asymptomatic to symptomatic AAA is accompanied by increasing FDG uptake

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We report about a patient with malignancy and coincident AAA who was subjected to FDG/PET-CT for oncological follow-up. During follow-up, the AAA turned from asymptomatic to symptomatic AAA accompanied by increasing FDG uptake.

P-265

Traumatic distal anterior cerebral artery aneurysm

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We report a case of 23-year-old female who had a non-penetrating cranial trauma, her CT was normal. Two weeks later, she developed seizure; on CT examination, falcian subdural hematoma and pericallosal aneurysm were detected.

P-266

Unusual posterior fossa venous angioma

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Venous angiomas are rarely symptomatic. We came across a case of bleed secondary to pontine venous angioma draining via an extremely unusual single vein traversing the pons parenchyma and draining into superior petrosal sinus.

P-267

Infantile hemangioma of the small bowel in a newborn presenting with lower GI bleed: a case report

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A newborn presented with lower GI bleed. CT angiography performed showed a complex and large vascular anomaly related to the terminal ileum. Due to its extension, an exploratory laparotomy was performed. Infantile hemangioma of the ileum was the final diagnosis.

P-268

Cardiac herniation following partial pericardiectomy for chronic constrictive pericarditis

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We report a case of a 63-year-old man with progressive right heart failure following constrictive pericarditis treated with partial pericardiectomy. Cardiac CT demonstrated an important herniation of both ventricles inducing a new constriction confirmed by cardiac catheterization.

Neuro and carotid intervention

P-269

Prediction of periprocedural ischemic complication in carotid artery stenting with filter embolic protection device using magnetic resonance (MR) plaque imaging

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Purpose: Our purpose is to investigate the feasibility of magnetic resonance plaque imaging (MRPI) to predict the high risk lesion for ischemic complication during carotid artery stenting (CAS) using filter embolic protection device (EPD).
Material and Methods: 108 carotid artery stenosis in 102 patients before CAS (90 males; mean age, 71.9 years) were evaluated by MRPI with black blood T1 weighted images. 45 were symptomatic with ≥50% stenosis and 63 were asymptomatic with ≥80% stenosis. All CAS procedures were performed using 2 types filter EPD and stent (Angioguard XP/Precise (A/P): 75, Filter wire EZ/Carotid Wallstent (F/W): 33). Main plaque components were classified into unstable plaque (intraplaque hemorrhage and lipid-rich/necrotic core) and stable (fibrous tissue and dense calcification) from the signal pattern. Development of new ischemic lesions on diffusion-weighted imaging (DWI) was assessed within 48 hours after CAS. We made statistical assessment on the plaque classification and the number of new ischemic lesions.
Results: All CAS procedures were successful. Ipsilateral new ischemic lesions were observed in 23 (32.4%) in A/P and in 5 (14.7%) in F/W. Ipsilateral multiple ischemic lesions (>10) were observed in 5 (6.7%) in A/P and in 1 (3.0%) in F/W. New ischemic lesions except multiple were all asymptomatic. In A/P, multiple ischemic lesions occurred significantly ($P < 0.01$) more frequently in patients with unstable plaque, but in F/W did not occur significantly.
Conclusion: Presence of unstable carotid plaques showed a higher risk of ischemic complication of CAS with in A/P than stable plaques, but there were no significant in F/W.

P-270

Patient-specific simulated rehearsal for the carotid artery stenting procedure

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Purpose: Recent advancements in simulation science permit patient-specific rehearsal (PsR) of carotid artery stenting procedures (CAS) by incorporation of DICOM data into endovascular simulations. This study aimed to assess face, content validity and the subjective sense of utility of PsR by the interventionalist and operative team members.
Material and Methods: All patients deemed candidates for CAS with suitable CT imagery were enrolled. All team members were involved in rehearsals conducted in the Laboratory, Simulated Operating Suite or Angiosuite environment immediately before the real case. Dexterity and qualitative metrics were recorded. Subjective questionnaires used a Likert scale from 1 (poor) to 5 (excellent).
Results: Of 16 patients, 3 were dropouts due to a technical problem, an inadequate CT scan and a patient no longer deemed a candidate for CAS. In 10/13 and 12/13 patients, respectively, endovascular material and fluoroscopy angles were identical. In 5/13 and 4/13 respectively, the simulator did not adequately predict cannulation difficulties of the stenotic internal/common carotid arteries. The realism (4/5), utility to evaluate the case (4/5), increase of efficiency in tool use (4/5), potential to increase communication (4/5), confidence (4/5) and team performance (4/5) were all rated highly.
Conclusion: PsR is rated highly for both face and content validity. Although certain biomechanical vessel properties seem to be replicated to a lesser degree, endovascular material use, access strategy and angiography imagery are effectively replicated. PsR constitutes a unique tool that may help tailor endovascular material choice for patients and enhance patient safety, procedural efficiency and clinical cost-effectiveness.

P-271

Supra-selective intra-arterial ophtalmic artery chemotherapy for advanced retinoblastoma as an alternative to surgical enucleation

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Purpose: To evaluate prospectively the efficacy of supra-selective ophthalmic artery chemoperfusion with Melphalan as a tumoricidal agent in children with advanced retinoblastoma in order to avoid surgical enucleation.
Material and Methods: From November 2008 to February 2011, 18 children (mean age 25 months) affected by group D retinoblastoma underwent intraarterial superselective chemotherapy using Melphalan (0.35 mg/kg) into the ophthalmic artery. This procedure was performed under general anesthesia and repeated for a total of 3 sessions separated by an interval of 3-4 weeks in between sessions. A total of 45 procedures were performed. Every endovascular treatment was coupled with intravitreal Melphalan injection, thermotherapy and/or cryotherapy.
Results: Technical success was achieved in all but two patients with dramatic regression of tumor volume, vitreous and subretinal seeds in 16 cases. In the other 2 cases, severe vasospasm of the femoral artery in one case and of the ophthalmic artery in the other

case prevented the successful technical realization of the procedure. Enucleation and external beam radiotherapy could be avoided in all but one treated patients, with a mean follow-up of one year. No severe systemic adverse effects or thromboembolic complications were observed. Local complications consisted of retinal detachment (2), conjunctival and lid edema (5), local skin pigmentation (1), transient carotid artery vasospasm (1), and sectoral choroidal occlusive vasculopathy (2).
Conclusion: Transarterial ophthalmic artery chemotherapy using Melphalan is an effective therapeutic protocol in advanced cases of retinoblastoma, as an alternative to enucleation and/or external beam radiotherapy.

P-272

Procedural complications of mechanical thrombectomy in ischemic stroke

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Purpose: The purpose of this study was to establish safety and efficacy of mechanical thrombectomy in ischemic stroke.
Material and Methods: We reviewed 239 patients who underwent endovascular mechanical thrombectomy at our department from 2007 until January 2011, for treatment of an acute ischemic stroke. 35 of them sustained intervention-related complications. 10 (28,6%) of these complications due to microcatheter perforation, in 5 (14,3%) patients the thromboembolus was displaced to a smaller vessel and was not accessible by the devices used. In 10 (28,6%) patients the follow-up CT showed a subarachnoidal bleeding, in these patients no evidence of a microcatheter perforation was found. A dissection of the treated vessel occurred in 4 (11,4%) patients. A rupture of a large vessel occurred in one (2,9%) patient. In two cases (5,7%) a unintentional stent separation was reported. Two (5,7%) patients sustained an intracranial hemorrhage. This hemorrhage led to a deterioration of neurological symptoms in one patient. In one (2,9%) case an in-stent thrombosis occurred one day after the procedure.
Results: The data show an improvement of the NIHSS following endovascular intervention in 19 of the 35 patients who sustain interventional-related complications. 10 patients show amelioration in the mRS score, approximate to the NIHSS. 13 patients of the collective show deterioration of symptoms.
Conclusion: The results show that mechanical thrombectomy is a safe and effective approach in the treatment of ischemic stroke and that it should become part of the standard treatment procedure.

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Early clinical single center data with the Solitaire thrombectomy device for the treatment of acute ischemic stroke

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Purpose: The purpose of this study was to demonstrate the early experience of using a self-expanding fully retrievable stent in the treatment of acute ischemic stroke.
Material and Methods: Eleven consecutive patients with acute intracerebral artery occlusions were treated with a self-expandable fully retrievable intracranial stent. For this technique, we used the Solitaire AB, which is the only intracranial stent that is fully recoverable. Four patients had an occlusion of the basilar artery, five had a middle cerebral artery occlusion and two had terminal carotid artery occlusions. Recanalization results were assessed by follow-up angiography immediately after the procedure. Neurologic status was evaluated before and after treatment (90-day follow-up) according to the National Institutes of Health Stroke Scale and modified Rankin scale.
Results: Successful revascularization was achieved in 11 of 11 (100%) patients TICI 2a/b and 3, a TICI 3 state was accomplished in two patients and partial recanalization was achieved in nine patients TICI 2a/2b. The stent was removed in all patients. The mean time from stroke symptom onset to recanalization was 351 min with a standard deviation of 124.6 min. Mean National Institutes of Health Stroke Scale score on admission was 16.1, with a standard deviation of 5.3. Almost two-thirds of the patients (61.2%) improved by >6 points on the National Institutes of Health Stroke Scale at discharge, and 30% showed a modified Rankin scale score of <2 at 90 days. Mortality was 9%. There were no intracranial hemorrhages.
Conclusion: Withdrawal of fully recoverable intracranial stents in ischemic stroke patients shows encouraging results.

P-274

Extracranial ICA aneurysms: endovascular treatment options, their success rate and complications

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Purpose: To demonstrate endovascular treatment options for extracranial internal carotid artery aneurysms and evaluate their usefulness based on treatment success rate and complications. These lesions are rare and are technically challenging for vascular surgeons (difficult anatomy of the region).
Material and Methods: There were 47 (25 females and 22 males) patients with extracranial aneurysms (both true aneurysms and pseudoaneurysms) of ICA treated using different endovascular methods. Various endovascular techniques were involved: stenting (with bare and covered stents) in 36 patients, stenting and coil placement in 5 patients and embolisation (ICA trapping, aneurysm coiling, NBCA) in 6 patients. Each procedure was performed after positive BTO. All patients were controlled during follow up which last from 12 months to 5 years.
Results: Endovascular treatment was successful in 46 cases. In one patient with an aneurysm which was treated with coils, total exclusion of the aneurismal sac was not achieved. There were no severe complications. Four patients suffered from hematoma in the groin which resolved spontaneously. In three patients in-stent restenosis was observed.
Conclusion: Our experience with extracranial carotid aneurysms shows that endovascular treatment of those lesions is both safe and efficient and should be considered a primary treatment option. However, good results depend heavily on proper choice of endovascular equipment and technique. BTO before each procedure is crucial to qualify patients for endovascular treatment.

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Virtual histology. Intravascular ultrasound as a diagnostic alternative for the morphological characterization of carotid plaques: comparison with histology and high-resolution MRI findings

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Purpose: Primary target was to validate VH-IVUS as diagnostic tool for plaque characterization through in vivo characterization of carotid artery plaques by correlation to ex vivo histological specimen. Secondary target was to compare in vivo VH-IVUS with HR-MR imaging in terms of the diagnostic accuracy in identifying the different plaque components.
Material and Methods: In ex-vivo study, data were acquired from 6 human carotid arteries explanted. The arteries were explanted from six male patients with a mean age of 72 ± 9.64 years, with known history of cerebral ischemia, either transient ischemic attack or stroke. Sectional images obtained by introducing the IVUS catheter into the explanted artery were compared with digitalized histological images. Twelve patients (8 males, 4 females, mean age of 75 ± 6.33 years), candidates for carotid artery stenting were included in in-vivo study. All histological and HR-MR images were converted to a digital format. Once digital images and number of pixels for each plaque component was obtained, the exact percentages of the four plaque components were determined.
Results: Forty-two images were used for correlation between VH-IVUS and histology. Quantitative analysis of different plaque components revealed a good concordance (0.80) between the two methods (95% CI 0.69 to 0.92). Comparison between HR-MR and VH-IVUS was performed on 27 images. Concordance between the two methods resulted 0.76 (95% CI 0.69 to 0.92).
Conclusion: VH-IVUS results being an effective diagnostic method that could be used as a valid alternative to HR-MR in centers where this technique is unavailable or when we need an intra-procedural plaque monitoring.

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Patient-specific simulated rehearsal is more effective than a preoperative generic warm-up in preparing novice interventionalists for the carotid artery stenting procedure

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Learning objectives: This study aimed to evaluate whether patient-specific simulated rehearsal (PsR) of CAS procedures can enhance the operative performance of novice interventionalists compared to a virtual reality (VR) generic CAS warm-up procedure or no preparation at all.
Background: PsR is a recent advancement that allows incorporation of patient-specific CT data into endovascular simulation software, enabling preoperative rehearsal of actual patient cases.
Clinical Findings/Procedure Details: Participants were trained in CAS during a 10 session cognitive/technical VR course. Thereafter, in a randomized crossover study, each participant performed a patient-specific CAS case 3 times on the simulator, preceded by 3 different tasks: a PsR, a generic VR case or no preparation at all (control). Technical performances were assessed using simulator-based metrics and expert-based video ratings. 20 medical trainees were recruited. Training plateaus were observed after 10 sessions. PsR was significantly better than generic warm-up and no warm-up for total procedure time (16.3±0.6 vs. 19.7±1.0 vs. 20.9±1.1 min, p=0.001) and fluoroscopy time (9.3±0.1 vs. 11.2±0.6 vs. 11.2±0.5 min, p=0.022) but did not influence the amount of contrast volume or the number of roadmaps used during the 'real' case. PsR was significantly better at enhancing the quality of the CAS performance as measured by the expert-based ratings (score 28 vs. 25 vs.25, p=0.020).
Conclusion: Patient-specific simulated rehearsal of a CAS procedure significantly improves the operative performance, compared to a generic VR warm-up or no warm-up at all. This technology requires further investigation with respect to improved outcomes on patients in the clinical setting.

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Direct percutaneous embolization of a carotid body tumor with Onyx: is it really safe?

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Carotid body tumors are rare highly vascular lesions that frequently require preoperative embolization to minimize surgical morbidity secondary to blood loss. Major complications following direct intralesional embolization with onyx have included migration of embolic material into the intracranial circulation.

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Management of acute middle cerebral artery occlusion due to embolization during angioplasty treatment of a carotid intrastent restenosis: a case report

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A 59-year-old male, previously treated with carotid stenting, had an intrastent restenosis. The patient underwent a redo-carotid angioplasty. A distal middle cerebral artery occlusion was evidenced at angiographic control. A mechanical thrombolysis was performed with penumbra system and a Wingspan stent was released.

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Endovascular treatment in one case of carotid stent fracture

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We report the case of a 62-year-old man with amaurosis, who underwent right internal carotid artery stenting six years before. CT angiography documented a restenosis due to stent breakage. A Carotid WALLSTENT® was placed inside the fractured one.

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Carotid-subclavian Dacron bypass graft stenosis: to stent or not to stent?

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PTA and stenting of a stenosed carotid-subclavian Dacron bypass graft. The graft was implanted in order to treat congenital subclavian steal syndrome due to aplasia of the proximal part of the left subclavian artery, with a right-sided aortic arch.

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Hybrid open and endovascular repair of intra-thoracic left carotid pseudoaneurysm

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Patient with previous mediastinal mass resection and an intra-thoracic carotid-carotid bypass. Post-operative neck and chest radiotherapy were performed. AngioCT showed left carotid intra-thoracic pseudoaneurysm. A cervical carotid-carotid bypass and coil embolization with stent-graft of the proximal left carotid artery were successfully performed.

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Emergency endovascular treatment of two innominate artery iatrogenic pseudoaneurysms

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We report two cases of innominate artery iatrogenic pseudoaneurysms. Emergency endovascular treatment was performed using a Wallgraft covered stent in the anonima. Postoperative course was uneventful and follow-up showed persistent exclusion of the pseudoaneurysms.

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Cerebral artery rupture during mechanical thrombectomy

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Mechanical thrombectomy is efficacious in opening intracranial vessels during acute ischemic stroke. Selective microcatheterisation of occluded artery carries a risk of vessel disruption. Cerebral artery rupture during mechanical thrombectomy is presented.

Oncologic intervention

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Stereotactic radiofrequency ablation (SRFA) for the treatment of colorectal liver metastases

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WITHDRAWN

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Locoregional control of metastatic well differentiated thyroid cancer in the neck by ultrasonography-guided radiofrequency ablation

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Purpose: To evaluate the efficacy and safety of ultrasonography (US)-guided radiofrequency ablation (RFA) to control metastatic well differentiated thyroid carcinoma (WDTC) in patients who are poor surgical candidates
Material and Methods: Between December 2004 and June 2008, 12 metastatic WDTCs (mean size, 13.8mm; range, 4-28mm) of 10 patients (6 females, 4 males; mean age, 44.8 years) were treated by RFA. The inclusion criteria for RFA were as follows: (1) number of metastatic tumor was less than 3 (2) confirmed by US-guided fine needle aspiration, (3) no metastatic tumor beyond the neck at the time of RFA, (4) poor surgical candidates. A radiofrequency generator and 18-gauge, 7-cm shaft length, 0.5- and 1-cm active-tip internally cooled electrodes were used depending on the size of targeted tumors. RFA sessions and ablation time were ranged from 1 to 2 and 60–900 seconds, respectively. Ten of the 12 metastatic tumors were treated by a single session RFA (83%).
Results: Following treatment, mean largest diameter decreased significantly, from 13.8 ± 7.0 mm^3 to 3.3 ± 3.9 mm^3 (p=0.002), as did mean volume, from 55.5 ± 50.3 mm^3 to 5.7 ± 9.3 mm^3 (p=0.002). At last follow-up, serum thyroglobulin had decreased in 7 of 10 patients. One patient developed dysphonia immediately after RFA of a left surgical bed.
Conclusion: Although surgery is the standard treatment modality for locally metastatic thyroid cancer, RFA is an effective for locoregional control of metastatic WDTCs in patients who are poor surgical candidates.

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Evaluation of a phase III clinical trial comparing transarterial chemoembolisation (TACE) using irinotecaN-loaded polyvinyl alcohol micrOsperes (Debiri) vs systemic chemotherapy Folfiri (CT) for the treatment of unresectable metastases to the liver (LM) in patients with advanced colorectal cancer (MCRC)

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Purpose: Patients with LM from MCRC have a severe prognosis with the 5-year survival of 25% after radical resection; for non-operable metastases the survival is poor. TACE using DEBIRI (D) is a feasible procedure. FOLFIRI (CT) is active for the treatment of MCRC. We planned this phase III study to assess survival as primary endpoint to increase median survival (MS) by 40% at 2-y (HR=0.72). QoL, responses, progression-free survival (PFS) and safety are secondary endpoints.
Material and Methods: Between December 2006 and December 2008, 74 pts were randomized, 38 patients to D (DC Beads loaded with IRI 200 mgr total dose) and 39 to CT. Two D patients had early progression, one refused and four CT patients refused. 72 cycles of D were administered in 35 pts, with a dose intensity (DI) of 99%, and 292 CT cycles were delivered to 35 pts with a DI of 90%.
Results: At a median follow up of 30 months (18-42), we reported (D vs CT): MS 48% vs 28%, response rate 70% vs 20%, acute toxicity 70% vs 20%, late toxicity 20% vs 80%, QoL improvement 65% vs 25%, costs for each pt: 4,500 vs 10,250 euro.
Conclusion: D increased the 30-month MS difference of 20% compared to CT. D improved responses, performance status and reduced costs. D reported higher immediate toxicity, mainly fever and abdominal pain, than CT. Late toxicity, mainly haematological, diarrhoea, asthenia and alopecia, was more common in CT. We conclude that D compared to CT increases survival and palliative results.

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The diagnostic value of dual phase cone-beam CT during hepatic arteriography in transarterial chemoembolization for hepatocellular carcinoma

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Purpose: To evaluate the diagnostic value of dual phase cone-beam CT during hepatic arteriography (CBCTHA) for hepatocellular carcinoma (HCC).
Material and Methods: 37 patients with unresectable HCC underwent dual phase CBCTHA (Xper CT: Allura Xper FD20, Philips Medical System) prior to transarterial chemoembolization (TACE). Three blinded observers independently reviewed and compared images of CBCTHA early phase alone and dual phase-CBCTHA (240mgI/ml, 30ml, 1.2ml/sec, scan delay 15 sec, 40 sec). The gold standard was defined as lipiodol accumulation on non-contrast CT within one week or tumor growth on dynamic CT within six months after TACE. Diagnostic accuracy was evaluated by the alternative free-response receiver operating characteristic (AFROC) method (Az value). Sensitivities and positive predictive values (PPV) were analyzed with the paired t test. In addition to the analysis for overall tumors, subanalysis for two subgroups, tumors equal or smaller than 1cm and those larger than 1cm, was performed.
Results: For tumors larger than 1cm, the mean Az value and sensitivity were significantly higher for dual phase than those for early phase alone (Az: 0.96 and 0.92, P=0.008, sensitivity: 0.85 and 0.75, P=0.013, respectively). For tumors equal or smaller than 1cm and overall tumors, Az value and sensitivity for dual phase and early phase alone showed no significant difference. (Az: 0.85 and 0.79, P=0.14, 0.88 and 0.81, P=0.07, sensitivity: 0.52 and 0.41, P=0.33, 0.73 and 0.61, P=0.11, respectively). PPV also showed no significant difference.
Conclusion: The diagnostic accuracy of dual phase-CBCTHA was superior to that of early phase alone in the diagnosis of HCC larger than 1cm.
Disclosure: This work was supported by a research grant from Philips medical system.

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Radiofrequency ablation guided by contrast harmonic sonography using perfluorocarbon microbubbles (Sonazoid) for small hepatocellular carcinoma

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Purpose: To evaluate the effectiveness of guidance of contrast harmonic sonography using perfluorocarbon microbubbles (Sonazoid) in radiofrequency ablation (RFA) for small hepatocellular carcinoma (HCC).
Material and Methods: Between April 2009 and December 2010, 132 patients with small 136 HCC nodules underwent RFA guided by contrast harmonic sonography using Sonazoid. The 132 patients were 108 men and 24 women whose age ranged 49 to 85 years (median, 68 years). The size of the 136 nodules was 0.5cm - 2.6cm (mean ± standard deviation, 1.4 ± 0.5cm). After intravenous injection of 0.01-ml/Kg Sonazoid, Sonazoid-enhanced harmonic sonography; early vascular imaging and late Kupffer imaging were obtained. RFA was performed, inserting a Cool-tip electrode into a nodule under guidance of Kupffer imaging. Two radiologists assessed whether the Sonazoid-enhanced harmonic sonography was superior or not to the B-mode US; a score of 1 = much better, a score of 2 = better, a score of 3 = equal, or a score of 4 = worse.
Results: All 136 nodules were completely ablated. Sonazoid-enhanced US was assessed as a score of 1 in 58 nodules (58/136 = 42.6%), a score of 2 in 33 nodules (33/136 = 24.3%), a score of 3 in 45 nodules (45/136 = 33.1%), or a score of 4 in none (0%). A score of 1 was assessed, because Sonazoid-enhanced US detected 32 nodules invisible on B-mode US, intratumoral viable lesions in 16 nodules, and local recurrence in 10 nodules.
Conclusion: Guidance of contrast harmonic sonography using Sonazoid was very effective in RFA for small HCC.

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Margin size is an independent predictor of local tumor progression after ablation of colon cancer liver metastases

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Purpose: To evaluate the relationship between margin size and local tumor progression (LTP) following CT-guided radiofrequency ablation (RFA) of colorectal liver metastases (CLM).
Material and Methods: From March 2003 to May 2010, 94 previously untreated CLM were successfully treated with RFA. The margin size was estimated by 2 blinded radiologists using anatomic

landmarks from the pre-procedure contrast-enhanced CT (CT), and 4-8 weeks post-RFA CT. CT every 2-4 months was used for follow-up. Kaplan-Meier methodology and Cox regression analysis evaluated the effect of the margin size, tumor location, size, and proximity to a vessel on LTP.
Results: During a median follow-up of 20 months; 45/94 (47.9%) CLM progressed. Median LTP-free survival (LPFS) was 16 months (95% CI: 6.60-25.41). Two-year LPFS rates for CLM with "0", "1-5mm", "6-10mm", "11-15mm" minimal margin were 74%, 54%, 26% and 20% (p=0.011); site concordance rates were 21/21 (100%), 16/19 (84%), 1/4 (25%), 0/1 (0%), respectively (p<0.001). Defects with several points of small margins under 5 mm had median LPFS of 9 vs 19 months (P=0.030). Minimal margin (p=0.002) and tumor size (p=0.028) were the only significant variables. The risk of LTP decreased 46% for each 5mm increase in margin and increased by 22% for each 5mm increase in tumor size.
Conclusion: There appears to be a direct effect of ablation margin on LPFS. Based on the 4-8 week post-RFA CT; defects covering the tumor with margins over 5mm in all directions were associated with best local tumor control.

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Microwave-ablation in porcine kidneys: effect of interrupted tissue perfusion on ablation morphology

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Purpose: To determine the effect of interrupted tissue perfusion on microwave-ablation morphology in an experimental in vivo study in porcine kidneys.
Material and Methods: Six pigs were studied. In three animals, both kidneys were microwave-ablated twice without interruption of the tissue perfusion (group I). In the remaining three animals, both kidneys were microwave-ablated twice with interruption of the tissue perfusion (hilar clamping) (group II). All microwave-ablations were performed with identical ablation parameters. After sacrifice of the pigs, the kidneys were harvested and cut in 2-3mm thin transversal slices. The morphology of the microwave-ablations was determined (e.g. long-axis, short-axis, volume and short-axis/long-axis ratio).
Results: Long-axis of the microwave-ablations was significantly larger in group II compared to group I (41.6/4.0mm versus 34.2/5.9mm; P<0.01). Short-axis of the microwave-ablations was significantly larger in group II compared to group I (16.6/1.2mm versus 12.2/2.1mm; P<0.001). Volume of the microwave-ablations was significantly larger in group II compared to group I (6.7/1.0ml versus 3.3/1.2ml; P<0.001). Short-axis/long-axis ratio was not significantly different in both study groups (1.12/0.09 versus 1.21/0.24; n.s.).
Conclusion: Interrupted tissue perfusion has an effect on microwave-ablation morphology. After interruption of the blood flow, microwave-ablations are significantly larger compared to microwave-ablations without interruption of the tissue perfusion.

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mRECIST tumour response and survival after Yttrium-90 radioembolisation for hepatocellular carcinoma (HCC)

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Purpose: To assess tumour response and survival after Yttrium-90 radioembolisation for hepatocellular carcinoma (HCC).
Material and Methods: 34 Yttrium-90 radio-embolisations were performed in 29 HCC patients. Patients were treated for unilateral disease (N=25), for extended unilateral disease with two subsequent Y90 sessions (N=1). Because of tumour progression, two patients received two treatments and one patient three treatments. Survival was estimated by Kaplan-Meier analysis, tumour response by the modified RECIST criteria up to one year follow up.
Results: mRECIST criteria could not be applied in 10 patients because of diffuse disease (N=2), lost to follow up (N=3), lack of hypervascularity of the nodules on CT/MRI (N=2), combined treatment (N=1), inadequate imaging (N=2). In 19 patients, early tumor response at a mean of 72 days was in, respectively, 14%, 32% and 32% complete response (CR), partial response (PR) and stable disease (SD). Progressive disease (PD) was present in 4 patients (22%). Late tumor response at a mean of 182 days could be assessed in 12 patients. CR, PR or SD was, respectively, observed in 8%, 58% and 8%. PD was present in 3 patients (25%). Comparing early and late response, two patients had an improved score changing from SD to PR and one patient from PR to CR. Only one patient worsened from CR to PD. The median survival time after therapy was 368 days (CI 227-459).
Conclusion: Yttrium-90 radioembolization for HCC is effective, but early response measurement with mRECIST seems to underestimate therapy effect.

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Neoadjuvant therapy for hepatocellular carcinoma improves drop-out rates in patients within Milan criteria awaiting liver transplantation

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Purpose: We evaluated the impact of image-guided therapy on dropout rates in a large cohort of patients within Milan criteria.
Material and Methods: All 391 patients listed with HCC from 1997 to 2009 were retrospectively reviewed. The study population was limited to patients within Milan criteria who received (N=183) or did not receive neoadjuvant therapy (N=151). From this cohort, patients were matched for native MELD, tumor size, tumor number, and blood type and distributed into two balanced groups. Kaplan-Meier estimates and the log-rank test were used to evaluate freedom from delisting.
Results: 101 patients with and 101 without neoadjuvant therapy were included in this analysis. In the neoadjuvant group, 73 received TACE, 15 RFA, 9 TACE+RFA, 2 Y-90, 1 cryoablation, and 1 acetic acid injection. The mean native MELD in the treatment group was 12.1+/-4.2, and in the non-treatment group 12.1+/-4.3. In the treatment group, 79 patients were transplanted, 15 delisted, and 7 remain

listed. In the non-treatment group, 80 patients were transplanted, 19 delisted, and 2 remain listed. In the treatment group, freedom from delisting was 85% at 6 months, 78% at 12 months, and 62% at 24 months. In the non-treatment group, freedom from delisting was 79% at 6 months, 58% at 12 months, and zero at 24 months. Median survival free from delisting was 687 days for the non-treatment group and not reached for the treatment group (p=0.023).
Conclusion: Patients within Milan criteria experience significantly lower drop-out rates with neoadjuvant therapy. Benefit can be seen at 6 months and persists beyond 2 years.
Disclosure: Consultant, Guerbet, Merit Medical

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Clinical usefulness of the triaxial microcatheter method in super selective transcatheter arterial chemoembolization for hepatocellular carcinoma

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Purpose: Transcatheter arterial chemoembolization (TACE) has been widely used for inoperable hepatocellular carcinoma (HCC). Super selective TACE is preferable to nonselective therapy, because it maximizes the impact of treatment on tumor while decreasing damage to tumor-free liver parenchyma. Thus, it is important to advance the catheter tip as close to tumor as possible in the feeding artery. Now, we have a new microcatheter which has a 1.9-Fr tip with no taper. It can be inserted into a 2.7-Fr. microcatheter. In this study, we evaluated treatment results for HCC using this new technique named the triaxial microcatheter method.
Material and Methods: We evaluated 63 super selective TACEs. Requirements for inclusion in this study were (a) HCCs 3 cm or less in diameter; (b) TACE performed by a single operator; and (c) no additional treatment in the absence of local progression. All patients were followed for more than a year after TACE. The median followed up period for living patients was 20 months (range, 17-31 months). The conventional microcatheter was used for 35 (control group), and the triaxial microcatheter method was used for 28 (triaxial group). We reviewed angiography at TACE and follow-up CT, and then evaluated local tumor status in the two groups.
Results: The 3-, 6- and 18-month local tumor control rate was 64%, 36% and 29%, respectively, in the triaxial group, compared with 40%, 14% and 8.6% in the control group (P=0.0086).
Conclusion: The triaxial microcatheter method appears to be useful in achieving higher local control rates.

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Super-selective Y-90 infusion guided by intra-arterial CT enables safe selective internal radiation therapy with a low coiling rate

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Purpose: To study the impact of super-selective Yttrium-90 (Y-90) infusions guided by catheter-directed intra-arterial CT (IACT) in addition to digital subtraction angiography (DSA) and technetium-99m-macroaggregated-albumin-scintigraphy (Tc99-MAA) on coiling rates and gastro-intestinal complications in patients undergoing selective internal radiation therapy (SIRT).
Material and Methods: From January 2008 to January 2011, 70 patients underwent 77 procedures of SIRT with Y-90 at our institution. For all procedures, IACT was performed using a hybrid 16-slice CT-angiography system to guide treatment in adjunction to DSA and Tc99-MAA. Retrospective analysis of images and electronic records was performed to retrieve information on position of infusion of Y-90 and type and number of branches coiled. Also, information was obtained on complications due to non-intentional radiation to extra-hepatic organs.
Results: In 5.3% of cases (n=4) Y-90 was infused from the proper hepatic artery. In all other cases (94,7%) super-selective infusion was performed. Of all patients, 27.3% (n=21) underwent coiling. The gastroduodenal artery (GDA) and right gastric artery (RGA) both had a coiling rate of 6.5% (n=5). Other coiling rates were as followed: accessory left gastric artery 7.8% (n=6), falciform artery 2.6% (n=2), right inferior phrenic artery 3.9% (n=3), left gastric artery branches in gastrohepatic trunk variant 5.3% (n=4), and left superior phrenic artery originating from the left hepatic artery 2.6% (n=2). Major gastrointestinal complications occurred in 3 patients (3.9%). All three patients had an endoscopically proven acute gastroduodenal ulcer.
Conclusion: Super-selective Y-90 infusion guided by IACT in adjunction to DSA enables safe SIRT and limits prophylactic coiling of the GDA and RGA.

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Multipolar hepatic RFA: influence of electrode configuration on coagulation volume

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Purpose: For multipolar hepatic radiofrequency (RF)-ablation it is known that the amount applied energy correlates with the generated coagulation volume. Our goal was to analyze whether the combination of electrodes also influences the ablation volume if the amount of applied energy is kept constant.
Material and Methods: In total, 60 RF-ablations were performed in freshly excised bovine liver using a multipolar RF-system (CelonLabPower, Celon AG Medical Instruments, Teltow, Germany). Ten ablations were performed with each of the following RF-applicator combinations: 3x2cm, 3x3cm, 3x4cm, 6x2cm, 6x3cm, 6x4cm. RF-ablations were interrupted after application of 25 kJ. During the experiment time, tissue impedance and generator output were monitored using a dedicated software tool. Generated coagulation zones were dissected and macroscopically measured along x-, y-, and z-axis followed by calculation of the approximate coagulation volume. An ANOVA was applied followed by Student-Newman-Keuls tests to analyze for significant differences.
Results: The combination of 6x3cm resulted in the largest mean coagulation volume (32cm^3). All other electrode combinations led to significant smaller coagulation volumes ranging from 25cm^3 (3x4cm) to 29cm^3 (3x3cm). Except for the 3x2cm combination (13.26min) there were no significant differences with regard to the application time (10.65–11.20min).
Conclusion: Besides the amount of applied energy, the combination of RF-applicators shows an influence on the generated coagulation volume in ex-vivo liver experiments.

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Long-term outcomes following drug-eluting bead transarterial chemoembolisation (DEB-TACE) as part of multimodality treatment for hepatocellular carcinoma

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Purpose: Hepatocellular carcinoma (HCC) is the commonest primary hepatic malignancy with more than half a million new cases annually. We sought to determine long-term outcomes in patients with hepatocellular carcinoma (HCC) treated with DEB-TACE as part of multimodality treatment at a single centre.
Material and Methods: From August 2006 to January 2011, 81 patients (61 males and 20 females) underwent DEB-TACE combined with surgery and/or percutaneous ablation for HCC. Our departmental database was reviewed retrospectively. Demographics, procedural details, clinical measures and outcomes were studied. Median age was 69 years (range 33-87). Median follow-up was 19.7 months (range 19 days – 54.2 months). All patients were included in the survival analysis. Overall survival was described using Kaplan-Meier methods.
Results: Median overall survival was 44.3 months. The 1- and 3-year survival rates were 74.5% and 50.3%, respectively. There were no deaths at 30 days following a DEB-TACE session. Fifty two patients with a median tumour size of 49mm (range 12-163) were treated with DEB-TACE alone. The median survival in this group was 28.5 months. Twenty nine patients with a median tumour size of 40mm (range 12-100mm) were treated with DEB-TACE combined with either resection and/or ablation. At 55 months, we have not yet reached median survival, survival in this group at the time of abstract submission being 51.1%.
Conclusion: In patients with HCC, DEB-TACE in combination with surgical resection and/or image-guided ablative therapies results in median survival of 44 months. Our results illustrate the importance of a multidisciplinary approach in the management of HCC.

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High-intensity focused ultrasound ablation for small hepatocellular carcinoma: long-term follow-up results

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Purpose: The aim of this investigation was to evaluate the long-term follow-up results of high intensity focused ultrasound (HIFU) ablation in the treatment of small HCC.
Material and Methods: From January 2000 to December 2004, thirty-five patients with small HCC were enrolled in this study. All patients were deemed not candidate for surgery nor suitable for local ablative techniques such as radiofrequency ablation (RFA), or unwilling to have any of those treatments. MRI was used to evaluate the efficacy of HIFU treatment.
Results: We conducted HIFU ablation for the treatment of 35 patients with 36 tumors, with each tumor measuring 3.9± 0.2 cm in its greatest dimension. Among the 35 patients, 29 were males and 6 females. The average age was 53.1±12.9 years. 34 patients had a solitary lesion, while 1 had two lesions. According to TNM classification, 27 patients were diagnosed as stage II, 3 patients were stage III, and 5 patients were stage IV. Follow-up imaging in one month after HIFU showed an absence of tumor blood supply in all 36 treated lesions. The survival rates at 1, 2, 3, 4 and 5 years were 96.3%, 87.5%, 80.2%, 71.3% and 71.3%, respectively. The cumulative tumor recurrence rates at the end of 1, 2, 3, 4 and 5 years were 20.3%, 30.8%, 30.8%, 39.5%, and 39.5%, respectively. No serious side effects were observed.
Conclusion: HIFU shows comparable results to other locoregional therapies for the treatment of small HCC. The long-term follow-up results show that HIFU can be safely used to treat small HCC.
Disclosure: W.Z.Chen is a shareholder in and consultants to Chongqing Haifu, Chongqing, China. Z.B.W. is a shareholder in and full-time employee of Chongqing Haifu. J.B. is a shareholder in Chongqing Haifu. L.Z. and H.Z. are consultants to Chongqing Haifu.

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Therapeutic effect of transcatheter arterial embolization for hypervascular hepatocellular carcinoma: web-based multicenter analysis in Korea

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Purpose: To evaluate the therapeutic effect of transcatheter arterial embolization (TAE) as first treatment for hypervascular hepatocellular carcinoma (HCC), using nationwide multicenter data in Korea.
Material and Methods: Eight hundred eighty-eight HCC patients who were registered in the internet homepage of primary liver cancer registry (www.plcr.or.kr) from August 2003 to August 2005 were enrolled and they were investigated till February 2007 regarding the following treatments after first TAE. The patients were divided into three groups according to the following treatments; TAE only, TAE + SL (any surgical resection, transplantation or percutaneous ablation followed), TAE + RC (radiation therapy or chemotherapy followed). The clinical and tumor characteristics, embolization factors and survival periods were analyzed.
Results: The 5-year survival rates of TAE in the groups of TAE only, TAE + SL and TAE + RC were 21.6%, 57.4%, and 13.1%, respectively. The independent prognostic factors were Child-Pugh classification, tumor size and modified 4th UICC stage. More selective embolization and complete embolization increased survival rates.
Conclusion: This study is the first nationwide multicenter analysis for TAE using online registration system in Korea, and it shows the 5-year survival rate of the patients who were treated by only TAE in the era of improved technique of embolization.
Disclosure: This study was supported by the Guerbe Korea research grant from Korean Society of Radiology 2003.

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Phase I/II study of transcatheter arterial chemoembolization with cisplatin powder and degradable starch microspheres for unresectable hepatic metastases from colorectal cancer refractory to standard chemotherapy

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Purpose: We conducted a phase I/II study of novel transcatheter arterial chemoembolization (TACE) with cisplatin powder (DDP-H) and degradable starch microspheres (DSM) to determine the recommended dose (RD) and to assess the efficacy and safety.
Material and Methods: DDP-H and DSM mixing solution was administered followed by the injection of DSM alone via hepatic artery every 4 weeks. In phase I, cohorts of 3 patients received escalating dose of DDP-H (50, 65 and 80mg/m2), and RD was estimated during the first cycle. In the phase II, more RD patients were added to assess tumor response, toxicity, hepatic progression-free survival (H-PFS) and overall survival (OS).
Results: A total of 24 patients (male 16, female 8; mean age 63.0, range 45-79) were enrolled in this study. FOLFOX had previously been administered to all patients, irinotecan-containing regimen to 12 and bevacizumab and/or cetuximab to 14. During phase I (n=9), maximum tolerated dose was not reached and DDP-H 80 mg/m2 was recommended for a phase II. Phase II enrolled 15 patients. The following Grade 3 toxicities were observed: thrombocytopenia 12.5%, aspartate transaminase elevation 33.3%, alanine transaminase elevation 12.5%, hyponatremia 8.3%, and cholecystitis 4.2%. The tumor response rate was 61.1%. The median H-PFS and OS were 8.8 months (95% CI; 4.06 to 13.5) and 15.5 months (95% CI; 5.61 to 25.3), respectively.
Conclusion: This phase I/II study demonstrates that the novel TACE with 80mg/m2 DDP-H and DSM is well tolerable, and can produce a high response rate with encouraging survival duration.

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A new method of quantitative analysis of 99mTc-MAA SPECT/CT accurately predicts response and survival in patients with HCC treated by radioembolisation with 90Y-loaded glass microspheres (Therasphere®)

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Purpose: Evaluation of ^{99m}Tc-MAA SPECT/CT-based dosimetry in the prediction of response and survival in patients with hepatocellular carcinoma treated with Therasphere®.
Material and Methods: Therasphere® was administered to 54 patients. SPECT/CT scintigraphy was done after arterial lobar injection of 99mTc-MAA. Quantitative analysis (Volumetric analysis software, Syngo Work Station, Siemens) was used for calculation of volumes and total counts in tumors, injected healthy liver and injected total liver using VOI drown with an isocontour method applied on the SPECT/CT fusion images. Those parameters were used for calculation of the absorbed dose in tumours (TD), injected healthy liver and total injected liver (LD) using the classical formula D(Gy) = A (GBq). 50/ W(kg). Response was evaluated at 3 months using EASL criteriae.
Results: Follow-up data longer than 6 months are available for 36 patients. Mean LD was 120.5±31.4 Gy. Mean TD was 327.7±106.8Gy for responding lesions versus 123.6±63.2Gy for non responding lesions ($p<0.0001$). With a threshold TD of 205Gy, MAA-SPECT/CT was predictive of response with a sensibility of 100%, a specificity of 75%, and an overall accuracy of 91%. Median TTP was 5.2 months for patients with a TD<205Gy versus 14 months if TD was >205Gy ($p<0.0003$). Median OS was 9 months for patients with a TD<205Gy versus 18 months if TD was >205Gy ($p<0.0322$).
Conclusion: In this retrospective study quantitative ^{99m}Tc-MAA SPECT/CT and TD is an accurate predictor of response and survival. Those results need to be validated in a prospective study, then MAA-SPECT/CT dosimetry should be used for an adaptation of the injected activity.
Disclosure: I am consultat for MDS nordion, the manufacturer of therasphere

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Micro-bland embolization (mb-TAE) may enhance local outcome of RFA in the treatment of complex liver metastases from CRC

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Purpose: Recurrence after RFA is a major concern. Tumor size, site and shape may affect local results. Our aim was to assess feasibility and local results of micro-bland embolization (mb-TAE) performed before RFA for improving post-ablation safety margin in patients with complex liver metastases from CRC.
Material and Methods: From may 2006 to December 2010, 15 patients affected by CRC with unresectable liver metastases underwent a combined treatment with TAE followed by RFA, in the same session, for a total of 17 treated lesions. Liver tumors had maximum axial diameter ranging from 18 to 49 mm. Mb-TAE was performed using 100 mm microspheres (Embozene); subsequent RFA was performed by inserting into the tumor a multitined needle under US and/or CT guidance. Initial local tumor response and systemic disease were assessed with CT and PET. The recurrence-free and overall survival rates as well as procedure-related complications were evaluated.
Results: Post-treatment unenhanced areas at CT ranged from 37 to 104 mm. Safety margins ranged from 9 to 30.5 mm (mean 13 mm). In all cases complete response at CT and PET was obtained (follow up 1 to 47 months; median 15 months); in one patient relapse of disease was observed at 12 months. Eight patients are still disease free. Seven patients developed new liver metastases or progressive systemic disease during follow-up. No treatment-related major complications were observed.
Conclusion: mb-TAE performed immediately before RFA enhances tumor ablation efficacy and expands its role in the treatment of hepatic metastases. However, our experience is limited and further prospective studies are needed.

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Cystic artery assessment with C-arm CT in patients with hepatocellular carcinoma undergoing transcatheter arterial chemoembolization

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Purpose: To assess the cystic artery anatomy and variation with C-arm computed tomography (CT) in patients with hepatocellular carcinoma (HCC) undergoing transcatheter arterial chemoembolization (TACE).
Material and Methods: From July 2009 to April 2010, 141 consecutive patients with HCC underwent the first TACE. Common hepatic angiography and C-arm CT were performed in all patients. The origin, number of the cystic artery and its communications with other arteries were retrospectively evaluated with C-arm CT.
Results: Cystic arteries were delineated in all 141 patients (100%). One cystic artery was seen in 96 (68%). Two cystic arteries were seen in 45 (32%). The cystic artery origin was right hepatic artery(HA) in 107 (76%), right anterior HA in 11 (7.8%), right HA and right anterior HA in 5 (3.5%), right anterior HA and right posterior HA in 3 (2.1%), right posterior HA in 2 (1.4%), segment 4 HA in 2 (1.4%), segment 6 HA in 1 (0.7%), left HA in 1, proper HA in 1, right HA and segment 8 HA in 1, right HA and segment 5 in 1, right HA and proper HA in 1, right HA and left HA in 1, right HA and middle HA in 1, right anterior HA and segment 6 HA in 1, common HA and proper HA in 1 and right HA and posterior superior pancreaticoduodenal artery in 1.
Communications with other arteries were seen in 57 (40%) patients: Communication with segment 5 HA in 42 (30%), segment 4 HA in 6 (4.3%), omental branch of gastroduodenal artery in 1 (0.7%) and dual communication with segment 4 and 5 HA in 8 (5.6%).
Conclusion: During TACE in patients with HCC, thorough understanding of the origin of the cystic artery and its variation with an aid of C-arm CT is crucial for adequate treatment of the tumor while avoiding gallbladder-associated complications.

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Percutaneous CT-guided high-dose-rate brachytherapy ablation of liver metastases from breast cancer: initial experience with 77 lesions

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Purpose: The aim of this study was to review our initial experience with computed tomography-guided high-dose-rate-brachytherapy (CT-HDRBT) ablation of breast cancer liver metastases (BCLM).
Material and Methods: Between January 2008 and December 2010, 36 consecutive female patients with 77 metastases were treated with CT-HDRBT in 56 treatment sessions. The mean age was 58,57 years (range: 34-83 years). Treatment was performed by CT-guided applicator placement and high-dose-rate brachytherapy with an iridium-192 source. The mean radiation dose was 18.57 Gy (SD 2.27). To evaluate tumor response a Gd-EOB-DTPA-enhanced liver MRI was performed before, six weeks after and every third months after treatment. The primary endpoint was local tumor control (LTC); secondary endpoints included progression-free survival (PFS), and overall survival (OS).
Results: Seven patients were lost at follow up, the remaining 29 patients were available for MRI evaluation at a mean follow-up time of 11.8 months (range: 2-32 months). The mean tumor diameter was 2.2 cm (0.6–6.2 cm). No major complications were recorded. Two (3%) local recurrences were observed after a local tumor control of 10 and 12 months, respectively. Nine patients (31%) experienced a distant tumor progression during the follow-up period. Two patients (6.9%) died during the follow-up period. Overall survival (OS) probabilities were estimated with the Kaplan-Meier method. OS ranged from 2 to 33 months (mean: 15.8 a months).
Conclusion: CT-HDRBT is a safe and effective alternative to thermal ablation and warrants an outstanding rate of local tumor control in patients with BCLM.

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Survival after transarterial chemoembolization (TACE) in patients with hepatocellular carcinoma (HCC) in 2010. Need to update assumptions for clinical practice and research

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Purpose: To evaluate the survival of HCC patients treated with TACE-DEB following a strict selection (preserved liver function, absence of cancer-related symptoms, extrahepatic spread or vascular invasion). To assess the rational basis to shift the patients to sorafenib because of untreatable progression (UTP).
Material and Methods: We registered the baseline characteristics and the development of treatment-related adverse events, as well as the overall survival of all HCC patients treated by TACE-DEB between February 2004 and March 2010.
Results: 97 pts were recruited, all of them cirrhotic, 60% HCV+, age 68.2 years, 96% Child-Pugh A, 46 BCLC stage-A and 51 BCLC stage-B. The causes of treatment with TACE-DEB in patients with single HCC were: 11 unfeasible ablation, 4 postablation recurrences and 17 nodules >5 cm. Seven patients presented major complications: 3 abscesses, 1 arterial dissection, 1 cholecystitis, 1 intratumoral bleeding, 1 pancreatitis and 1 severe pain. After a median follow-up of 24.4 months (2.6-79.6), 31 patients have died, 2 received transplantation and 22 sorafenib because of untreatable tumor progression [new tumor sites without indication for TACE (10), biliary dilatation (3), extrahepatic spread (5), technical issues (3), TACE-DEB intolerance (1)]. The median whole cohort survival was 47.7 months (95% CI: 36.6-58.8). Survival according to BCLC stage was 54.2 months for stage A and 40.2 months for stage B. Survival after censoring follow-up at the time of transplant or Sorafenib treatment was 40.2 months.
Conclusion: These data validate the safety of TACE-DEB and expose that the survival expectancy applying current selection criteria and technique are far better than those previously reported. The observed 50% survival at 4 years should be considered when suggesting treatment for patients fitting into controversial scenarios such as expanded criteria for transplantation, or resection of multifocal HCC or portal hypertensive patients.

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Prospective study upon TACE for unresectable HCC: evaluation of survival rates and statistical analysis of prognostic factors

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Purpose: To illustrate efficacy of trans-arterial chemoembolization (TACE) for patients with unresectable hepatocellular carcinoma (HCC) and to analyze possible factors affecting survival.

Material and Methods: During the last 5 years, 71 patients with unresectable HCC underwent TACE with a mixture of 100 mg cisplatin, 50 mg doxorubicin and 10 ml lipiodol followed by embolic materials in cases of superselective catheterization. CT scans and biochemical blood tests were obtained prior and post TACE session. Survival was the primary end point of the study. Kaplan–Meier method calculated survival rates. Cox proportional hazard model was used for evaluation of multivariate analyses of the factors affecting survival. Mean follow-up period was 24.6 months.
Results: Cumulative survival rates at 1 year, 2 years, 3 years and 5 years were 73.2% (SE=5.3%), 45.4% (SE=6.0%), 33.2% (SE=5.9%) and 14.9% (SE=5.1%), respectively. Univariate analyses showed that multinodular HCC, lesion diameter, Child –Pugh classification, alcohol abuse, RESIST and EASL classification were related and predictive for the patient's risk. Furthermore, albumin, total and direct bilirubin, γ-GT, ALP and AFP values prior TACE were also related and predictive for patient's risk. Multivariate analyses showed that lesion diameter, Child-Pugh classification, alcohol abuse, tumor response according to EASL criteria and AFP levels prior to the session were independently related to the patient's risk. Procedure-related mortality was 0%.
Conclusion: TACE is a safe and efficient technique for unresectable HCC. Biochemical tests variations post TACE are not statistically related to patient's survival rate which is however related to alcohol abuse, tumor response rate criteria and AFP levels prior to the session.

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Percutaneous microwave ablation of the liver at 2.45 GHz: lessons learnt from CT volumetry

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Purpose: Few data exist on ablation zone volumes (AZvol) achieved in human liver following microwave ablation (MWA) at 2.45 GHz. Whilst a formal dosimetry study has not been performed, we have analysed AZvol achieved in the clinical setting by liver MWA at 2.45 GHz with correlation against ablation time (AT), total energy delivered (TED) and number of treatment stations (TS). We also compared AZvol achieved in cirrhotic versus non-cirrhotic livers and against tumour type.
Material and Methods: 17 liver tumours were treated and AT, TED & TS were recorded prospectively. Post-procedural dual phase CT was performed at a mean of 17 (standard deviation (SD) +/-11.9)) days post-treatment. AZvol was calculated using drawn regions of interest and Siemens volume software.
Results: Mean total AT was 562 seconds (SD +/-315.0). Mean TED was 98.1 kJ (SD +/-53.2). MWA was performed at 1 (n=9), 2 (n=5), 4 (n=2) and 5 (n=1) stations. Mean tumour diameter was 30mm (SD +/-18.5). Mean AZvol was 49.7 cc (SD +/21.8). Significant positive Pearson's product correlations (r) were found between AZvol and TS (r=0.799), AT (r=0.757) and TED (r=0.748) ($p<0.02$). Comparison by Mann–Whitney U test did not demonstrate significant differences in AZvol in cirrhotic (n=7) versus non-cirrhotic (n=10) patients and in hepatocellular carcinoma (n=8) versus metastatic (n=9) ablations.
Conclusion: Early clinical liver MWA experience suggests that increasing AZvol can be achieved by increasing AT, TED and TS. Tumour type and presence of cirrhosis does not affect AZvol. Our results indicate that probe re-stationing is a significant factor in achieving larger microwave liver ablation volumes.

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Drug-eluting microsphere-based transarterial chemoembolization of hepatocellular carcinoma: safety and clinical efficacy in comparison with lipiodol

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Purpose: To compare the safety and clinical efficacy of drug-eluting microspheres (DEB) with lipiodol in transarterial chemoembolisation (TACE) of hepatocellular carcinoma (HCC).
Material and Methods: Between January 2010 and January 2011 thirty-four patients (28 males, 6 females, mean 62 years) underwent TACE for HCC in preparation for liver transplantation at our university centre. Fifteen patients received DEB-TACE, 19 patients received lipiodol-TACE. BCLC stadium, liver function test rise, transplantation waiting list score, and lesion number, size, vascularity and response following RECIST criteria were assessed after TACE. Clinical complications were documented.
Results: Twenty-seven patients were BCLC stadium A, 7 in stadium B. 67 TACE procedures were performed (26 DEB-TACE, mean 40 mg doxorubicin). LFT rise and clinical symptoms were less severe in DEB than with lipiodol ($p<.001$) including pain, nausea and post-embolization syndrome. There was no downstaging of BCLC stadium in any patient. Tumour response was better in DEB than with lipiodol (PR in 10 patients (7 DEB), SD18 in (8 DEB), DP in 6 (0 DEB), $p<.05$). Average increase in transplantation waiting list score was 3 over all TACE courses (3.2 after DEB, $p>.05$).
Conclusion: TACE with our protocols is safe. Less clinical side effects were observed with DEB than with lipiodol, and a better tumour response. This did not affect the transplantation waiting list score as essential parameter of waiting time to liver transplantation.

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Repeated non-selective non-occlusive TACE of far advanced HCC with degradable starch microspheres (DSM) and Carboplatin: long-term results

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Purpose: To assess the long-term efficacy and safety of non-selective non-occlusive TACE with DSM and Carboplatin in patients with far advanced large or multifocal HCC.
Material and Methods: 18 patients were analysed retrospectively. 16 patients were UICC stage III or IV, 16 had multifocal disease, mean lesion number was 5,6 (1-25). Mean tumour size (largest lesion) was 8 cm (1-20 cm). 14 patients had cirrhosis (12 Child A and 2 Child B). TACE was performed non-selectively into the left, right or common hepatic artery using 225-900 mg DSM (Spherex or Embocept) and 450 mg Carboplatin. The endpoint was flow reduction but no stasis. TACE was repeated at 1-6 monthly intervals until tumour progression. Mean follow-up was 8 years.
Results: A total of 117 TACE were performed with a mean of 6.8 (1-18) per patient. Nine patients had partial response, 7 stable disease and 5 progression on initial follow-up. Mean time to progression was 14,4 months. Median survival from first TACE was 26 months. Survival at 1, 2, 3, and 5 years was 77%, 59%, 29% and 18%, respectively. Two patients are still alive after 8.5 and 2 years. Side effects were: peri/postinterventional vomiting 17%, nausea 8%, pain 5%. One patient had transient bone marrow depression. Typical post-embolisation syndromes did not occur.

Conclusion: Our TACE protocol produced remarkably good survival rates given the very extensive, mostly multifocal tumours treated. Toxicity was low.

P-309

Percutaneous US-guided interstitial laser ablation of new metastatic lymph nodes in the neck from papillary thyroid carcinoma following thyroidectomy and lymphadenectomy: preliminary experience

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Purpose: We report our preliminary experience with percutaneous US-guided interstitial laser ablation (EchoLaser X4, Esaote, Genoa, Italy) for metachronous cervical nodal metastases from papillary thyroid carcinoma following total thyroidectomy and central + laterocervical lymph node dissection.
Material and Methods: Thirteen metastatic nodes (mean size 1.1 cm; range 0.7-2.1 cm) in 13 patients were treated. All cases were negative at 131I whole body scan, but had marked uptake at 18F-FDG PET and elevated serum levels of thyroglobulin (Tg). Under local anesthesia a 300 mm quartz fiberoptic guide was placed into the node through a 21G needle. Nodes were treated with one (8 cases) or two (5) fiber insertions, each one with 3 W power for 400 sec (total energy 1,200 joules). After withdrawing the fiber, contrast-enhanced US (CEUS) was performed. All cases were followed at 3 and 6 months with B-mode US, CEUS, 18F-FDG PET and assessment of serum levels of Tg.
Results: Laser ablation was technically feasible and well tolerated in all patients, with no either immediate or late complications. In 12/13 (92.3%) cases complete ablation was achieved. In 1 case residual uptake at 18F-FDG PET with abnormal SUV was found. The treatment was repeated and subsequent normalization of all parameters was achieved.
Conclusion: Despite the limited number of cases in our experience, percutaneous US-guided interstitial laser ablation seems to be an effective, low cost and safe therapeutic tool for the treatment of metachronous nodal metastases from papillary thyroid carcinoma in the neck.

P-310

Consolidation of hepatic arterial inflow by embolization of variant hepatic arteries in preparation for 90Y radioembolization

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Purpose: Hepatic tumors may receive arterial supply from variant hepatic arteries (HA). Prior to radioembolization, we attempted to consolidate arterial inflow by embolizing these arteries to simplify delivery and to achieve complete distribution to targeted tumors. We reviewed the success of these consolidation procedures.
Material and Methods: Preparatory and treatment angiograms were retrospectively analyzed for 201 patients. Variant HAs were coil-embolized during preparatory angiography to convert patients to simpler anatomy. Collateral arterial supply to territories previously supplied by variant HAs was evaluated by digital subtraction angiography (DSA), C-arm computed tomography (CACT), and ^{99m}TcMAA scintigraphy, and by follow-up evaluation of regional tumor response.
Results: 47 variant HAs were embolized in 43 patients. After embolization of variant HAs, cross-perfusion into the embolized territory was depicted by DSA and by CBCT in 100% of patients, and by scintigraphy in 92.7%. Uniform progressive disease prevented evaluation in 33% of patients, but regional tumor response in responding patients supported successful delivery of microspheres to the embolized territories in 95.5% of patients.
Conclusion: Embolization of variant HAs for consolidation of hepatic supply in preparation for ^{90}Y radioembolization promotes treatment of affected territories via intrahepatic collateral channels.
Disclosure: Daniel Y. Sze: Consultant to MDS Nordion, Inc.

P-311

Is a good strategy subject intermediate hepatocellular carcinoma (HCC) to a p-TACE treatment for downstaging? Outcomes in a single center study

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Purpose: The patients with intermediate stage hepatocellular carcinoma (HCC) have a very poor overall survival rate: the BCLC staging system suggests transarterial chemoembolization (TACE) as the standard of care for intermediate HCC. This study proposes to assess overall survival into two groups of patients who underwent orthotopic liver transplantation (OLT) with (downstaging) and without p-TACE administration.
Material and Methods: 56 patients with intermediate HCC were enrolled for OLT: 20 patients were eligible for direct OLT as they met the surgical Milan Criterion. However, 36 patients did not meet the Milan Criterion. 36 patients underwent p-TACE (precision TACE) treatment using drug eluting microspheres (DC Beads©-Biocompatibles UK) loaded down with 75mgr doxorubicin: a superselective angiogram was performed to release the beads. A 30-day follow-up using TC examination defined the success of the p-TACE treatment: if any residual active tumors were found (according to mRECIST criteria) one more p-TACE session was scheduled (at most three chemoembolization sessions). All the 56 patients underwent OLT: a MRI follow-up examination (Gd EOB-DTPA contrast media) was performed at 12 ± 6 months.
Results: The mean observation time was 3.5 years (range of variability: 67 months-1 month): according to the Kaplan-Meyer method, the data were compared by the log rank test revealing a better overall survival for the patients who underwent p-TACE chemoembolization versus patients who went directly to OLT ($p<0.025$).
Conclusion: These preliminary results suggest that treatment strategy for OLT could change in the next future but it actually needs for a longer follow-up time.

P-312

Image-guided biopsy of pleuric and peripheral lung lesions: comparison between ultrasound (US) and computed tomography (CT) guidance

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Purpose: Image-guided biopsy represents the reference standard in the characterisation of pleuric and peripheral lung lesions that can be sampled under CT or US guidance. Our purpose was to compare the outcome of CT or US guidance when sampling peripheral lung or pleuric lesions.
Material and Methods: From 1/ 2000 to 8/2010, 711 thoracic biopsies were performed at our institution. Among these, 284 lesions had pleuric origin or had a peripheral location in the lung with at least a small contact with the pleura. These lesions were biopsied either under CT (179 lesions; 170 patients, 71/99 males/females, mean age 64 ± 12,5 years) or US guidance (105 lesions; 103 patients, 44/59, 67 ± 9,9 years), according to location of the lesion and patients' general conditions, using a 23G modified-Menghini needle. For each biopsy, duration of the procedure, occurrence of post-procedural pneumothorax, and sample adequateness were recorded. Chi-square and U-Mann-Whitney statistics were used.
Results: No statistical difference was found for sex and age distribution (p>0.544). CT-guided biopsies mean time was 588 ± 175s, while US-guided biopsies mean time was 445 ± 156s (p<0,001). Post-procedural pneumothorax was observed in 44/170 patients (25,9%) biopsied under CT guidance and in 25/103 (24,3%) biopsied under US guidance (p=0.489). Adequate samples were obtained in 172/179 lesions (96,1%) under CT guidance and in 101/105 (96,2%) under US guidance.
Conclusion: When dealing with pleuric or peripheral lung lesions, US guidance is comparable to CT in terms of sample accuracy and post-procedure pneumothorax, while allows for reducing significantly time of execution, being also free from ionising radiations.

P-313

Intra-arterial and systemic chemotherapy as second line treatment for advanced pancreatic carcinoma: a phase II study

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Purpose: Most of patients with advanced pancreatic carcinoma (APC) failing gemcitabine-based therapy retain a good performance status and receive second-line chemotherapy, for which there is no established standard. We evaluated in a phase II study the efficacy and toxicity of a combination approach, epirubicin plus cisplatin administered intra-arterially with systemic gemcitabine and capecitabine (EC-GEMCAP), in patients with APC failing first-line gemcitabine systemic chemotherapy.
Material and Methods: The patients received the 4-drug regimen as a 28-day cycle: day 1 celiac axis catheterization with intra-arterial infusion of epirubicin 35 mg/m^2; day 2 systemic gemtabicine 10000 mg/m^2; days 2-15 capecitabine 650 mg/m^2 twice a day. Primary endpoint was objective response evaluated with CT scan at 3 months from the beginning treatment according the mRECIST criteria.
Results: Among 45 patients enrolled, 33 had stage IVa disease, 12 stage IV b; none had extra-abdominal disease. Eight patients had partial response (17%), 22 stable disease (49%) and median progression-free and overall survival were 6.9 (1-20.2) and 16.4 (1-25.6) months, respectively; 8 were progression-free and 14 were still alive. Incidence of grade 3 and 4 neutropenia was 15% and 11%, grade 3-4 thrombocytopenia 11% and 8%, and grade 3 anemia 4%. Other toxicities included grade 2 mucositis (11%), grade 1 diarrhea (4%), grade 2 nausea/vomiting (11%) mild hand-foot syndrome (8%). The median overall survival since the diagnosis was 24.6 months.
Conclusion: EC-GEMCAP as second-line chemotherapy following gemcitabine-failure in patients with APC and good performance status demonstrated good activity and tolerability.

P-314

Radiofrequency ablation treatment of functional mediastinal parathyroid adenomas: initial experience

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Purpose: Patients with hyperparathyroidism are usually treated surgically; however, ectopic retro-sternal parathyroid adenomas require major surgery. As well, functional residual tissue is a frequent issue. We report our initial experience with CT-guided radiofrequency ablation (RFA) as an alternative treatment for mediastinal adenomas.
Material and Methods: Three patients with primary hyperparathyroidism caused by solitary ectopic mediastinal parathyroid adenoma were treated with RFA, to avoid a sternotomy. The diagnosis was confirmed by enhanced CT and sestamibi scan. The adenoma was located in the preaortic space in one and at the anterolateral space in the other two. The procedures were performed under general anaesthesia with CT guidance. In two patients, a multi-tine needle (LeVeen, Boston Scientific) was used and in the third case a single probe (Cool tip, Radionics) was used. The patients stayed in-hospital for 24 hrs and calcium levels were measured next day and at 1 month.
Results: An oblique access to the retrosternal space was used in all cases. In one patient, iatrogenic pneumothorax was created to optimize access, followed by a pleural catheter with a Heimlich valve. There were no major complications and the three patients were discharged next day. Two patients were normocalcemic on the next day; however, one patient had no significant reduction of calcium levels. Repeat sestamibi showed persistent activity and she required a second RFA.
Conclusion: RFA is proven for the treatment of multiple tumour types. In this innovative series we demonstrate the safety and efficacy of RFA for mediastinal functional parathyroid adenomas, avoiding major surgery.

P-315

Advanced HCC ablation after downstaging with Sorafenib

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Purpose: We report the findings and the results in a series of patients with hepatocellular carcinoma (HCC), excluded from any locoregional treatment at presentation, then successfully treated with ablation after downstaging with Sorafenib.
Material and Methods: 65 patients with advanced HCC not eligible for locoregional therapies were treated with Sorafenib (800 mg daily) from January 2008 to December 2009. Patients responding to Sorafenib at imaging follow-up (monthly US, CT every 3 months) were reconsidered for ablation.
Results: 16/65 responded to Sorafenib. 7/16 patients showed evident downsizing of the tumor and 9/16 a reliable stabilization at

follow-up CTs. 4 out of these 16 patients were successfully treated with RF ablation after downstaging with Sorafenib. Basal imaging in these 4 patients showed: 1. multiple large (>4cm) HCC nodules in all cases; 2. right portal vein thrombosis in 1 case; 3. inferior vena cava thrombosis in 1 case. CT and US follow-up (9 - 15 months) after Sorafenib treatment in these 4 cases showed marked hypovascularity and evident downsizing of HCC nodules over time, complete recanalization of portal vein and partial marked downsizing of the caval thrombosis. HCC nodules and residual caval thrombus were treated with radiofrequency and/or microwave and/or ethanol injection. The 4 patients are still alive. Post-ablation CT showed complete necrosis of the HCC nodules in all cases. New nodules at follow-up CT have been detected in 3 patients.
Conclusion: In a small rate of patients with advanced HCC (4/65 = 6%) an effective downstaging with Sorafenib allows a successful ablation treatment.

P-316

Evaluation of the ability and the long-term safety of an experimental 15-gauge Bio-Seal device to prevent pneumothorax after percutaneous lung radiofrequency ablation: case-control study in a porcine model

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Purpose: To evaluate the ability and the long-term safety of an experimental 15-gauge Bio-Seal device in preventing pneumothorax after in vivo percutaneous lung radiofrequency ablation (RFA) in a porcine model.
Material and Methods: In 12 anesthetized and ventilated swine, 24 RFA procedures under CT guidance (one for each lung) were performed using a 15-gauge radiofrequency LeVeen probe with coaxial introducer and following an increasing thermo-ablation protocol complying with literature guidelines. For each pig, one lung was implanted with Bio-Seal and the other did not receive any closure device. Pre- and post-procedure CT were acquired to detect and quantify pneumothorax. Swines were sacrificed at day 2, month 1, month 3 and month 6 after RFA (4 groups of 3 swine), for pathological analysis.
Results: In the Bio-Seal group, one 150 ml clinically significant pneumothorax appeared after needle withdrawal. In the control group, three clinically significant pneumothorax occurred after needle withdrawal. After Bio-Seal implantation, the relative risk reduction of acute pneumothorax occurring after needle withdrawal was 66.7% (p=0.309). Pathological analysis showed that the Bio-Seal was well adhesive to the wall of the needle pathway at day 2 and month 1. It started to resorb at 3 months, and was almost fully hydrolyzed at month 6, with only small residue still visible. The needle tract was well filled with a well delineated scar, occluded by fibromuscular processes, and no patent tract was still visible.
Conclusion: The RFA-dedicated 15-gauge Bio-Seal can prevent pneumothorax occuring after needle withdrawal after lung RFA, with a good efficiency and a very good long-term safety.

P-317

Percutaneous MR-guided prostate cryoablation: technical feasibility and preliminary results

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Purpose: Currently, percutaneous cryoablation is carried out under transrectal US-guidance. However, ice-ball visualization is impossible with US due to the posterior acoustic shadowing. We herein report nine cases of transperineal prostate cryoablation under MR-guidance.
Material and Methods: MR-guided cryoablation was performed in 9 patients with prostatic adenocarcinoma, contraindicated for surgery (including 2 cases of local recurrence after radiotherapy) (mean age 71.6 y.o, mean Gleason-score 6.3, mean PSA prior-treatment 7.25 ngr/ml, T1-2c/N0/M0, mean prostate mass 37,33 gr). Free-hand probe positioning was performed under real-time TRUFI images. 4 to 7 cryoprobes were inserted in the prostate, depending on the gland volume. A urethra double-lumen warming-catheter was used in all cases, while a similar homemade rectal warming-balloon was used in the last seven cases. Two 10-min freezing cycles separated by a 10-min passive thawing cycle were performed systematically. The ice-ball was monitored using real-time and high-resolution BLADE multi-planar imaging.
Results: Transperineal prostate cryoablation was technically feasible in all patients. The ice-ball was clearly and sharply visualized in all cases as a signal void area. Mean ice-ball volume was 57.11 ml. Median PSA-nadir one month post-treatment was 0.38 ngr/ml. Mean hospitalization was 6.4 days. Complications included an urethro-rectal fistula, urinary infection, and mild haematuria. Mean follow-up was 11.8 months (max. 19, min 2).
Conclusion: MR-guided is feasible and promising, with excellent monitoring of the ice-ball covering the gland. However, the free-hand probe positioning is time-consuming and difficult. The use of a template and image fusion, as used in brachytherapy, will make the procedure easier and reproducible.

P-318

Radiolabeled lipiodol for the treatment of nonresectable hepatocellular carcinoma

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Purpose: Hepatocellular carcinoma (HCC) is a primary malignant tumor of the liver. Since only a minority of patients are surgical candidates, local ablative and transarterial therapies have been developed. Radioembolization with radiolabeled lipiodol aims to deliver selective internal radiation to the tumor, while the surrounding liver parenchyma is spared. Response to therapy and survival of HCC patients treated with radiolabeled lipiodol was evaluated.
Material and Methods: A total of 82 patients not suitable for surgical resection were treated with Rhenium-188 (188Re) and/or Iodine-131 (131I) labeled lipiodol. Kaplan-Meier survival analysis was carried out. Response to therapy was studied by comparing pre- and post-treatment imaging (MRI) according to the EASL modified

response evaluation criteria in solid tumors (mRECIST).
Results: An average of 1,5 treatments per patient was carried out. Patients who received the treatment in a palliative setting had a median survival of 13,1 months (95% CI 8,1-18,0). In 13 patients, treatment was followed by liver transplantation. mRECIST was carried out in 13 patients at a mean time period of 7 months after the first treatment. Complete response (CR), partial response (PR), stable disease (SD), and progressive disease (PD) was identified in, respectively, 7%, 38%, 38% and 15% of treated patients.
Conclusion: Radioemolization with radiolabeled lipiodol is an effective treatment for HCC patients not suitable for surgical resection. The long-term results of radiolabeled lipiodol are comparable to our results with Yttrium-90 (90Y) radioembolization. However, patients underwent a higher number of treatment sessions compared to our 90Y cohort.

P-319

New method of intraarterial chemoinfusion through an implanted catheter-port system for locally advanced breast cancer

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Purpose: Recurrent advanced breast cancers are uncontrollable and usually supplied by various arteries such as internal thoracic (ITA). Conventional selective arterial infusion chemotherapy for breast cancer has been difficult to continue infusion therapy until satisfactory clinical efficacy was achieved, because of subsequent arterial damage. Therefore, we developed a new redistributed subclavian arterial infusion chemotherapy (RESAIC) method using an implanted catheter-port system after embolization of ITA. We will report the clinical experiences and the efficacy of RESAIC.
Material and Methods: Twenty-nine patients with Stage IIIb or IV breast cancers aged from 34 to 82 (median 61) were enrolled in this study between April 2006 and February 2010. At first, the arterial redistribution was achieved by emobolizing ITA using mixture of N-butyl cyanoacrylate (NBCA) and iodized oil (LPD) via an ipsilateral brachial approach. The tip of an implanted catheter was placed in SCA, and the connected port was implanted in a subcutaneous porch at the forearm. The patients were treated on outpatient basis with the regimen consisted of Cisplatin, 5 FU and Epirubicin, and blood pressure cuff was used during the injection of anticancer drugs to prevent drug perfusion to the arm.
Results: The technical success rate was 100%. The local response rate of PR and CR was 88% (CR;14%) was appreciated in relatively short time. There was no serious drug-induced toxicity or procedure-related complications.
Conclusion: RESAIC is feasible in clinical use to achieve local control in patients with advanced breast cancers who have no alternative treatment.

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T1-breast carcinoma treated with radiofrequency ablation in elderly patient unfit for surgery

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Purpose: Radiofrequency ablation may be an alternative treatment in patients with breast cancer not eligible for surgery. This study was designed to assess the feasibility, efficacy and safety of in-vivo RFA in T1-breast carcinoma.
Material and Methods: Five inoperable patients (age: 76-87 years) with T1-breast carcinoma (9-20mm) were included. All patients were treated with an aromatase inhibitor over 6 months, showed stable disease and the treatment was continued. US-guided RFA was performed on an outpatient basis after thoracic nerve block and local anesthesia. Ablation was performed with a 17-gauge Cool-Tip RF-needle with ablation times ranging from 90 to 120 s. Pain was evaluated after the procedure with a visual analogue scale. Follow-up consisted of mammography, CE-MRI and US at 1, 6 and 12-month intervals. After a year, 10-gauge vacuum-assisted US-guided biopsies were obtained form the core and periphery of the ablated area. Quality of life was assessed using the EORTC-QLC-30 form.
Results: All procedures were technically successful. One patient was lost to follow-up. In another, interval follow-up was cancelled because of a CVA. Imaging modalities showed normal post-procedural state without signs of residue. Ablated areas decreased in size and rim enhancement stabilized over time. Histopathologic analysis of the biopsies after 12 months showed fat necrosis, and scar tissue without signs of atypia or malignancy. Procedural VAS-score was 3 (range: 0-6) and QOL decreased by one point, mainly on daily activities.
Conclusion: RFA is a safe and accessible procedure in inoperable patients with T1-breast cancer. Treated patients showed no signs of recurrence after a year. The procedure was bearable and had minimal negative impact on quality of life.

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Salinoma formation for an extrapleural approach for CT-guided subcarinal lymph node biopsy using a co-axial gun: an experience with 525 cases

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Purpose: To report the advantages of a salinoma window to create an extrapleural approach for CT-guided subcarinal lymph node biopsy using a co-axial technique.
Material and Methods: A total of 525 consecutive patients underwent CT-guided subcarinal biopsy with a co-axial technique and salinoma formation with an extrapleural approach, over a period of 7-1/2 years from March 2003 to November 2010. The nodes were localized with either a single-slice spiral CT (Somatom AR*, Siemens, Erlangen) or a 64-slice multidetector CT (Somatom 64, Siemens, Erlangen). With the patient prone, the pleura was separated from the vertebra using 20 ml injections of saline mixed with lignocaine. A 20-gauge co-axial gun was introduced and multiple tissue samples were obtained.
Results: Extrapleural access to the lesions was achieved in 520 (99%) of the 525 cases. In four cases the needle traversed the lung and in one the procedure was abandoned due to pain. Adequate diagnostic samples were obtained in 503 (96%) cases. Diagnoses obtained were non-caseating granulomatous disease in 318 (62%), tuberculosis in 84 (15.25%), sarcoidosis in 45 (9.25%), lymphoma in 38 (9%) and metastasis in 18 (4%). Immediate complications included pneumothorax in 18 (4.5%) patients, managed conservatively, post-procedure pain at the site of needle puncture in 11 (2.75%) and hemothorax in 8 (1.5%) patients. No delayed complications were seen.
Conclusion: The extrapleural approach with saline injections yielded 99% technical success. The co-axial method helped achieve diagnostic tissue samples in 96% of the cases. This is a useful technique to biopsy subcarinal lymph nodes and masses.

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Radiofrequency ablation therapy for thoracic malignancy: are roll-off phenomenon and correct tumor puncture necessary to ablate the tumor?

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Purpose: To retrospectively investigate whether roll-off phenomenon (ROP) and correct tumor puncture (CTP) are necessary to ablate the thoracic malignancy during radiofrequency ablation therapy (RFA) under computed tomography (CT) guidance.
Material and Methods: Twenty-three patients (13 men and 10 women; age range, 28-81 years) with 94 lung nodules (17 primary and 77 secondary lung neoplasms, mean diameter 1.6 cm) were treated with an internally cooled electrode (13 patients with 29 nodules, 20 sessions) and an expandable electrode (10 patients with 65 nodules, 50 sessions) from September 2005 to January 2009. The overall local control rates were estimated using Kaplan-Meier analysis.
Results: The median follow-up period was 13.3 months (range, 3-33 months). The number of non-ROP was 7 (7.4%) and non-CTP was 29 (30.9%). However, CT images showed ground glass opacity surrounding the tumor after RFA in all neoplasms. The overall primary technique effectiveness rates were 71% at 1 year and 20% at 2 years. There were no statistically significant differences between subgroups including ROP group (P = 0.2217), CTP group (P = 0.588) and ROP + CTP groups (P = 0.7114). The difference between the local control rates associated with large (>2 cm) and small (<2 cm) tumors was significant (P < 0.0001). The use of an internally cooled electrode was associated with local tumor progression than the use of an expandable electrode (P = 0.0181), respectively. However, there was no statistically significant difference between primary and secondary lung neoplasms (P = 0.9908).
Conclusion: ROP and TCP in RFA therapy under CT guidance for thoracic malignancy are not necessary to achieve local control of tumor.

P-323

Embolotherapy for gastrointestinal bleeding due to esophageal carcinoma

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Purpose: Bleeding from esophageal carcinoma may be critical and many physicians do nothing in this situation. However, bleeding occurs from not only the thoracic aorta, but also from the branches, e.g. bronchial artery and intercostal artery. In this study, we evaluate the efficacy of embolotherapy for bleeding due to esophageal carcinoma.
Material and Methods: Between September 2002 and December 2010, we performed ten embolotherapy for nine patients, who had hemorrhage from esophageal carcinoma. The embolic materials were selected as follows: if extravasations were revealed, we used coils and/or N-butyl 2 cyanoacrylate (NBCA); if extravasations were not revealed, we embolized the feeding artery using NBCA or gelatin sponge. We evaluated the overall survival time and complications.
Results: The detection rate of bleeding point was 50% (5/10): carotid artery in one patient, thoracic aorta in one, bronchial artery in one, intercostal artery in one, and left gastric artery in one. In another five cases, the feeding artery was the intercostal artery. The clinical success rate of embolotherapy was 90%. The overall survival was 112 (1-875) days, and one iliac arterial stenosis due to migration of NBCA occurred and was treated by metallic stent.
Conclusion: Embolotherapy for gastrointestinal bleeding due to esophageal carcinoma may be considered if it is possible to move the patient to an angiographic room.

P-324

Incidence and characterization of adverse reactions relating to outpatient-based doxorubicin/superabsorbant polymer microsphere embolization in hepatocellular carcinoma: dose escalation study

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Purpose: To determine if outpatient-based hepatocellular carcinoma embolization can be performed safely with doxorubicin superabsorbant polymer microspheres using a doxorubicin dose of 25-75 mg.
Material and Methods: A single-arm prospective single-institution study was conducted. This cohort's patients had Child-Pugh A or B hepatic disease with surgically resectable hepatocellular carcinoma. A total of 11 out of 18 patients were enrolled. Doxorubicin-based superabsorbent polymer microsphere (Quadrasphere, Merit Medical, South Jordan, Utah) embolization utilizing 12.5-25 mg of 50-100 µm microspheres with an escalation schema of 25, 50 and 75 mg of doxorubicin was performed in patients with single reference tumors [mean diameter = 5.1 cm (range 2.9-9.3 cm), mean volume = 93.7 cc (range = 16.4-379 cc)]. Patients were discharged on the same day as administration. Documentation (NCI CTCAE CRC v4.0) of adverse events was performed immediately prior to the procedure, 24 h post-administration and at 1-week and 1-month follow-up appointments.
Results: A mean of 31.3 mg of doxorubicin was administered (range 25-75 mg) in 15.1 mg of microspheres (range = 12.5-25 mg). A total of 73 events occurred in 11 patients; 44 events were reported as Grade 1, 20 as Grade 2, and 9 as Grade 3 (3 from a patient with puncture complications), with no Grade 4 events. Mean time between procedure and event was 5 +/- 7 days. One patient required hospitalization 7 days post-procedure.
Conclusion: Interim data suggest that outpatient-based drug eluting microsphere embolization can be performed safely without significant adverse events with dose ranges as high as 75 mg and minimal reported post-embolization syndrome. Completion of this cohort, with additional analysis, will be provided at the time of presentation.

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Percutaneous computed tomography-guided cryotherapy of thoracic masses in nonsurgical candidates

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WITHDRAWN

P-326

Risk factors for hepatic decompensation and/or bleeding complication following percutaneous radiofrequency ablation therapy of hepatocellular carcinoma in patients with liver cirrhosis : retrospective analysis of 64 patients with thrombocytopenia

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Purpose: To assess if thrombocytopenia is a predictive factor of bleeding and/or liver decompensation following percutaneous radiofrequency ablation (RFA) therapy of hepatocellular carcinoma (HCC) in patients with cirrhosis.
Material and Methods: A total of 64 consecutive patients with cirrhosis, associated with mild thrombocytopenia ranging from 37 to 99 x 10^9 platelets/L, who had undergone percutaneous RFA to treat 86 HCCs were retrospectively studied. Nine possible factors were analyzed for their ability to predict bleeding or liver decompensation using the Cox proportional hazards regression model: age, sex, Child-Pugh class, etiology of cirrhosis, platelet count, prothrombin activity, number of tumors, maximum size of the tumor and type of electrode.
Results: It was shown that a platelet threshold of 37 x 10^9/L and the other variables were not significant risk factors of bleeding. Univariate and multivariate analysis revealed that liver decompensation was clearly linked to prothrombin activity ($p = 0.010$ and $p = 0.006$, respectively) and ≤63% of prothrombin activity was found to be a significant threshold for the occurrence of liver decompensation ($p = 0.003$) confirmed by Cox model ($p = 0.05$).
Conclusion: Mild thrombocytopenia ≥37 x 10^9/L is not an independent risk factor of bleeding or liver decompensation after RFA therapy of HCC in patients with cirrhosis. However, in such a situation, a significant higher risk of liver decompensation following the procedure was found in cases of prothrombin activity ≤63%.

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Preliminary clinical results of thermal ablation of primary and metastatic tumor lesions with a new percutaneous microwave device

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Purpose: Microwaves ablation has emerged as a relatively new technique with the promise of larger and faster ablation area without some of the limitations of radiofrequency thermal ablation (RFTA). Herein, we report our preliminary results on the feasibility and effectiveness of the thermal ablation of primary and metastatic tumor lesions with a new coaxial antenna for microwave.
Material and Methods: We treated 116 hepatic unresectable lesions (74 HCC, 6 Intrahepatic cholangiocarcinoma, 36 metasases from gastroenteric cancer) in 87 patients (mean age 69.8 years). Mean diameter of the lesions was 29.6 mm (range 8-79 mm); We used a microwave generator (AMICA-GEM apparatus for microwave ablation) connected to a 14- or 16-gauge coaxial antenna working at 2450 MHz and endowed with a miniaturized sleeve choke to reduce back heating effects and increase the sphericity of the area of necrosis. Contrast-enhanced CT scan was carried out 30 days after thermal ablation, and then every 3 months to assess therapeutic efficacy.
Results: Complete necrosis was achieved in 87% of patients with HCC (necrosis was 98% if we only considered the nodules ≤30 mm) and in 78% of patients with metastases (necrosis was 89 % if we only considered the nodules ≤30 mm). A self-limited pleural effusion occurred in three patients. In two patients, tip needle breakage occurred during difficult insertions through the intercostal space without late complications.
Conclusion: In our experience, the newly tested device has proven to be an effective and safe percutaneous ablative method capable of producing large areas of necrosis.

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Percutaneous microwave ablation therapy for treatment of primary and metastatic lung tumors: preliminary experience

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Purpose: To assess the feasibility, effectiveness and safety of percutaneous computed tomography (CT)-guided lung tumor microwave ablation in the follow-up period.
Material and Methods: From May 2009 to August 2010, 28 consecutive patients (18 men, 10 women, mean age 62 years) underwent CT-guided percutaneous microwave ablation (MWA) of unresectable lung tumors (11 primary NSCLC and 17 metastases) of mean size 3.2 cm (2.5-8 cm). The study cohort was selected according to the following criteria: 1) maximum tumor size less than 9 cm in diameter; 2) less than five metastatic tumors; 3) patients with a normal coagulation status; 4) provision of written informed consent. All procedures were performed with CT guidance under conscious sedation and local anesthesia. One or two straight microwave antennae (14 or 16 gauge) were placed directly into the tumor for 8-12 min. Follow-up included contrast-enhanced CT at 1, 3 and 6 months and then at 6-month intervals; stable size or reduction in size and the absence of tumor enhancement CT images were considered indicative of complete tumor necrosis.
Results: In all cases, the procedure was technically successful. Morbidity was found in eight cases of partial pneumothorax (28.6%), which resolved spontaneously within 7 days. At a mean follow-up of 8 months (range 2-15), we recorded a 67.8% of complete response (tumor necrosis = 100%) and a 32.2% of partial response (tumor necrosis range, 65-92%).
Conclusion: Our preliminary results show that percutaneous CT-guided microwave ablation seems to be feasible, effective and safe for the treatment of lung tumors.

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Efficacy of small renal lesion cryoablation: an outcome study of 69 patients

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Purpose: Incidentally discovered small renal masses are more commonly diagnosed today than in the past due to the widespread use of abdominal CT. Management of incidentally discovered small renal masses has traditionally been accomplished via surgical resection; however, this choice has always been limited in a patient population with multiple comorbidities. In our study, we intend to demonstrate the emergence of cryoablation as a viable minimally invasive treatment option for incidentally discovered small renal masses.
Material and Methods: A total of 61 patients underwent 62 CT-guided cryoablations during the period of 2001-2005. Saline and air dissection techniques were used. All lesions were simultaneously biopsied. Multiple follow-up CTs were obtained to assess the success.
Results: Of the 69 patients who underwent a percutaneous cryoablation, 61 patients were available for analysis with a total of 62 lesions, as one patient had two lesions. Local control of the neoplasm was obtained in 48 of 61 patients (78.8%) after one cryoablation cycle and in 59 of 61 patients (96.7%) after two or three cryoablations using three cryoprobe cycles. Recurrence rate correlated with the pathology results. A potential early inflammatory neovasularity on CT pitfall was identified.

Conclusion: Cryoablation of incidentally discovered small renal masses is an alternative to traditional surgical resection, which is specifically helpful in patient populations with significant comorbidities. Recent literature has established a high technical success rate, high rate of cancer-free survival and low complication rate for cryoablation of small renal masses.

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Hepatocellular carcinomas 2-3 cm in diameter: transarterial chemoembolization plus radiofrequency ablation versus radiofrequency ablation alone

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Purpose: There is a debate whether transarterial chemoembolization (TACE) plus radiofrequency ablation (RFA) is more effective than RFA alone in the treatment of patients with small hepatocellular carcinoma (HCC). We therefore retrospectively compared these treatments in patients with HCCs of diameter 2-3 cm.
Material and Methods: Outcomes, including tumor progression, survival rates and major complications, were compared in 83 patients (83 tumors) treated with combined TACE and RFA and in 231 patients (231 tumors) treated with RFA alone.
Results: Median follow-up periods were similar in the TACE + RFA and RFA alone groups (37 vs. 38 months). During follow-up, local tumor progression was observed in 16% and 41% of tumors, respectively. The 1-, 3- and 5-year local tumor progression-free survival rates were significantly higher in the TACE + RFA group (95, 86 and 83%, respectively) than in the RFA-alone group (78, 61 and 53%, respectively; $P < 0.001$). The 1-, 3- and 5-year overall survival rates, however, were similar in the TACE + RFA (93, 72 and 63%, respectively) and RFA (93, 73 and 53%, respectively) groups ($P = 0.545$), as were the rates of major complications (1.2 vs. 0.4%).
Conclusion: Combined TACE and RFA was safe and provided better local tumor control than RFA alone in the treatment of 2- to 3-cm sized HCCs, although survival rates were similar.

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Transcatheter chemoembolization using a novel lipophilic platinum derivative in patients with hepatocellular carcinoma

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Purpose: Miriplatin is a novel lipophilic platinum derivative designed for use in the transarterial treatment of hepatocellular carcinoma (HCC), but the concomitant use of miriplatin and embolic agents has not been evaluated previously. In this study, the safety and efficacy of transcatheter chemoembolization (TACE) using miriplatin in combination with gelatin particles were investigated.
Material and Methods: Eighteen patients (13 males and 5 females; mean age, 71.9 years) with Child-Pugh A or B liver damage and unresectable HCC have been treated with TACE using miriplatin-lipiodol. We performed superselective TACE with gelatin particles after injection of miriplatin-lipiodol mixture. Response to the therapy was evaluated by imaging studies 4 weeks after TACE and also by the change of tumor markers. Complete response (CR) was defined as disappearance or 100% necrosis of all tumors, and lipiodol accumulation in tumors was regarded as indicating necrosis. Adverse effects relating to the therapy were evaluated based on CTCAE v4.0.
Results: TACE limited to the tumor-bearing subsegment or segment was performed in all patients. The dose of miriplatin ranged from 10mg to 100mg (mean 41.1mg). Nine patients achieved CR and eight of them showed no local recurrence on follow-up studies. There was no grade 3 or 4 toxicities and follow-up imaging studies showed no significant signs of biliary or vascular complications related to the therapy. Tumor markers decreased to lower than 50% of pretreatment level after TACE in 11 of 15 patients.
Conclusion: TACE with miriplatin can be a safe and promising treatment for non-resectable HCC. Further investigations for long-term prognosis should be necessary.

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Percutaneous transthoracic needle biopsy of pulmonary nodules with Xperguide Cone Beam CT guidance: a preliminary experience

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Purpose: The aim of this study is to evaluate the accuracy and technical success of positioning a core needle biopsy in pulmonary nodules by the use of Xperguide Cone Beam CT (CBCT) guidance.
Material and Methods: Fifty patients (26 males, 24 females), with 50 pulmonary nodules (size range 8-60 mm, mean size 27.2 mm), underwent percutaneous transthoracic needle biopsy (PCNB) with Xperguide CBCT guidance.
Technical success, diagnostic accuracy, sensitivity, specificity, positive predictive value, negative predictive value and complications were evaluated.
Results: Technical success was obtained in all cases (100%).
Lesions were correctly characterized with biopsy as follows: 33 malignancies (26 primitive tumors, 7 metastases), 15 benign lesions and 2 inadequate materials.
Diagnostic accuracy, sensitivity, specificity, positive predictive value and negative predictive value of PCNB were 98%, 97.06%, 100%, 100% and 94.12%, respectively.
No major complications were registered; minor complications, in particular thin PNX, occurred in 6 patients (12%).
Conclusion: PCNB of pulmonary nodules can be performed under Xperguide CBCT guidance and seems to be safe and accurate.

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Improved drug targeting of liver tumors following transarterial embolization (TAE) using magnetic nanoparticle (MNP) and lipiodol complex: preclinical assessment in a rabbit model of liver tumor

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Purpose: To evaluate the feasibility of novel drug delivery system comprising a complex of magnetic nanoparticle (MNP) and lipiodol to improve selective drug delivery following TACE for experimentally induced hepatic tumor.
Material and Methods: Sixteen rabbits with hepatic VX2 carcinomas were treated with TAE using 4 different agents: doxorubicin alone (group A, n=3), doxorubicin/lipiodol (group B, n=3), doxorubicin/Feridex complex (group C, n=5), doxorubicin/Feridex/lipiodol complex (group D, n=5). The transarterially infused amount of doxorubicin (1mg) was equal in all groups. Serum concentration of doxorubicin was measured at 30, 60, 120, 180 minutes after TACE to determine the pharmacokinetics of doxorubicin in all groups. Seven days after TACE, all the animals were euthanized to measure doxorubicin concentrations at tumors, and tumor viabilities were assessed by pathologic analysis. The distribution of Feridex in the tumor

and liver parenchyma was assessed on MR performed at day 7 after TACE.
Results: Plasma concentration of doxorubicin in group D was significantly lower than those in other groups, suggesting higher tumor retention of doxorubicin in group D. Doxorubicin concentrations of tumors measured at day 7 after TAE were 34.1 ng/g in group A, 142 ng/g in group B, 251 ng/g in group C, and 521 ng/g in group D. MR demonstrated excellent Feridex distribution corresponding to doxorubicin deposition in groups C and D.
Conclusion: The new drug delivery system using MNP and lipiodol can result in excellent drug targeting when used for TAE of liver tumors. The promising results of this study warrant further investigation as a potential treatment for advanced liver cancer.

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3-Year results: robotic high-intensity focused ultrasound (rHIFU) for the prostate cancer treatment of 600 patients

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Purpose: Here, we explored the effectiveness of the rHIFU treatment for the prostate cancer, hormone-resistant prostate cancer (HRPC) and failure after external beam radiotherapy (EBRT).
Material and Methods: 600 patients were treated in our center between Sep 2007 – December 2010: 110 – hormone-resistant, 229 – received neoadjuvant hormone therapy 6 months, 235 – no treatment before HIFU, 26 – after the EBRT failure. 454 patients underwent TURP+rHIFU, 55 only rHIFU (volume prostate <40cc). Mean follow-up is 32 months (range 3-40). All patients were divided into 3 groups: low-risk progression (Gleason <7, stage T1-2N0M0, PSA<20, number of patients 337), high-risk progression – (Gleason ≤9, stage T2-3N0M0, PSA <60, number of patients 183), after EBRT failure (number of patients 26).
Results: Median PSA level 12 months after rHIFU treatment were 0,04 ng/ml – low-risk group, for high-risk group - 0,5 ng/ml, with failure after EBRT - 0,5 ng/ml; 30 months after rHIFU treatment were 0,2 ng/ml – low-risk group, for high-risk group - 2,7 ng/ml, with failure after EBRT - 1,5 ng/ml. Patients with low risk had 4,5% of progression, with high-risk PC – 25%, with failure after EBRT 19,6%. Kaplan-Meier analyses of the total group indicated that the risk of progression was 21% after 3 years of follow-up. Complications: incontinence I 17,5%, incontinence II 7,7%, stricture 18,2%, fistula 0,5%.
Conclusion: Results show that rHIFU ablation is a safe, effective treatment with moderate side effects for the PC, hormone-resistant prostate cancer; rHIFU may be used as a salvage therapy after EBRF.

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Improved bench model for microwave ablation

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Purpose: Microwave ablation (MWA) is emerging as an effective method to ablate soft tissue. Bench model lesion size is the primary source of guidance for clinicians when determining power and time settings to achieve a desired outcome. Bench models are also key tools for evaluating microwave ablation probe design during technology development efforts. This study introduces an innovative MWA bench model which reduces operator bias, improves repeatability and offers a robust and retrospectively accessible dataset with regard to probe performance over time.
Material and Methods: The novel MWA model utilizes fresh ground ex vivo bovine liver as a tissue phantom to improve homogeneity. Fiber optic thermo probes are used to map a radial plane in one half-space about the device probe and shaft. Post processing utilizes scattered data fitting and image processing techniques to fully characterize the thermal profile generated by the probe over the ablation cycle.
Results: Overall sample-to-sample variability is improved in some cases by an order of magnitude. Temperature surfaces are well described by numerical techniques and yield ablation sizes which are comparable to previous bench model techniques.
Conclusion: This study introduces a novel bench ablation model whose major benefits are a reduction in operator bias and variability due to non-homogeneous tissue. It is clear that utilizing the methods discussed in this work will aid in the future evaluation and comparison between MWA devices.
Disclosure: Employees of Covidien

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Long-term outcome of transcatheter subsegmental and segmental arterial chemoembolization using lipiodol for hepatocellular carcinoma

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Purpose: To clarify the efficacy of transcatheter hepatic subsegmental and segmental arterial chemoembolization using lipiodol (Subseg/Seg Lip-TACE) for hepatocellular carcinoma (HCC), long-term outcomes of patients who had been treated using Subseg/Seg Lip-TACE alone were retrospectively examined.
Material and Methods: Subjects comprised 199 patients with HCC (T1/2/3£: 30/108/61; Child-Pugh A/B/C: 115/52/32; Japan Integrated Staging score (JIS) £1/2/^{3}3: 88/64/47) who underwent only Subseg/Seg Lip-TACE using lipiodol mixed with an anticancer drug followed by injection of gelatin sponge particles from the initial to repeat treatment during the entire course at our hospitals from September 1986 to December 2004 were retrospectively analysed. Subgroup analyses were performed by stratifying the population according to T factor, Child-Pugh classification, and JIS.
Results: Median overall survival was 4.2 years. One-, 3-, 5-, 7- and 10-year survival rates were 91.5%, 66.6%, 43.6%, 22.1%, and 9.8% for all patients, and 96.5%, 77.2%, 58.7%, 32.5% and 20.3% for patients with JIS £1, respectively, and 96.7%, 63.4%, 36.5%, 13.1% and 0% for patients with JIS 2, respectively, and 76.6%, 50.7%, 27.7%, 17.3% and 0% for patients with JIS ^{3}3, respectively. Significant survival differences were found across two subgroups of staging systems (T2 vs. T3£, P=0.0067, JIS£1 vs. 2, P=0.002).
Conclusion: This study demonstrated that Subseg/Seg Lip-TACE is feasible treatment for obtaining prolonged survival in patients with localized HCC showing rich vasculature and the outcomes are influenced by both tumor stage and liver function as verified by the best prolonged survival for JIS £1.

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Lung percutaneous radiofrequency ablation (RFA) under live 3D guidance: first experience

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Purpose: To evaluate the technical success of lung radiofrequency ablation using a real-time needle guidance technology combining cone-beam computed tomography and fluoroscopy.

Material and Methods: Lung percutaneous RFA was performed in 17 patients (21 tumors) under general anesthesia, using a cone-beamCT (Philips Allura XperFD20) and fluoroscopic guidance. XperGuide was used for path planning by drawing a virtual needle path. Ablation was done with multitine or single radiofrequency electrodes (Leveen Boston Scientific or cooltip Covidien): 6 patients presented primary lung carcinoma and 11 presented metastases.
The primary endpoint of this study was the local efficacy assessed by CT (at 48h, 3-6-12 months) during the follow-up period (6 months minimum).
The secondary endpoints were: technical success, evaluation of the complications, duration of the procedure, CT evaluation of the ablation zone at 48h.
Results: Tumoral median diameter was 25.4 mm (range 12-40)
Primary endpoint: median follow-up was 7 months (range 3-12). During this period 2 local recurrences were depicted for 2 patients.
Secondary endpoints: all the cases were technically successful.
Complications during the 17 procedures were 10 pneumothorax; three of them underwent additional chest tube insertions.
Middle time of fluoroscopy was 3.15 mn and numbers of CT acquisitions were 5.For 14 patients (and 18 tumors) the 48-h CTscan shows ablation size (median size 55.7mm) and security margins >5mm (10 on 18) .
Conclusion: Cone-beam CT and live 3D needle guidance is a useful technique for percutaneous lung RFA. In this series all the treated tumors were more than 1 cm in diameter.

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Arterial infusion (AI) and chemoembolization (CE) in advanced pancreatic carcinoma

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Purpose: To study results of arterial chemotherapy in the treatment of unresectable pancreatic cancer.
Material and Methods: Between 1998 and 2009, we treated 90 pts with morphologically proven irresectable pancreatic head adenocarcinoma. Obstructive jaundice in 78 pts was resolved using percutaneous stenting. Celiac AI of gemcitabin (1000 mg/m^2) was performed in 41 pts. In 49 pts, CE of the tumor-feeding artery was done with 500-1000 mg/m^2 in 3-5 ml Lipiodol. Treatments were repeated every 28 days for as long as possible.
Results: There was no serious complication of 130 AIs. After 199 CE mild abdominal pain, fever, and elevation of amylase resolved within 3 days. One patient developed acute post-CE pancreatitis requiring surgery. Partial response was seen in 12 (29%), stable disease in 11 (27%), and progression in 18 pts (44%) receiving AI. CE showed 2 complete (4%) and 20 partial (41%) responses while 13 pts (27%) developed stabilization disease and 14 (29%) tumor progression. At present all 90 pts died. The mean survival after AI vs CE was 6.6$\pm$1.8 vs 14.9$\pm$3.3 mo (P<0.05) with maximal survival 41 mo vs 94 mo.
Conclusion: CE appears to be effective palliative treatment of advanced pancreatic head adenocarcinoma.

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Anatomical relationship between hepatic communicating arteries in hilar area: analyzed by MDCT-assisted hepatic arteriography

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Purpose: It has now become possible to easily select subsegmental branches and even finer peripheral branches of the liver by using highly advanced microcatheters during TACE for HCCs. However, the flow of fine embolic materials into unintended regions through communicating artery (CA) in the hepatic hilum has been observed, resulting in insufficient embolization due to blood inflow from the CA. Then, we analyzed anatomical characteristics of the CA from thin section data by CT-assisted hepatic arteriography (CTHA).
Material and Methods: We retrospectively analyzed 126 patients who had undergone CTHA of all existing hepatic arteries from December 2007 to August 2008. The original CTHA data was developed from 0.5-mm thickness volume data which was acquired using a 64-row MDCT. Patients who had a history of hepatectomy, portal vein thrombus coming up to main portal trunk or tumor invasion to the hilum were excluded.
Results: Between one and four CA branches were confirmed in all the patients in our study. 84% of the CAs were found to have some relation to the caudate branch. Additionally, 25% of the CAs were found to have some relation to the dorsal side of the medial lobe; here were some CAs with relations to the arterial plexus around the hilar bile duct.
Conclusion: In this analysis, we could find the presence of CA in all cases. Many CAs were related to hepatic branches arising from the hepatic hilum. The effect of these CAs needs to be taken into account during TACE.

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Does "vessel guard (VG) technique" improve local control rate in cryoablation for lung tumors?

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Purpose: We have revealed that the existence of vessels, 3.0-mm or larger in diameter, within 3-mm from the tumor was determined as a statistically significant risk factor for local recurrence after cryoablation of lung tumors. It is probably due to the cool-sink phenomenon. Then, we performed "VG technique": we inserted another cryoprobe between the tumor and the vessel or peripheral edge of the tumor adjacent to the vessel. The purpose of this study is to clarify the usefulness of VG technique during cryoablation for lung tumors close to large vessels.
Material and Methods: From October 2002 to December 2008, cryoablation was performed for 396 tumors. Tumors with a 3.0-mm or larger diameter vessel that were within 3-mm from the edge of the target tumor were included in this study. 59 tumors matched with the inclusion criteria and were divided into two groups according to with or without "VG technique". We retrospectively compared the local control rate between the two groups using Kaplan-Meier analysis.
Results: The procedures were all successful. The mean follow-up period was 535 days (range, 90 - 1832 days). The mean tumor size was 17.0 $\pm$ 5.3 mm and 14.0 $\pm$ 4.5 mm, and the local recurrence rate was 29.2% and 45.7% in the group with "VG technique" and that without "VG technique", respectively. The intergroup difference of

local control rate was statistically significant (p=0.028).
Conclusion: "VG technique" improves local control rate in cryoablation for the lung tumors close to large vessels.

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Pathological evaluation of the superselective intra-arterial chemotherapy with radiotherapy for advanced pharyngeal cancers

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Purpose: To evaluate the pathological efficacy of intra-arterial chemotherapy with radiotherapy for advanced pharyngeal cancers (stage IV).
Material and Methods: Thirteen patients with advanced pharyngeal cancers (oropharynx 8 cases, hypopharynx 5 cases) received intra-arterial chemotherapy with radiotherapy between April 2009 and July 2010. All 13 cases were fresh cases and the pathological evaluation was performed at the end of neo adjuvant therapies (before surgical operations or surgical biopsies). Under the DSA with cone beam CT, CDDP or NDP (100-150 mg/m) was infused to the feeding vessels superselectively. Three to 6 injections were given every 2 weeks during a radiation period (60-80Gy). The pathological evaluation of primary cancers was performed by surgical operations (n=4) and surgical biopsies (n=9). The cervical node resections were done in 11 cases.
Results: Of 13 primary pharyngeal cancers pathologically evaluated, 11 cases (84.6%) achieved a CR (complete remission) and 2 cases (15.4%) were PR (partial remission). On the other hand, in cervical node metastases, pathological CR rate was 46.2% and PR rate was 53.8%.
Conclusion: Former studies by others evaluated the efficacy of superselective intra-arterial chemotherapy for head and neck cancers by medical imaging and clinical following up. In our study, we evaluated the pathological efficacy of this treatment and believe that this treatment seems to be the best therapy for advanced pharyngeal cancers. By the way, the pathological CR rate of this treatment for cervical node metastases was not satisfactory and cervical node resections are recommended for the condition.

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Percutaneous CT-guided localization of pulmonary nodules with hook-wire prior to video-assisted thoracoscopic surgery

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Purpose: To evaluate the use of percutaneous CT-guided localization of suspicious pulmonary nodules with hook-wire prior to video-assisted thoracoscopic surgery (VATS).
Material and Methods: From April 2010 to January 2011, 14 patients with suspicious pulmonary nodules underwent CT-guided hook-wire localization of the lesions, prior to VATS. Various types of hook-wires were used. The diameter of the lesions ranged from 1 to 3 cm and their distance from the nearest pleural surface ranged from 3 to 5 cm.
Results: The placement of the hook was successful in all patients. The mean time needed to position the hook was 10 min. No major complications were experienced. Histological analysis of the resected nodules revealed malignancy in 11 cases, 2 cases with granulomas and 1 case with bronchiolitis obliterans organizing pneumonia (BOOP). Higher anchorage capacity was provided by the double-thorn hook-wire. Thoracotomy conversion was necessary in 1 case, due to limited hemorrhage at the site of the lesion. Dislodgement of the hook-wire occurred in 1 case, during surgical manipulations. Hospital stay was reduced from 7 days, when conventional thoracotomy was performed, to 1 day with VATS.
Conclusion: Preoperative CT-guided nodule localization using hook-wire fixation is a useful and safe technique that helps in the precise localization of suspicious lesions, reduces operation time, postoperative complications and hospitalization costs.

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Percutaneous treatment for rebel pain through techniques guided by radiologic methods

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Purpose: To explain our experience in the palliative treatment of oncological and non-oncological pain, rebel to intensive pharmacological treatment, through techniques such as neurolysis by alcohol or guided radiofrequency with radiologic methods.
Material and Methods: During 60 months we have carried out 28 procedures in 27 patients for the treatment of rebel pain: 25 neurolysis by alcohol (in 23 patients with intractable abdominal pain of oncological origen and 1 of non-oncological) and 3 radiofrequencies in 2 patients with pelvic pain of oncological origin and 1 of non-oncological. The procedures that were carried out were: celiac plexus block by alcohol (19 patients with pancreatic cancer), neurolytic block by alcohol of the Walter ganglion and the superior hypogastric plexus (5 patients, 4 with presacra recurrence of rectal cancer and one with non-oncological post-surgical proctalgia), and radiofrequency (3 patients, two of oncological origen and one neuralgia of the trigeminal nerve resistant to treatment).
Results: The procedure was carried out with success in 26 of the 27 patients. We obtained a significant relief of pain in 92% of the patients (24/26). In the remaining two cases there was no improvement. There was one technical failure, as the second needle in the neurolysis of the celiac plexus was not able to be placed properly. There were no major complications due to the procedure.
Conclusion: Percutaneous radiology techniques provide an effective, cheap and safe alternative for the treatment of pain that is resistant to an intensive pharmacological treatment.

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Bronchial artery chemo-embolization therapy for the primary lung cancer

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Purpose: To exhibit the feasibility of transarterial management of primary lung cancer by presenting the bronchial arterial supply to the pulmonary tumors and satisfactory results by this treatment.
Material and Methods: Nine patients (54 – 89 y/o) with primary lung cancer who could not be treated by the standard therapy were included. All patients had measurable tumor (19 – 74 mm, mean;36.5) in the lung field with or without mediastinal metastases. A microcatheter was selectively inserted into the bronchial

artery. After conventional DSA study, CT during contrast infusion to the bronchial artery was taken to estimate the blood supply to the pulmonary lesion. Infusion of CDDP and 5-FU followed by embolization using HepaSphere was carried out. The same treatment was repeated monthly at least 3 times. The tumor response was estimated RECIST criteria.
Results: In all patients, a microcatheter was successfully placed in the relating bronchial artery. The pulmonary lesions were clearly enhanced by contrast infusion to the bronchial artery on the CT images (whole;7, partial;1, ring;1). The tumor response was CR;0, PR;3, SD;6, PD:0 in three months. There was no major complication caused by drugs or embolic material during the procedure and post-treatment period. The longest survival was 43 months and shortest was 5 months.
Conclusion: Pulmonary lesions of lung cancer were exclusively fed by the bronchial artery in the study of arterial infusion CT. The bronchial arterial chemo-infusion followed by embolization was effective to control tumor growth even in the patients who cannot be treated by the standard therapy with minimum complications.

P-345

Hemodynamic and hormonal changes during cryoablation of adrenal gland in swine: in vivo experimental study

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Purpose: To determine the hemodynamic response, which is called hypertensive crisis, and hormonal changes during cryoablation of normal adrenal gland in swine. The amount of catecholamine in the adrenal gland was also measured.
Material and Methods: During general anesthesia, laparotomy was performed to expose the bilateral adrenal gland. An arterial catheter was used for direct blood pressure measurements during the procedure. Then, a cryoprobe was introduced into the right or left adrenal gland and cryoablation was performed in four swine. The protocol of cryoablation consisted of five minutes freezing followed by 5 minute active thawing. Blood samples were collected immediately before and at 2, 3, 4, 5, 6, 7, 8, 10, 15, and 20 minutes after the beginning of thawing in two swine. Plasma catecholamine and cortisol determinations were performed. In another swine, the adrenal gland was harvested and adrenal homogenate was centrifuged at 3000rpm for 15 min, then the supernatant fluid was used to measure the concentration of catecholamine.
Results: In all four animals, hypertensive crisis with tachycardia and intense elevation of blood pressure was observed. Hypertensive crisis started about 4-5 minutes after the beginning of thawing. Plasma catecholamine began to increase just before the beginning of hypertensive crisis. The total amount of epinephrine in the normal adrenal gland was 1.0 mg.
Conclusion: Cryoablation of normal adrenal gland induced hypertensive crisis by released catecholamine. The timing when hypertensive crisis occurred was about four minutes after the beginning of thawing. The adrenal gland contained enough amount of catecholamine to cause hypertensive crisis.

P-346

Locally advanced pancreatic cancer: role and preliminary local results of ultrasound-guided high-intensity focused ultrasound (USgHIFU) in selected patients

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Purpose: To define the clinical role and assess safety and feasibility of USgHIFU ablation in patients with advanced pancreatic cancer.
Material and Methods: From May 2008 to January 2011, 22 patients, mean age 64.3 years (range 43-77), affected by pancreatic tumors were treated for: 13 adenocarcinomas, 7 NET and 3 pancreatic metastases from RCC. Eighteen tumors were located within the pancreatic head, 2 within the isthmus and 2 in the tail. Tumours average diameter was 5.2 cm (range 2.5 - 7.6). All patients had previous chemotherapy, biological therapy, radiation therapy and were unsuitable for resection. The procedure was always performed by the JC-HIFU system [Chongqing-Haifu (HIFU)], under general anaesthesia. The assessment of the ablated areas during the procedure was performed by i.v. bolus injection US contrast-agent (SonoVue, Bracco-Italy). All patients were evaluated clinically and by PET-CT, MRI, MDCT.
Results: All procedures were carried out without early complications. MDCT and PET-CT showed local tumor control in all cases (2 SD, 1 CR, 19 PR). Nineteen/22 patients were rapidly palliated in symptoms with long lasting pain control after a mean follow-up of 16 months. Five patients are still under chemotherapy. Two late complications were recorded: complete thrombosis of the tumor encased portal vein and one transient focal pancreatitis. Average treatment and sonication time were 140±41.2 minutes and 1820±750 seconds, respectively. All the patients but three returned home 3 days after treatment.
Conclusion: According to our preliminary experience, USgHIFU ablation could be considered as a safe and feasible approach for controlling solid pancreatic tumors within a multimodal management.

P-347

The safety and efficacy of combining radioembolization with TACE for HCC

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Purpose: Transarterial chemo- and radio-embolization are the mainstay of local-regional therapy for hepatocellular carcinoma (HCC). Yet the two modalities commonly are deployed to the exclusion of each other. We report our initial experience with the combination of the two in terms of safety and efficacy in HCC.
Material and Methods: Eleven cirrhotic HCC patients received ^{90}Yttrium (Y-90) microspheres, then doxorubicin-eluting beads (DEBDOX), one session of each, within a period of three months. The median intervening time between treatments was 43 days (range 29-91 days). Y-90 doses were in the range of 110-137 Gray, whereas doxorubicin doses were either 75 mg or 150 mg. LC Bead 100-300 microns in diameter was utilized for all sessions except for one, where beads 300-500 microns in diameter were used instead.
Results: The median primary tumor size was 5.0 cm. With a median follow-up time of 163 days (0-877), 7 patients (87.5%) scored complete response by EASL criteria with progressive disease in one patient (12.5%). Three patients had no follow-up imaging. 6 patients remain alive; 3 of the surviving group have received orthotopic liver transplants. 3 patients experienced serious adverse events within 90 days of treatment (death-2, bilirubin toxicity-1), attributable to pre-existing risk factors such as Child-Pugh Score of B, AST 5 times the

upper normal limit, portal vein invasion or diffuse disease.
Conclusion: Combining radio-embolization+chemo-embolization with LC Bead in the treatment of HCC is deemed a safe strategy in selected patients with a potential synergistic response. Patients with underlying conditions predisposing to treatment-related toxicity may experience serious adverse events.
Disclosure: I have a contracted research agreement with Biocompatibles, Ltd., and with Nordion.

P-348

Image-guided palliation of painful bone metastases using percutaneous cryoablation: clinical experience and preliminary results

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Purpose: To assess the ablative effectiveness and the palliation efficacy of image-guided percutaneous cryoablation in the treatment of bone metastases. Combination with percutaneous bone cementoplasty to provide stabilization in bones at risk for pathologic fracture.
Material and Methods: Fourteen patients were undergoing cryoablation technology with a single/multiple probes dedicated under computed tomography (CT) guidance. For palliation of symptomatic metastases, ablation was reserved for patients with moderate pain (4 on a 10-point scale in a 24-hour period). Before and 4 weeks after cryoablation was performed 18FDG PET/CT. Combination therapy was also useful in patients at risk of fracture.
Results: Cryoablation resulted in significant pain reduction with a 43% mean reduction in worst pain in 4 weeks (Cleeland Brief Pain Inventory). No serious complication was seen. Pain relief from cryoablation was durable in 80% patients during the 20-week follow-up period. The ablative treatment resulted in complete tumor necrosis and reduction in metabolic data as shown on follow-up imaging.
Conclusion: Image-guided percutaneous cryoablation is an effective treatment for the palliation of painful bone metastatic lesions that are refractory to standard therapies.

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A randomized phase II trial of irinotecan drug-eluting beads administered by hepatic chemoembolization with intravenous cetuximab (DEBIRITUX) versus systemic treatment with intravenous cetuximab and irinotecan in patients with refractory colorectal liver metastases and Kras wild-type tumors

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Purpose: About half of patients with newly diagnosed colorectal cancer will develop metastatic disease and, however, in spite of the significant progress in the therapeutic strategies for metastatic disease, virtually all patients will eventually succumb to their illness. It is therefore highly needed to develop new efficacious and safe therapies in this indication. Based on prior clinical data there is a good rationale for the expectation that the combination of systemic treatment and transarterial chemoembolization with drug eluting beads may be effective in the setting of patients with unresectable and/or chemorefractory liver metastases.
Material and Methods: In a multi-center, randomized phase II trial conducted in Germany, 80 patients with unresectable metastatic Kras wild type colorectal cancer confined to or predominately in the liver after failure of fluoropyrimidines (FP)/irinotecan and/or FP/oxaliplatin with or without bevacizumab will be recruited. Patients are randomly assigned in a 2:1 ratio to DEBIRITUX: i.v. cetuximab plus DEBIRI TACE (two times per lobe in monthly interval, can be repeated after 3 months), or i.v. cetuximab plus i.v. irinotecan (q 2 weeks). The primary objective of this study is to evaluate the efficacy of DEBIRITUX compared to standard of care (BOND trial, Cunningham, NEJM 2004). Primary endpoint is the progression-free survival rate at 6 months. Secondary objectives are safety and tolerability of DEBIRITUX and the added value of an escalated antiemetic regimen with aprepitant in patients treated by TACE. The trial is registered NCT01060423.
Results: First three patients were included and two treated with DEBIRITUX so far.
Conclusion: The trial is ongoing.
Disclosure: D. Arnold received honoraria and research funding from Merck KGaA and Terumo, P. Pereira and A. Petrovitch received honoraria from Terumo, S. Pluntke received honoraria and research funding from Terumo.

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Image-guided palliation of painful soft tissue metastases using percutaneous cryoablation: clinical experience and preliminary results

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Purpose: To assess the ablative effectiveness and the palliation efficacy of image-guided percutaneous cryoablation in the treatment of soft tissues metastases.
Material and Methods: Twenty patients were undergoing cryotherapy technology with a single/multiple probes dedicated ablation system under ultrasound (US)/computed tomography (CT) guidance. Before and 4 weeks after cryoablation was performed 18FDG-PET/CT for the evaluation of the metabolic data of the lesions.
Results: Cryoablation resulted in significant pain reduction with a 63% mean reduction in worst pain in 4 weeks (Cleeland Brief Pain Inventory). No serious complication was seen. Pain relief from cryoablation was durable in 90% patients with excellent pain control in the treated area during the 20-week follow-up period. The ablative treatment resulted in complete tumor necrosis and reduction in metabolic data as shown on follow-up imaging.
Conclusion: Cryoablation is a safe and effective treatment for the palliation of painful metastatic lesions that are refractory to standard therapies. Importantly, the quality of life for these patients is improved with this therapy with a single ablation treatment.

P-351

Switching the loaded agent from epirubicin to cisplatin: salvage transcatheter arterial chemoembolization with drug-eluting microspheres for unresectable hepatocellular carcinoma

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Purpose: There is no consensus on switching anticancer agents loaded onto drug carriers in transcatheter arterial chemoembolization (TACE) for HCC. This study aimed to evaluate the safety and clinical outcomes of TACE with cisplatin-loaded microspheres (CLM-TACE) in HCC patients refractory to TACE with epirubicin-loaded microspheres (ELM-TACE).
Material and Methods: Between February 2008 and June 2010, 85 patients with unresectable HCC refractory to ELM-TACE were enrolled to undergo CLM-TACE. The number of ELM-TACE sessions until judgment of resistance ranged from 1 to 4 (median, 2.1). Thirteen (15.3%) patients had portal vein invasion. CLM-TACE was performed with 50–100-μm HepaSphere loaded with 1 mg cisplatin/1 mg microspheres together with hepatic arterial infusion of 25 mg cisplatin and 500 mg 5-fluorouracil per body. Tumor responses were evaluated by CT according to the European Association for the Study of the Liver criteria.
Results: The median number of treatment courses was 1.8 (range, 1–5), and the mean total dose of cisplatin per session was 42.8 mg (range, 30.0–59.0). After 6 months, 3 (3.5%) patients achieved complete response, 31 (36.5%) had partial response, 15 (17.6%) had stable disease and 36 (42.4%) had progressive disease. The median overall survival and time to treatment failure after initial CLM-TACE were 13.3 and 7.2 months, respectively. Overall, 9.4% of patients experienced grade 3/4 adverse events.
Conclusion: Switching the loaded agent from epirubicin to cisplatin is a safe, well-tolerated and efficacious treatment strategy for salvage TACE with drug-eluting microspheres in HCC patients refractory to ELM-TACE.

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Comparison of diagnostic quality of intra-arterial CT images obtained using cone beam CT and multidetector CT systems for hepatic radioembolisation

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Purpose: To compare the diagnostic quality of images obtained during intra-arterial injection of contrast using cone-beam CT (CBCT) and multi-detector CT (MDCT) for hepatic radioembolization.
Material and Methods: A retrospective review of patients who underwent hepatic angiography for Tc99-MAA infusion and Yittrium-90 radioembolization for hepatocellular carcinoma (HCC) on both CBCT (Artis zeego, Siemens) and MDCT (Infinix VC-i, Aquilion 16, Toshiba) systems from October 2008 to January 2011 was performed. The scans were evaluated for tumor number, enhancement pattern, presence of extrahepatic enhancement and image quality. The images were graded A1 to A4 in descending quality.
Results: Fifteen patients with 64 HCC nodules identified on multiphasic CT/MR were evaluated using intra-arterial CBCT or MDCT at the time of the Tc99-MAA study and Yittrium-90 radioembolization. Twenty-three pairs of CBCT and MDCT scans with comparable catheter positions were analysed. CBCT (n=166) and MDCT (n=170) identified more tumor nodules than multiphasic CT/MR (n=64). Both techniques were equivalent in identifying extrahepatic enhancement. In large tumors, MDCT was better than CBCT in determining the proportion of tumor supplied by different arteries. MDCT provided A1 grade images in all 23 scans. The image quality on CBCT was A1 grade in 4%, A2 in 87% and A3 in 9% of scans. Respiratory motion and streak artifacts were responsible for the poorer image quality.
Conclusion: Intra-arterial CBCT and MDCT were both more sensitive than triphasic CT in detecting HCC nodules. Although image quality was better in MDCT, both techniques provided comparable diagnostic information required for patients undergoing radioembolization treatment.

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Preliminary study of hepatic arterial infusion chemotherapy combined with endogenetic field tumor hyperthermia for hilar cholangiocarcinoma

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Purpose: To analyze curative effect and clinical application of hepatic arterial infusion (HAI) chemotherapy combined with endogenetic field tumor hyperthermia (EFTH) in patients with hilar cholangiocarcinoma.
Material and Methods: Between October 2003 and December 2010, six patients with unresectable hilar cholangiocarcinoma, who were unwilling to undergo operation, were enrolled in this study. They were first treated with HAI using Gemcitabine (1.0mg/m^2). And then carboplatin (0.25g/m^2) was continuous intraarterial (i.a.) infused, while EFTH lasting 60 minutes. After hyperthermia, 5-fluorouracil (0.75g/d) was i.a. infused in the following 3 days. The same dose of Gemcitabine was administered intravenously on day 8. Every patient would receive about 2 to 4 courses of a 3-week cycle. The curative effects, such as side effect, tumor markers and live time, were observed during follow-up period.
Results: Six patients underwent 17 cycles of the therapeutic combination. Follow-up period ranged from 10 to 88 months. Three patients are still alive, without the primary tumor, and three died. There were 3 patients with CR, 2 patients with PR and 1 patient with PD, as assessed by RECIST. Tumor markers decreased at varied degrees in 5 patients. The overall response rate (CR+PR) was 83.33%. Median and mean overall survival time were 30 and 43 months. And the 1-year, 2-year and 5-year cumulate survival rates were 83.33%, 62.50% and 31.25%, respectively. There was no relevant side effect of the treatment.
Conclusion: HAI chemotherapy combined with EFTH is safe, minimally invasive, well-tolerated and may be a useful option for hilar cholangiocarcinoma. The mechanisms of the combination are worth further studying.

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Humeral bone tumors treated with percutaneous cementoplasty

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Purpose: Bone metastases are a common complication in different cancers. For these patients, the treatment priority includes a pain relief, a bone consolidation, a prevention of complications and a better quality of life.
Material and Methods: We report a retrospective series of 9 patients treated with cementoplasty for humeral bone tumor. Percutaneous cementoplasty was always decided after discussion with an orthopedic surgeon. Percutaneous cementoplasty

was performed under general anesthesia and CT or cone beam CT guidance. Primary endpoint was evaluation of pain relief and evaluation of the bone consolidation. Secondary endpoints were tolerance and complications. Pain relief was evaluated with a VAS score before cementoplasty, then at one and 3 months. Patients were followed clinically and radiologically at 1, 3 and 6 months then every 6 months.
Results: 5 patients presented a cephalic and metaphysal tumor and 4 a diaphyseal tumor. 6 tumors were from metastatic origin, 3 were myelomatous. Median follow-up was 11 months (range 1month-60 months). At 1 month, 6 patients obtained a pain relief >50%; at 3 months, 7 patients obtained a pain relief. During the follow up, bone consolidation was obtained in all the cases but one. For this patient a fracture appeared one year after the cementoplasty. In one case, cementoplasty was performed after surgery, in two cases cementoplasty was followed by surgery.
Conclusion: Minimally invasive options as percutaneous cementoplasty are available to treat humeral bone lesions in patients who are poor candidates for surgery or in areas not amenable to surgical stabilization.

P-355

Interventional radiologist: an important role in the treatment of metastatic radioiodine refractory thyroid carcinomas

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Purpose: Slowly evolving radioiodine refractory thyroid cancer metastases may indicate a local treatment. Interventional radiology may be proposed (revised ATA guidelines; recommendation 63). Our aim is to evaluate efficacy and toxicity of lung radiofrequency ablation and cement injection.
Material and Methods: During this retrospective study (2004-10), twelve consecutive patients with lung metastases were treated with radiofrequency ablation (RFA). Regular follow-up was done with CT-scanner and PET-CT. When more than 5 nodules were present, only hypermetabolic PET-CT nodules were treated. Endpoints were local efficacy based on imaging follow-up, decrease of thyroglobulin (Tg) and clinical outcome. Eleven consecutive patients with painful bone metastases were treated with cementoplasty. End points were pain relief, patient outcome and assessment of fracture prevention.
Results: Lung RFA: 12 patients (mean 62.9 y), 23 nodules (mean 12.3 mm) were treated during 18 sessions. The main complication was a pneumothorax (67%). No local recurrence was noted with a median follow-up of 3.2 years. Tg decreased in all cases. 4 patients remain in complete remission. Cementoplasty: 11 patients (mean 61.3 y) were treated by cementoplasty. 10 vertebras, 2 long bones, 8 pelvic bones. In 20 sessions, 3 leakages occurred. Pain relief except for one was obtained; no fractures were depicted. Six patients are still alive (mean follow-up time 3.2 y), 6 with ECOG 0-1 performance status.
Conclusion: Interventional radiology and mainly lung radiofrequency ablation and cementoplasty are very useful options for treating slowly evolving radioiodine refractory thyroid cancers. They could be repeated and help to maintain a good quality of life in metastatic long surviving patients.

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Lipiodol versus DcBead in primary liver tumor transarterial chemoembolization (TACE)

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Purpose: To compare hepatocellular carcinoma (HCC) response to TACE with doxorubicin and Lipiodol (conventional TACE, c-TACE) versus embospheres-loaded with doxorubicin (DEB-TACE).
Material and Methods: From 2007 to 2010, 131 patients (100 males, mean age 71,3 yrs) were treated by selective c-TACE (2007-2008, 45 patients), DEB-TACE (2009-2010, 68 patients) or both (2009, 18 patients). A total of 248 procedures were performed in the study group (128 c-TACE, 120 DEB-TACE). Tumor response was evaluated on CT, MR or CEUS within three months according to WHO criteria as modified by the EASL.
Results: All procedures were technically successful, and there were no major complications. Complete tumor response (CR) was observed in 33 procedures (13,3%), partial response (PR) in 82 (33,1%), stable disease (SD) in 54 (21,8%) and progression (PRO) in 79 (31,8%). CR, PR, SD and PRO were 6 (7%), 15 (17.4%), 25 (29%) and 40 (46,5%) after c-TACE; 19 (21,6%), 35 (39%), 19 (21%) and 15 (17%) after DEB-TACE and 8 (9,5%), 32 (38,1%), 10 (11,9%) and 24 (28,6%) in the mixed group. There was a significant reduction in tumor diameter in the DEB-TACE (mean diameter from 25,3 mm to 22,7 mm) and in the mixed group, not in the c-TACE group (mean from 24,2 to 28,2 mm). Patients of the c-TACE group underwent a mean of 1,97 procedures versus 1,35 procedures of DEB-TACE group.
Conclusion: DEB-TACE was more effective in HCC disease control, accounting for a greater size reduction of the nodules treated, a higher rate of CR and PR and reduction of the number of procedures.

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High-frequency percussive ventilation for complete target immobilization in radiofrequency ablation under multiphase CT guidance of malignant liver tumor

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Purpose: To demonstrate the feasibility of complete liver immobilization by means of high-frequency percussive ventilation (HFPV) and to show that the target localization can be predicted with reliable accuracy even if the lesion not depicted by multidetector computed tomography (MDCT).
Material and Methods: The efficiency of HFPV neutralizing the liver's respiratory motion during multiphase MDCT was evaluated using anatomical landmark in the liver. The procedure was carried out on 6 patients with malignant liver tumour (HCC=3, liver metastases=3) only visible during the arterial phase and/or portal phase of the MDCT but not clearly identified at the delayed phase. For all the images acquisition steps, needle placement and radiofrequency treatment of the tumor, patient was placed under HFPV with the same pressure and frequency parameters in order to obtain an identical lung and liver low motion.
Results: The liver landmark motion in each anesthetized patient was limited to under 4.0 mm in all directions. The spatial localization of the tumours was determined during the early phase and then reported on the delayed phased for needle placement based on stereotactic coordinates. All 6 patients were effectively oxygenated and ventilated and there were no oxygen desaturations for less than or more than 5 min. 2-month follow-up MDCT showed that all lesions were correctly localized and treated without evidence of local recurrence.

Conclusion: HFPV provided a reliable immobilization of the liver. Based on this technique, stereotaxic radiofrequency treatment of liver lesion is feasible when lesion identified only on early CT phases.

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Comparative study in hepatocellular carcinoma (HCC) post-treatment imaging with CEUS and MDCT after RFA and MVC

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Purpose: To investigate the accuracy of multidetector CT (MDCT) compared with contrast-enhanced ultrasound (CEUS) in the evaluation of treatment response after radiofrequency ablation.
Material and Methods: We retrospectively studied the follow-up imaging studies of a total of 68 nodules (diameter ranged between 1,5 and 4 cm), observed in 58 patients (30 males and 28 females that ranged in age from 48 to 75) with biopsy proven HCC, who had underwent RFA and MCW. All patients were examined with multiphasic contrast-enhanced MDCT and CEUS approximately 4 weeks after RFA or MCV. Contrast enhancement appearing within the site of ablation was interpreted as incomplete treatment or tumor recurrence. All examinations were interpreted blindly by two radiologists and afterwards CEUS findings were compared with MDCT by an experienced radiologist in abdominal imaging. MDCT was used as reference standard.
Results: In 68 nodules a complete response was obtained in 60 nodules and incomplete response in the other 8. Percentage of complete response was 88,2%. Post-RFA CEUS was able to detect 7 of 8 cases with residual tumor. The results obtained with CEUS agreed with those obtained with MDCT in all cases, rendering a diagnostic accuracy of 100%. There was no statistically significant difference in overall diagnostic accuracy between MRI and MDCT in the evaluation of residual tumor ($p > .05$).
Conclusion: CEUS represents a cost effective and valuable tool in the evaluation of RFA outcome in HCC. Immediate CEUS evaluation may improve efficiency of the treatment and better patient management.

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Outcome in patients who underwent more than three sessions of transarterial chemoembolization for hepatocarcinoma

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Purpose: To analyze the outcome of 15 patients after more than 3 sessions of transarterial chemoembolization (TACE) for hepatocellular carcinoma (HCC).
Material and Methods: Single center retrospective study including cirrhotic patients (65 ± 8 years). Eleven patients had alcoholic cirrhosis and 14 were Child-Pugh class A. After 3 sessions, the second series of TACE, justified by the recurrence of the HCC in 94% of the cases. The number of session of TACE, quantity of drug, grade of hepatic arterial damages (HAD) and their technical consequences, evolution of hepatic lesions and survival rate of patients were studied.
Results: Number of session was 4.7 ± 0.7. Only 2 patients had a total of 6 sessions. Quantities used for the two series; anthracyclines: 287 ± 120 mg; lipiodol: 48 ± 9 ml. Besides the postembolization syndrome, one acute pulmonary edema, one hepatic necroses and HAD were observed in 40% of the patients. TACE was stopped in 2 patients because of occlusion of the proper hepatic artery. Lesion stability on CT scans following was found in 50% of the patients. Survival rate was 100% at 1 year, 67% at 2 years, 11% at 3 years; median of survival: 25 months (12 - 43).
Conclusion: TACE seems to be able to be repeated in hepatic cirrhosis as long as tumor response is obtained and that the liver function and the arteries allow it. HAD in TACE could be limited by a selective technique and an optimizing of the dose of the chemotherapeutic agents.

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Microwave ablation of adrenal metastatic tumors originating from lungs: our initial experience

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Purpose: Adrenal metastatic disease has limited treatment options. It most commonly originates from lung. Our purpose is to compromise our initial experience in image-guided local tumor ablation of adrenal metastases, with microwave energy.
Material and Methods: Over a 1-year period a total of 17 MWC sessions were performed in our hospital (15 patients). 9 of the patients were men and 6 were women, ranging in age between 51 and 80 years. They all had lung cancer. 8 of the adrenal tumors were located on the right and 9 on the left. The diameter of the tumors ranged between 3,8 and 5 cm. The whole procedure of MWC was performed percutaneously, under CT guidance and using local analgesic therapy. The microwave energy was applied for 3 to 5 min. A dual-phase dynamic contrast-enhanced CT was performed after the antenna removal to evaluate the immediate lesion's response to the ablation. Follow-up was performed at 1, 3, and 6 month's post-MWC and every 6 months afterwards.
Results: 14/17 (82,3%) tumors showed complete response. 3/17 (17,6%) tumors showed partial necrosis and in those a second MWC was performed. 4/17 tumors showed a local recurrence and they also underwent a second session. Major complications did not occur.
Conclusion: MWC of adrenal metastasis is a promising alternative treatment. However, more studies need to be conducted in order to prove its efficacy and establish its role as far as long-term survival is concerned.

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Comparative study in hepatocellular carcinoma (HCC) post-treatment imaging with CEUS and MDCT after DC-beads chemoembolization

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Purpose: The purpose of our study was to compare the accuracy of contrast-enhanced ultrasound (CEUS) and multidetector CT (MDCT) for evaluating the outcome of transarterial chemoembolization with doxorubicin beads (DC-beads) in patients with HCC.
Material and Methods: We retrospectively studied the follow-up imaging studies of a total of 33 nodules, observed in 21 patients (13 males and 8 females that ranged in age from 56 to 78) with biopsy proven HCC, who had underwent chemoembolisation with DC-beads. All patients were examined with multiphasic contrast-enhanced MDCT and CEUS approximately 4 weeks after DC-beads chemoembolisation. Contrast enhancement appearing within the tumor was interpreted as incomplete treatment or *tumor* recurrence. MDCT was used as reference standard and angiography in case additional DC-beads treatment was performed due to incomplete

response. All examinations were interpreted blindly by two radiologists and afterwards CEUS findings were compared with MDCT by an experienced radiologist in abdominal imaging.
Results: In 33 nodules a complete response was obtained in 26 nodules and incomplete response in the other 7. Percentage of complete response was 78,7%. Post-DC-beads chemoembolisation, CEUS was able to detect 6 of 7 cases with residual tumor. The results obtained with CEUS agreed with those obtained with MDCT in all cases, rendering a diagnostic accuracy of 100%. There was no statistically significant difference in overall diagnostic accuracy between MDCT and CEUS in the evaluation of residual tumor ($p > .05$).
Conclusion: CEUS represents a cost effective and valuable tool in the evaluation of the outcome of chemoembolisation with DC-beads in HCC.

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Necrosis grade assessment after transarterial chemoembolization in hepatocellular carcinoma

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Purpose: To assess the necrotic grade achieved after transarterial chemoembolization (TACE) in patients with HCC who underwent orthotopic liver transplantation (OLT).
Material and Methods: From December 2008 to December 2010, 228 TACE procedures to 154 patients with HCC were performed. For this aim, doxorubicin-loaded microparticles (DC Beads^{TM}) were used. During this period 18 men (age, 44-68) with 27 lesions underwent OLT. Lesion diameter was <35 mm in 21 cases, the rest were between 35 and 50 mm. We used 100-300 and 300-500-micron sized particles in 85% of the procedures, the median doxorubicin dose was 95 mgrs. Necrosis was histologically graded as severe (more 90%), moderate (50-90%) and mild (less 50%).
Results: The histology review revealed severe necrosis in 17 lesions (63 %), moderate necrosis in 8 lesions (29,63 %) and mild necrosis in the remaining 2 (7,37 %). The time elapsed between last TACE and OLT was 118 days.
Conclusion: In our series, transarterial chemoembolization of hepatocellular carcinoma with doxorubicin-loaded microparticles has proven its usefulness as adjuvant treatment for OLT. The pathologic review reveals a severe necrosis degree in most of the treated lesions.

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Liver-directed therapies for neuroendocrine metastatic liver disease: what is the evidence?

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Learning objectives: 1. Review the current indications for liver-directed therapy of neuroendocrine metastatic liver disease. 2. Examine the current evidence for chemoembolization verses hepatic artery embolization for metastatic neuroendocrine tumors. 3. Review the technical aspects of both chemoembolization and hepatic artery embolization
Background: Neuroendocrine tumors have a predilection for metastasizing to the liver. This is often the first presentation of disease and is associated with a poor prognosis. In these cases, surgical resection is possible in less than 10% of patients, and systemic chemotherapy has been shown to have a poor response rate. Hepatic artery embolization, chemoembolization, and ablation therapies have become the mainstay of therapy in patients with metastatic neuroendocrine tumors to the liver.
Clinical Findings/Procedure Details: An extensive review of the current literature will be performed with an emphasis on the evidence for liver-directed therapies for neuroendocrine carcinomas that have metastasized to the liver.
Conclusion: Neuroendocrine metastases to the liver are often unresectable and respond poorly to systemic chemotherapy. Therefore, liver-directed therapies have become an important form of primary therapy. This educational poster will review the current evidence for liver-directed therapies in the treatment of neuroendocrine metastatic liver lesions.

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Percutaneous right portal vein embolization for induction of effective hypertrophy of the left hepatic lobe before right liver resection due to malignancy

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Learning objectives: To present the safety and the efficacy of preoperative embolization of right portal vein branch.
Background: Embolization of right portal vein induces hypertrophy of the left liver lobe and so the patients become suitable for right lobectomy as an adequate liver function is accomplished.
Clinical Findings/Procedure Details: Nineteen patients were admitted to our department in the last 3 years with diagnosed space occupying lesion in right liver lobe. They underwent preoperative percutaneous embolization of the right portal vein with tissue glue and with metallic coils in some cases. The access was performed percutaneously under ultrasound guidance, through the right liver lobe in 16 patients and through the left liver lobe in 3 patients. The method was technically successful in all patients regardless the way of access. No complications occurred, apart from the post-embolic pain. The imaging control that took place between 2 and 5 months after the procedure revealed a 10%-60% increase of the remnant hepatic parenchyma. The 14 of 19 patients were later on operated successfully with right lobectomy. In 3 of 19 patients the regeneration of left lobe appeared to be insufficient for right lobectomy whereas 2 patients developed at the meantime multiple metastatic lesions to the whole liver. These 5 patients were then successfully managed with chemoembolization.
Conclusion: Percutaneous embolization of portal vein is a safe and adequate method for the volume increase of contralateral liver, but also does not exclude other possible therapeutic approaches.

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Evaluation of nephrotoxicity after transarterial chemoembolization with a miriplatin-lipiodol suspension for hepatocellular carcinoma

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Learning objectives: We evaluated the nephrotoxicity of miriplatin in comparison to cisplatin in patients with hepatocellular carcinoma (HCC).
Background: At transcatheter arterial chemoembolization (TACE) to treat HCCs, various anticancer drugs are mixed with iodized oil (LPS). The strong dose-response relationship of cisplatin (CDDP), an anti-neoplastic agent with demonstrated activity against a variety of

human cancers, renders it useful for TACE to treat HCCs. A new lipophilic platinum complex, a miliplatin associates with superior antitumor effects against HCC. It is highly compatible with lipiodol in suspension and when thus suspended, cyclohexan-1,2- diamineplatinum (II) dichloride and cyclohexan-1,2-diamineplatinum (II) dioxide are released into the aqueous phase, thereby providing its antitumour effects. Although nephrotoxicity is an adverse side effect of platinum-containing drugs, in phase 2 trails miriplatin yielded favorable results in terms of renal toxicity.
Clinical Findings/Procedure Details: HCC patients underwent intra-arterial CDDP/LPS- (n=9) or miriplatin/LPS embolization (n=11). Renal toxicity was determined by creatinine clearance before and after TACE. After TACE with CDDP/LPD, there was a mild elevation of serum creatinine and a decrease in creatinine clearance. There was no significant difference before and after TACE with miriplatin/LPD.
Conclusion: Unlike cisplatin, TACE with miriplatin does not induce nephrotoxicity. Miriplatin is a better anticancer drug than cisplatin in HCC patients with mild renal dysfunction.

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Single-session arterial embolization and percutaneous radiofrequency ablation is useful in patients with renal cell carcinoma at surgical risk

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Learning objectives: We assessed the feasibility of single-session renal arterial embolization temporary embolic materials and percutaneous radiofrequency ablation (RFA) for unresectable renal cell carcinomas (RCCs).
Background: As blood flow promotes heat loss of tumors, its reduction or elimination during RFA increases the ablation volume. As RCCs are supplied almost exclusively by the renal arteries, effects of RFA can be enhanced after blockage of the renal arterial blood flow. Although CT-guided RFA after arterial embolization was reported as a feasible, safe, and promising treatment for unresectable RCCs, it required two interventional sessions, using a permanent embolic material to maintain prolonged arterial occlusion.
Clinical Findings/Procedure Details: Ten patients with 12 RCCs who were ineligible for surgery underwent RFA. We first introduced gelatin sponge particles as a temporary embolic material for selective arterial embolization and then proceeded to RFA under real-time CT fluoroscopic guidance. Iodized oil was used as a marker at CT-guided puncture. RFA was technically successful in all patients and tumor enhancement was eliminated after 2 RFA sessions. There were no major post-RFA complications and no patient experienced local recurrence during a mean follow-up period of 24 months. One patient with von Hippel-Lindau disease manifested ectopic recurrence.
Conclusion: Single-session renal arterial embolization using a temporary embolic material and percutaneous RFA was a feasible, safe and promising treatment in patients with unresectable RCC.

P-367

"What happens?" Imaging spectrum after radiofrequency ablation of renal cell carcinoma: typical and atypical presentation

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Learning objectives: The learning objectives of this exhibit are: to know variations of imaging findings after radiofrequency ablation (RFA) of renal cell carcinoma (RCC), appearances of the ablated tumor with or without local progression and complications. To inform atypical imaging findings that mimic complications and procedure-related appearance.
Background: Recently, RFA has been one of therapeutic options for treatment of renal cell carcinoma. However, imaging findings after RFA has not been widely accepted, therefore accurate assessment of ablated tumor and around the tumor is essential for early detection of residual or recurrent tumor and management of complication.
Clinical Findings/Procedure Details: 1. Typical imaging finding after RFA a) tumor density on CT and signal intensity on MRI immediately after RFA, b) morphological change after RFA including renal halo sign, c) contrast enhancement with or without local progression, and d) utility of MRI, especially diffusion weighted imaging 2. Imaging findings of complications: a) Bleeding (subcapsular, perirenal or calyceal). b) ureteral injury, c) bowel injury, d) tumor seeding, and e) urine leak. 3. Imaging findings that mimic complications a) pneumoretroperitoneum and retroperitoneal fluid collection, b) wedge-shaped retention of contrast medium, and c) imaging after trans-hepatic and trans-pulmonary approach.
Conclusion: The major teaching points of this exhibit are: 1. Tumor without local progression tends to shrink over time and lose contrast enhancement. On the other hand, those with local progression tends to show nodular or crescent enhancement or signal change in diffusion weighted imaging. 2. There are a variety of complications and its mimickers after RFA of renal cell carcinoma.

P-368

Radiofrequency ablation treatment of benign lesions: indications, technique and clinical outcome

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Learning objectives: To describe the main indications and the technical steps to perform percutaneous radiofrequency ablation (RFA) image-guided procedures in benign lesions. To access procedure safety, effectiveness and clinical outcome.
Background: With expertise and the ability to adjust them to the special needs of patients several image-guided RFA techniques can be made. Besides necrosis and according to the main principles of thermal ablation, heat production can be helpful in providing coagulating and sterilization effects in biological tissues. This exhibit reviews the indications and contraindications of the described techniques in benign lesions. All techniques were made under sedation and with appropriate electrodes.
Clinical Findings/Procedure Details: Different procedures are described: RFA of symptomatic liver hemangiomas, RFA of lung aspergilomas, RFA of liver hydatid cysts and RFA of functioning adrenal adenomas. We illustrate the main indications, patient preparation, material needed, procedure steps. Follow-up was made using different imaging modalities.

Conclusion: Successful adaptation of RFA technique for benign lesions requires attention to the specific needs of patients in the different procedures. Clinical results are very effective and thus replacing surgery, other guided techniques or antimicrobial agents.

P-369

Radiofrequency thermo ablation (RFA) in locally advanced pancreatic cancer: long-term results

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Learning objectives: RFA application
Background: Using ANGIODYNAMICS® Model 1500X Electrosurgical Radiofrequency Generator.
Clinical Findings/Procedure Details: In our pilot experience, 49 patients with locally advanced pancreatic adenocarcinoma (LAPC) underwent RFA and were enrolled for a minimum 12 months follow up. Male/female ratio was 24/25 with a median age of 61. Tumor was located in the head in 29 pts (59%) and in body-tail in 20 pts (41%). Median tumor diameter was 37 mm. Thirty seven pts (76%) received RFA as up front treatment while 12 pts (24%) received different associations of Ch-TR before RFA (3 pts only Ch, 7 pts Ch+RT, 2 pts Ch + RT + locoregional Ch). Palliative surgery was associated with RFA in 30 pts. Mortality occurred in 2 pts (4%). The 1- and 2-year OS was 67% and 45%, respectively, with a median survival of 20 months. The 1- and 2-year DSS was 74% and 51%, respectively, with a median survival of 28 months. In all, 34 pts had recurrence of disease and 20 of them eventually died of the disease. The 6 and 12 months PFS were 62% and 24%, respectively, with a median of 10 months. Patients who received RFA as upfront treatment (#37) had 1- and 2-year OS of 67.4% and 52.6%, respectively, with a median survival of 28 months, not significantly different for patients who underwent RFA after Ch-RT.
Conclusion: The impact on survival achieved in the present study is tempting. On this basis RFA could be considered as part of future new multimodal therapy for LAPC.

P-370

CT and MR imaging features after percutaneous radiofrequency and cryoablation of renal tumors

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Learning objectives: Physical principles and biological effects of radiofrequency and cryoablation. Standardization of the imaging follow-up protocols after renal thermal ablation. Typical imaging findings during and immediately after renal thermal ablation. Sequential changes after percutaneous renal thermal ablation. Assessment of adequate treatment and detection of residual or recurrent tumor. Major differences between post-cryoablation and post-radiofrequency ablation imaging.
Background: Percutaneous thermoablation of renal tumors is now widely accepted as a minimally invasive alternative technique for tumors less than 4 cm in poor surgical patients. Radiofrequency uses alternating current to heat tissues and induce coagulation necrosis. Cryoablation uses fast decompression of high pressure argon gas to freeze tissues, thus inducing cell-membrane disruption and microvessel thrombosis.
Clinical Findings/Procedure Details: Imaging follow-up after renal thermal ablation is based on CT and MRI. The appearance of the ablated zone may vary depending not only on the ablation technique used but also on the initial tumor size and composition. The absence of contrast enhancement and shrinkage of the ablated zone is highly suggestive of complete ablation. Residual or recurrent tumor can be detected as nodular, central or crescent shaped contrast enhancement or secondary increase in the size of the ablated zone. An atypical follow-up with imaging should be accompanied by a more intensive surveillance and targeted biopsies should be considered.
Conclusion: Radiologists should be familiar with thermal ablation techniques to recognize typical post-ablation CT and MR imaging findings. They should be aware of sequential changes and differences between post-cryoablation and post-radiofrequency ablation finding, particularly in the early phase follow-up.
Disclosure: X. Buy and A. Gangi are consultant for Galil Medical

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Hepatic chemosaturation therapy (HCT) using the percutaneous hepatic perfusion (PHP) system: procedural details and technical considerations

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Learning objectives: This exhibit will review the procedural details and technical considerations for HCT using the PHP system (Delcath Systems, Inc).
Background: Hepatic malignancies represent a leading cause of world-wide cancer-related mortality. Currently, multiple locoregional therapies are available for the treatment of these malignancies, including various embolic (e.g. chemo-, radio- and bland embolization) and ablative therapies. HCT is a novel percutaneous therapy designed to allow the delivery of high-dose chemotherapeutic agents (CTA) to the liver while simultaneously protecting extrahepatic structures from exposure. HCT using the PHP system is performed in three steps. The isolation step combines arterial seclusion of the liver with venous sequestration to functionally isolate the hepatic vasculature. The saturation step delivers high-dose CTA directly into the hepatic arterial circulation. The filtration step captures the hepatic venous outflow, and then prior to its return to the patient, it is cleansed via extracorporeal filters to remove toxic contaminants.
Clinical Findings/Procedure Details: The basic technique of HCT will be described using illustrative cases drawn from our institutional involvement in the phase III melanoma study together with the published literature. Critical technical considerations for patient safety, as well as strategies for streamlining case efficiency will also be reviewed and illustrated using selective cases.
Conclusion: HCT provides a novel technique for delivery of high dose CTA to the liver while minimizing systemic side effects. In the hands of an experienced interventional radiologist, this technique can be safely and efficiently performed. HCT is poised to become another key weapon in our arsenal for the treatment of hepatic malignancy.

P-372

Nerve injury during lung thermal ablation: anatomy review, complications, review of the literature

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Learning objectives: To describe the potential damage to nervous structures during percutaneous lung thermal ablation (radiofrequency ablation, micro-waves, cryotherapy).
Background: We review and describe all the main nervous structures of the thorax with images and corresponding CT slices. We

analyze the consequences and the complications induced by a nerve injury. We present recommendations and advices to avoid these complications.
Clinical Findings/Procedure Details: Thermal injury of nerves during thermal ablation of lung tumors has previously been reported in the literature. Reported cases of phrenic nerve injury, brachial nerve injury, stellate ganglion injury have been published recently. Other potential nerve injuries exist: recurrent nerve, vagus nerve, etc. In order to avoid nerve damage, the interventional radiologist may need to analyze the anatomy of the treated region carefully, to monitor the temperature in the anatomic area of the nervous structure to protect, and to separate the nervous structure from the ablation zone as much as possible. Thanks to an artificial pneumothorax it is possible to avoid nerve injury.
Conclusion: Nervous tissue is sensitive to heat and the degree of nerve damage depends both on the temperature level and on exposure duration. Before a thermal ablation, the interventional radiologist should be aware of the different thoracic nervous structures.

P-373

Tips and tricks for colorectal stent placement in malignant large bowel obstruction

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Learning objectives: Techniques and tips for successful fluoroscopic colorectal stent placement in the management of malignant colonic obstruction.
Background: The management of large bowel obstruction due to colonic malignancy has progressed since the introduction of stents. Self-expanding stent placement is a safe, effective procedure and can be used as a palliative measure or bridge to surgery. This presentation aims to educate the interventional radiologist regarding valuable tips and tricks leading to successful stent placement and outcome.
Clinical Findings/Procedure Details: In our institution, 60 patients have undergone fluoroscopic colorectal stent placement over a 42-month period with an 80% success rate. The complication rate was 8% including early stent migration and stent occlusion. Based on our experience, factors that influence successful deployment and outcome include: 1. multi-planar reconstruction of the pre-procedural CT scan to allow accurate identification and orientation of the stenosed lumen. This facilitates better positioning of the image intensifier to open out the lumen for effective guide wire passage. 2. Administration of pre-procedural steroids as an effective method of reducing inflammatory oedema around the stricture. 3. The use of a coaxial system to give extra stiffness to prevent catheter buckling. 4. The availability of a range of stent types for effective deployment in differing lesion morphology. 5. The recognition that annular strictures are easier to cross than polypoid lesions. If no contrast can be injected retrogradely the failure rate is high. 6. Lesions proximal to the splenic flexure may benefit from colonoscopic assistance.
Conclusion: Good pre-procedural and intra-operative planning makes fluoroscopic colorectal stent placement a successful and safe procedure.

P-374

Percutaneous prostate cryoablation under MR-guidance: technique, advantages and limitations

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Learning objectives: To describe the technique for percutaneous prostate cryoablation under MR-guidance, with step-by-step explanations and rich illustrations. To precise the advantages, drawbacks and limitations of MR-guidance, over the "traditional" US-guidance. To give some tips on how to overcome difficulties and to avoid complications.
Background: Currently, percutaneous cryoablation for localized prostate cancer is carried out under transrectal US-guidance. However, ice-ball visualization is impossible with US due to the posterior acoustic shadowing. MR-guidance has the major advantage of precise probe positioning and visualization of the ablation zone (ice-ball) as a signal void, along with capabilities of multi-planar high-resolution imaging.
Clinical Findings/Procedure Details: Probes positioning is done using the transperineal approach and a free-hand technique under real-time TRUFI imaging. High-resolution T2 BLADE imaging, in at least two planes, is performed for verification of the proper position. A urethra double-lumen warming-catheter and a similar home-made rectal warming-balloon are used for protection of the urethra mucosa and rectal wall from thermal damage, respectively. Fiberoptic temperature sensors or non-invasive MR-temperature mapping are used for temperature monitoring. Real-time and high-resolution BLADE multi-planar imaging is used for ice-ball monitoring. Two 10-min freezing cycles, separated by a 10-min passive thawing cycle, are performed systematically.
Conclusion: MR-guided percutaneous prostate cryoablation is feasible and promising, with excellent monitoring of the ice-ball covering the gland. However, the free-hand probe positioning can be difficult and time-consuming. Further advances applied (use of a template and image fusion, as used in brachytherapy) can make the procedure easier and reproducible.

P-375

Insulation and temperature monitoring during tumor thermal ablation: state of the art

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Learning objectives: To describe the different techniques for thermal insulation during the thermal ablation procedures. To precise the best indications of each technique with rich illustrations, and to point out the significance of temperature monitoring.
Background: Percutaneous image-guided thermal ablation techniques are widely used for therapeutic or palliative treatment of tumors (benign and malignant). Common areas treated include: kidney, liver, adrenal, and musculoskeletal tumors. The above procedures are relatively safe. One of the most common complications is the unintended thermal damage to nearby structures (i.e. GI-tract, neural structures). Sufficient coverage of the lesion along with thermal protection of the "organs-at-risk" is mandatory.
Clinical Findings/Procedure Details: Different techniques of insulation can be used. Hydro-dissection offers thermal insulation and can also cool-down or warm-up tissue. Saline is not suitable for radiofrequency-ablation and D/W 5% should be advocated.

Gas-dissection creates an excellent insulation blanket by displacing the organs-at-danger away from the ablation zone, with minimal cooling or warming effect. Balloon-interposition can be used in specific cases. Electrode "torquing" (used with multi-tined expandable-electrodes and cryoprobes) can displace the ablated organ and add further safety distance. Temperature monitoring can be done with thermocouples or fiberoptic temperature sensors. MRI offers the possibility of non-invasive temperature monitoring.
Conclusion: Several thermal insulation and temperature monitoring techniques have been advocated in order to protect the "organs at-risk". The above techniques can be applied alone or in combination. Familiarity with the possible thermal insulation and temperature monitoring techniques is essential in order to avoid major complications and to increase the indications.

P-376

Transpulmonary radiofrequency ablation of hepatocellular carcinoma contiguous to the heart

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A 71-year-old woman with a 2.2-cm hepatocellular carcinoma contiguous to the right atrium underwent CT fluoroscopy-guided transpulmonary radiofrequency ablation safely 7 days after transcatheter arterial chemoembolization, though pneumothorax occurred. There is no evidence of tumor progression 12 months after treatment.

P-377

Have you ever seen HCC with a shunt fraction of 50%?

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A 62-year-old male presented with cirrhosis and 6 cm HCC; hepatic arteriography found intense tumor vascularity, opacification of portal vein, hepatofugal flow to varices; Tc99m MAA study demonstrated shunt fraction 50%; not eligible for Y-90-options?

P-378

A long-term survival of a patient with intrahepatic cholangiocarcinoma treated with repetitive superselective transarterial chemoembolization: a case report

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A 59-year-old woman with unresectable intrahepatic cholangiocarcinoma, who refused to continue chemotherapy, underwent 10 superselective transarterial chemoembolization sessions, 3 biliary stenting procedures and 3 biliary drainages. The patient survived for 48 months and had a good quality of life.

P-379

Hepatocellular carcinoma (HCC) with tumor thrombus in the right branch of portal vein treated with transarterial chemoembolization using drug-eluting beads (DEB-TACE): 2-year follow-up

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A male patient with cirrhosis and HCC in the right liver lobe invading the right branch of portal vein underwent single DEB-TACE. Follow-up examinations during 2 years demonstrated complete tumor response.

P-380

Transarterial chemoembolization (TACE) for carcinoid liver metastases via dorsal pancreatic artery

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Common hepatic artery occlusion developed after TACE performed for single carcinoid liver metastasis. Disease progression was detected after 5 years of follow-up. Second TACE with drug-eluting beads was carried out via unusual collateral vessel - dorsal pancreatic artery.

P-381

Multiple bilateral neck paragangliomas treated with transarterial embolization using PVA microspheres

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A male patient with bilateral carotid body tumors and vagal paragangliomas underwent two embolizations. Surgery was not performed; after one year follow-up, computed tomography demonstrated considerable decrease in the tumors' size and vascularization.

P-382

Computed tomography-guided percutaneous splanchnic neurolysis for pancreatic cancer pain treatment

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Bilateral transdiscal computed tomography-guided splanchnic neurolysis performed to patient with pancreatic cancer T4N1M0 using 20 ml 10% phenol water solution. After two weeks, additional right unilateral retrocrural neurolysis was performed with 15 ml 95% alcohol. Pain relieved for lifetime.

P-383

Covered bronchial stent insertion to manage airway obstruction with hemoptysis caused by lung cancer

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Six covered bronchial stents were placed in 4 patients with hemoptysis and airway obstruction by lung cancer. Stop bleeding and improvement of respiratory distress were seen in all patients. Migration with granulation tissue and mucous retention occurred in 2 patients.

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Improvement of quality of life using metallic stents in three different stenosis of recurrence in colon cancer

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We placed metallic stents in duodenum, biliary duct and rectum for a patient with recurrence of colon cancer. His quality of life was remarkably improved and he survived over a year by those therapies.

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HCC, endovascular treatment of pathological shunt between the V. portae and A. hepaticae

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HCC and local infiltration of V. portae. Pathological shunt between V. portae and A. hepaticae. 2 ways of approaching percutaneous approach to V. portae and radial approach to A. hepaticae. Stenting V. portae and embolisation of A. hepaticae.

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A case of transcatheter portal chemoembolization during portal vein occlusion for unresectable hepatocellular carcinoma with marked arterioportal shunts

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For unresectable hepatocellular carcinoma with marked arterioportal shunts and fed by cystic artery, we injected anti-cancer drug from the origin of the portal vein branch with arterioportal shunt and confirmed a dense accumulation of Lipiodol in the tumor.

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Unexpected complication in a patient submitted to pulmonary radiofrequency ablation

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We present an uncommon and unexpected complication in a patient submitted to pulmonary radiofrequency ablation 1 month before. The patient developed broncho-pleural fistula resulting in hypertensive pneumothorax, massive subcutaneous emphysema and pneumomediastinum.

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The use of balloon-occluded percutaneous radio-frequency thermal ablation (RFA) plus transcatheter arterial chemoembolization (TACE) for management of hepatocellular carcinoma with hepatic arteriovenous fistulae: a technical innovation

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We describe the case of two patients with multinodular unresectable HCC excluded from TACE procedure due to an arteriovenous shunt, successfully treated using a combined single-step therapy with balloon-occluded RFA followed by TACE, without any complications.

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TIPSS occlusion as modified Pringle maneuver for juxta-TIPSS tumor ablation

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TIPSS can act as a heat-sink during tumor ablation, especially if the tumor is in close vicinity with the TIPSS. We describe the technique of the use of temporary occlusion balloon in closing down this heat-sink during tumor ablation.

Peripheral vascular disease intervention

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Initial experience with Angioseal™: safety and efficacy of the endovascular closure device

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Purpose: Vascular access site management is crucial to safe, efficient and comfortable diagnostic or interventional percutaneous procedures. The Angioseal vascular closure device has been shown to be safe and effective in reducing the time to haemostasis following angiographic or interventional procedures. Relatively few studies have been conducted in the UK to assess the safety and efficacy of the device in a local setting.
Material and Methods: Data were retrospectively reviewed on 147 patients who underwent either diagnostic angiography or

percutaneous interventional procedures from January 2008 to October 2009, who had the femoral access site closed by 6F VIP Angioseal. A total of 147 patients (F: 49, M: 98), including 80 right femoral punctures, 57 left femoral punctures and 10 bilateral punctures were reviewed using radiological reports and patients clinical data. All procedures were carried out by 2 interventional radiologists at a single institution, under similar operating conditions.
Results: There were a total of 6 complications (4.47%), of which 1 was a major complication (0.75%) - retroperitoneal bleed. There were 5 minor complications (3.73%), which included device deployment failure (2), device malfunction (2) and a superficial haematoma (>6cm). Total complications were 6 out of 157 (3.8%) (95% CI {0.8%-6.8%}). Successful haemostasis was achieved in under 5 minutes in over 97% of patients. Successful device deployment was seen in over 98% of cases.
Conclusion: We conclude that in our experience, the Angioseal vascular closure device is a safe and efficient means of achieving haemostasis post-antegrade/retrograde puncture for diagnostic and percutaneous intervention procedures.

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Analyzing clinical and cost effectiveness of endovascular treatment in patients with critical ischemia of crural arteries in a tertiary university hospital from 2005 to 2010

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Purpose: Studies reporting efficacy of endovascular therapy are characterized by heterogeneous definition of endpoints. As a result, in particular, for crural arteries only poor information regarding functional patient outcome is available. Also, data analyzing treatment costs in those patients are rare. We report our results from a tertiary university hospital in Munich/Germany.
Material and Methods: A retrospective analysis of all patients who underwent infrapopliteal angioplasty for critical limb ischemia (CLI) from 2005 to 2010 was performed. Clinical, procedural and hemodynamic outcome was analyzed. The primary end point was limb salvage. Secondary end points were technical success, improvement according to Rutherford, ulcer healing, overall survival, recurrence and complications. In addition, material consumption and costs were reviewed.
Results: In 191 patients (mean age 64,7yrs; 70,7% males) 486 percutaneous endovascular interventions (PEI) were performed. Single vessel run-off to the foot was present in 120 (62,8%) patients and complete occlusion of all crural vessels in 42 (22,0%) at initial presentation. The mean follow-up was 6,5 months, 17 patients were lost during follow-up. Technical success rate was 81,1% (394/486 interventions) and limb salvage could be achieved in 71,7% (123/174 patients). A high recurrence rate was especially found in diabetic patients. The mortality rate was 5,2% and major complications occurred in 7.3%. Average total cost/patient/intervention was 1118,02 ± 309,42 € and 2381,76 ± 518,41 € for the total length-of-stay in hospital.
Conclusion: PEI is a valuable option particularly in multimorbid patients in which the use of bypass surgery is limited and who otherwise might face amputation. Taking into account a longer hospitalization and higher periprocedural complication rates in patients undergoing surgery, PEI is economically advantageous.

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Primary PTFE-covered stenting for focal infrarenal aortic stenosis; midterm results

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Purpose: This study evaluates the feasibility, safety and midterm success of primary PTFE-covered stenting in isolated atherosclerotic lesions of the infrarenal aorta.
Material and Methods: Between November 2008 and July 2010, 10 patients, aged 59 (42-78) years, with disabling claudication (n=9) or rest pain (n=1) underwent primary stenting of isolated stenoses (n=9) or occlusions (n=1) using an Advanta V12 balloon expandable PTFE-covered stent (Atrium Medical Corporation, Hudson, USA). Clinical examinations, plain abdominal radiography and duplex ultrasonography were used to evaluate the stents' patency and clinical success.
Results: Nine procedures were performed percutaneously and one in combination with an endarterectomy of the right common femoral artery. Technical success was achieved in all patients. After the procedure all patients were asymptomatic. The mean ankle-brachial index increased with 0.25 to 1.02 on average. Complications included a conservatively treated access hematoma and a puncture-related femoral nerve neuropathy. After a median follow-up of 20 (8-28) months all patients were free of intermittent claudication. Duplex ultrasonography showed no instent stenoses and plain abdominal radiographs showed no stent migration or fractures.
Conclusion: The use of PTFE covered stents is a feasible, effective and safe treatment for symptomatic infrarenal aortic stenoses in patients with arterial occlusive disease after a mean follow-up of 20 months.

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Excimer laser atherectomy after unsuccessful PTA recanalisation attempt of TASC C and D lesions in femoropopliteal arteries

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Purpose: The study objective was to examine the application of excimer laser atherectomy (ELA) in patients with refractory occlusions in femoropopliteal arteries, where previous conventional recanalisation attempts, using percutaneous transluminal angioplasty (PTA), were unsuccessful.
Material and Methods: The average age of the 40 patients (32 men, 8 women) included in this study was 65.4 years. The average occlusion length was 17.5 cm (range: 12-25 cm). The initial recanalisation attempts were performed with stiff Terumo guidewires (curved or straight) supported by various catheters (straight/multipurpose/ Cobra). After the unsuccessful attempt, an excimer laser catheter (catheter diameters from 1.7 – 2.5mm) was used for recanalisation using the step-by-step method of crossing. After successful crossing, balloon dilatation was performed in all cases. Stent implant was required in 10% (4/40) of procedures. Patients were followed for 12 months with CCDS.
Results: The initial technical success rate of 90% (36/40) resulted in primary, primary-assisted and secondary-assisted patency rates of 58.9%, 67.8% and 83.2%, respectively, after 12 months. No serious complications occurred that were attributable to the intervention.
Conclusion: According to these results, ELA recanalisation provides

a low stent rate alternative to surgical procedures for refractory occlusions. This would offer patients, with increased operative risks, a promising and low-risk therapeutic procedure. The option of a subsequent vascular operation would not be compromised.

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Endovascular repair of branch-artery involved aneurysm with multi-layer bare stents

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Purpose: To summarize the preliminary experience of endovascular therapy for branch-artery involved aneurysm using multi-layer bare stents.
Material and Methods: We began to use multi-layer bare stents for endovascular therapy of branch-artery involved aneurysm from October of 2008. Herein, we reviewed our cohort for the intra-operative outcome and the follow-up results. Location of the aneurysm and bare stents number and characteristics were analyzed.
Results: From October 2008 to December 2010, we had 24 cases treated with multi-layer bare stents. Our cohort included 3 cases of subclavian artery aneurysm, 3 cases of iliac artery aneurysm, 5 cases of superior mesenteric artery (SMA) aneurysm, 3 cases of renal artery aneurysm, 2 cases of thoracoabdominal aortic aneurysm, 8 cases of thoracic aortic dissection aneurysm. The average number of bare stents per case was 3, coils were occasionally used in some cases. Only a few cases achieved intra-operative total exclusion of the aneurysm along with preservation of branch-artery blood flow. But during follow-up, most cases had complete exclusion of the aneurysm and patency of the branch-artery with 3-6 months.
Conclusion: Our preliminary experience demonstrated that multi-layer bare stents for endovascular repair of branch-artery involved aneurysm is a new choice, the intra-operative and short-term outcomes proved encouraging. But the mechanism and long-term results remain unknown.

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Current trends in heparin use in vascular intervention

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WITHDRAWN

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Initial experience with a new self-expanding, helical nitinol stent for endovascular treatment of the popliteal artery in patients with chronic critical limb ischemia

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Purpose: To evaluate the safety and efficacy of a new, helical nitinol stent with high radial force and increased flexibility for the treatment of the popliteal artery in patients with chronic critical limb ischemia.
Material and Methods: Between 3/2009 and 1/2011 35 patients with Rutherford category 4–5 disease (20 men, 15 women, mean age 76y) underwent percutaneous transluminal angioplasty (PTA) and stent implantation (SUPERA®, IDEV, JS Beuningen, Netherlands) into the bending segments of the popliteal artery. Indications for stent placement were bailout situations: residual stenosis, flow-limiting dissections, or elastic recoil after PTA. All patients were considered poor candidates for bypass surgery. Before and after intervention and during 6-month follow-up, clinical investigation, colour-flow and duplex Doppler ultrasonography, and digital subtraction angiography were performed. Mean follow-up was 164d (range, 1-620d). Technical success, primary patency at 6 months, clinical improvement as defined by Rutherford with clinical and hemodynamic measurement and complications were evaluated.
Results: Stent implantation was successfully performed in all patients. After stent placement, the primary cumulative patency rate for the study group at 6 months was 78%. The mean resting ankle-brachial index at baseline was 0.35 and significantly increased to 0.90 at latest follow-up ($P<0.01$). Sustained clinical improvement rate was 80% at 6-month follow-up. The 6-month limb salvage rate regarding major amputation was 97%. The rate of major complications was 9%.
Conclusion: Implantation of the new helical nitinol stent into the bending segments of the popliteal artery in patients with chronic critical limb ischemia is a safe, feasible, and effective method with good short-term patency.

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3-year results after atherectomy of heavily calcified stenotic lesions of the lower limb

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Purpose: To investigate the 3-year outcome of patients with peripheral occlusive disease (POD) and calcified stenotic lesions of the lower limb after atherectomy.
Material and Methods: Patients suffering from POD (Rutherford 3 to 6) were treated with the Silverhawk atherectomy device (ev3 Endovascular, MN, USA) if calcified lesions in the superficial femoral artery and/or the popliteal artery were present. Overall, 42 lesions of 38 consecutive patients (mean age: 70±8) were included into this prospective study. Patients were followed up 36 months (every 6 months) for clinical re-evaluation including measurement of the maximum walking distance and ankle brachial index (ABI) and to perform duplex-sonography.
Results: The primary technical success rate was 88%. In five cases additional PTA and/or stenting was necessary. Procedure-related embolizations were seen in 3 cases, which were successfully treated by aspiration. Primary patency rate was 68% after three years. The mean Rutherford score decreased significantly from 4.11 to 0.6 ($p < 0.001$), while the mean ABI increased from 0.67 to 0,86 after 36 months, respectively. Ten out of eleven patients with crural ulcera demonstrated complete wound healing.
Conclusion: In this subgroup of patients with POD and calcified stenotic lesions, atherectomy was successfully applied to reduce the plaque burden. Results after 3 years revealed a significant reduction of the Rutherford score and an improvement of the ABI with a reasonable patency rate.

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Development and assessment of a procedure-specific checklist for superficial femoral artery angioplasty using an endovascular simulator

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WITHDRAWN

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Efficacy of iliac artery stent placement for claudicators having both iliac and superficial femoral artery lesions

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Purpose: To evaluate outcome of treatment strategy for intermittent claudicants having both iliac and superficial femoral artery (SFA) lesions with stent placement for iliac artery occlusive disease to improve inflow.
Material and Methods: Primary stent placement for iliac artery occlusive disease has been performed for 74 claudicants with 94 limbs having both iliac and SFA occlusive disease. Treatment for SFA lesions was not performed concomitantly. Mean age of the patients was 73 years. Rutherford classification was 2 in 20 limbs, and 3 in 74 limbs. Median duration of follow-up was 40 months (1-100 months). We evaluate the initial clinical improvement rate and continued clinical improvement rate in long-term follow-up retrospectively.
Results: Initial technical success rate and initial clinical improvement rate of the iliac stent placement was 100% and 87%, respectively. Continued clinical improvement rate at 7 years was 64%. Dividing the SFA lesions to Trans-Atlantic Inter-Society Consensus (TASC)-II A/B group (n=49) and TASC-II C/D group (n=45), continued clinical improvement rate at 7 years in the TASC-II A/B group (75%) was significantly higher compared with TASC-II C/D group (54%; p=0.02, Log-rank test).
Conclusion: Initial improvement of intermittent claudication was obtained in most of cases after revascularization of inflow vessels. Moreover, continued improvement rate was relatively high in TASC-II A/B SFA lesions, treatment strategy with iliac artery stenting in patients with both iliac artery and SFA lesions, especially TASC-II A/B lesions, is acceptable. However, aggressive follow-up and additional revascularization for SFA lesions may be required for patients with TASC-II C/D SFA lesions.

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Cool excimer laser-assisted angioplasty (CELA) vs tibial balloon angioplasty (TBA) in management of infragenicular tibial arterial occlusion in critical lower limb ischaemia (CLI) TASC DE. A pivotal observational analogy congregate proportional analysis over 48 months "six L trial"

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Purpose: The primary endpoints are sustained clinical improvement. Secondary endpoints are binary restenosis, target lesion revascularisation (TLR), target extremity revascularisation (TER), all-cause survival and survival free from major adverse events (MAE).
Material and Methods: From June05 - December08, 1406 patients were referred with PVD, 372 had CLI. 56 patients underwent 65 EvRs for tibial TASC D^E; 35 using TBA and 30 using CELA. All patients were Rutherford Category 4-6.
Results: Technical success was 80% for CELA vs 74% for TBA (p=0.278). Improvement to Rutherford category ≤3 occurred in 80% of CELA vs 66% of TBA (p=0.048) with hemodynamic success in 90% of CELA vs 71% of TBA (p=0.041). At four years the rate of sustained clinical improvement was enhanced with CELA (73.3%) compared to TBA (65.7%) (P=0.409). 4-year freedom from TLR was significantly augmented with CELA (93.3%) in comparison to TBA (65.7%). (P=0.0053). At four years, freedom from binary restenosis was substantially improved with CELA (76.6%) when compared with TBA (54.2%) (P=0.0699). Four-year freedom from TER remained superior with CELA (90% vs. 80%, P=0.256). 4-year freedom from MAE was significantly more likely with CELA. (P=0.02). CELA patients had a substantial improvement in quality of life at 4 years with a Q-TWiST of 9.72 months (P=0.078). CELA an incremental cost effectiveness ratio of €7,209.27 per QALY gained.
Conclusion: Tibial EvR bestows exceptional outcome in CLI TASC D^E. CELA has superior freedom from binary restenosis, freedom from TLR and survival free from MAE, with improved Q-TWiST better QALY and cost-effectiveness.

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Paclitaxel-eluting balloon angioplasty of infrapopliteal arteries: one-year results in a prospective patient cohort

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Purpose: To evaluate the safety, efficacy and clinical outcome of infrapopliteal drug-eluting balloon PTA in patients with peripheral arterial disease (PAD).
Material and Methods: Between September 2009 and February 2011 all patients presenting with infrapopliteal artery disease (PAD) Fontaine 4 underwent CTA or MRA of the abdominal aorta and lower limbs. All patients had ankle-brachial pressure indices (ABPI) below 0.6. Patients with suggested stenotic disease at imaging underwent DSA and paclitaxel-eluting balloon angioplasty (PEPTA) of infrapopliteal arteries. All patients underwent clinical follow-up at 3, 6 and 12, and MRA or CTA at 12 months. Technical success, primary and assisted patency rates (re-intervention in patients with clinical deterioration and restenoses), technical and clinical complications and clinical outcome were assessed.
Results: Thirty-nine patients were included and received 45 PEPTAs of the preipheral runoff. Two received additional nitinol stents for primary technical PEPTA failure. There were no clinical complications. The ABPIs were enhanced significantly (mean 0.35+-0.18 to 0.71+-0.23, p<0.001). The clinical CAD stadium was improved from Fontaine 4 to 3 or the ulcus size was decreased (22 and 15 patients, respectively). Patency was satisfactory (7 months and 11 months for primary and assisted patencies, respectively).
Conclusion: Infrapopliteal paclitaxel-eluting balloon PTA appears safe and effective with excellent mid-term patency and clinical results. Valid comparison to plain balloon angioplasty will require prospective randomized trials.

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The validity of endovascular treatment for chronic total occlusion of unilateral iliac artery in TASC type D

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Purpose: TASC II classifies chronic total occlusion (CTO) of unilateral iliac artery into three types i.e. B, C and D, and recommends endovascular treatment in localised occlusion of the common iliac artery (CIA) or external iliac artery (EIA) for type B and surgery in long-segment occlusion of both CIA and EIA for type D. However, clinically, type D includes cases with effective endovascular treatment. In this retrospective study, we compared the results of endovascular treatment for CTO of unilateral iliac artery in type B and D, and confirmed its validity for type D.
Material and Methods: A total of 105 patients underwent endovascular treatment for CTO of unilateral iliac artery between August 2000 and December 2010, with 75 type B patients and 30 type D patients. The criteria were: (1) initial success rates, (2) technique: 1. procedure time, 2. time required to pass the guide wire, 3. the amount of contrast agent used, (3) cumulative patency rates (5 years): 1. primary patency rates, 2. secondary patency rates, and (4) complication rates. As a statistical study, we used the chi-square test for (1) and (4), the student t test for (2) and the Kaplan–Meier method for (3), with $p < 0.05$ as a significant difference.
Results: (1) B: 89.3%, D: 86.7% (p=0.926), (2) 1.B: 97.9±47.8 min, D: 134.8±56.6 min, (p<0.05), 2.B: 31.1±29.7 min, D: 47.1±40.1 min, (p<0.05), 3.B: 159.5±86.6 ml, D: 193.4±101.5 ml (p=0.07), (3) 1.B: 92.8%, D: 84.0% (p=0.311), 2.B: 96.0%, D: 95.0% (p=0.997), (4) B: 2.7%, D: 6.7% (p=0.626).
Conclusion: No significant difference was observed in the initial success rates, patency rates and complication rates; therefore, endovascular treatment can be performed for CTO of unilateral iliac artery corresponding to type D.

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Endovascular treatment of iliac artery aneurysms

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Purpose: To evaluate the efficacy of endovascular treatment for the treatment of iliac artery aneurysms (IAAs).
Material and Methods: Between 2007 and 2010, 17 patients (14 men 3 women: age range 61 to 84 years, mean age 76.4) underwent endovascular treatments of 19 IAAs including 16 common iliac artery aneurysms (CIAAs) and 3 isolated internal iliac aneurysms (IIAAs). CIAAs include 4 aortoiliac aneurysms, 7 isolated CIAAs, and 5 residual iliac aneurysms after Y-grafting for abdominal aortic aneurysm. One IIAA had bled prior to treatment. Depending on the local anatomy of the IAA and the common iliac bifurcation, the IAA was treated by coil embolization and/or endovascular stent-graft. We evaluated the techniques, angiographical occlusion rate, complications, shrinkage of aneurysm, and clinical outcomes.
Results: Eleven CIAAs and one IIAA were treated by endovascular stent grafting with coil embolization of internal iliac artery. Two IIAAs and 5 post Y-grafting CIAAs were treated by endovascular trapping with coils and endosaccular packing with coils or N-butyl 2-cyanoacrylate. Complete exclusion of the IAA immediately after treatment was achieved in all patients (100%). There were no periprocedural deaths and major complications. Follow-up CT showed shrinkage of IAA in 18 of 19 IAAs (94.7%).
Conclusion: The endovascular treatment using several techniques is a safe and effective way to treat IAAs.

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Percutaneous approach to severe ischemic hand disease: technical aspect and results

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Purpose: Ischemic disease of hands is a rare pathology, with the exception of post-traumatic occlusions. We report our experience with endovascular approach focusing on technical aspects and results.
Material and Methods: In a single-center retrospective clinical analysis, from January 2008 to October 2010, we collected 12 patients with critical hand ischemia (9 males and 3 females). All patients were symptomatic for pain and 4 patients present ulcers to distal fingers. 1 patient had a severe stenosis of the brachial artery. All patients were treated by an antegrade omeral puncture. In 6 patients an antegrade approach was successful. In 3 patients a combined antegrade and retrograde radial to ulnar and in 1 patient ulnar to radial approach was performed passing through the palmar arch.
Results: Successful recanalization was obtained in 11 patients (91.6%). Symptomatic improvement was obtained in 10 patients (83%). A resolution of ulcers was obtained in 10 patients (83%). In 2 patients a distal phalanx amputation was necessary. Mean TcPO2 increased from a basal mean value of 6,3 mmHg to 54,6 mmHg.
Conclusion: In selected cases percutaneous angioplasty may be considered the best approach to treat hand ischemia.

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Intraluminal recanalization of long infrainguinal chronic total occlusions using the Crosser system

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Purpose: To assess the safety and efficacy of a device for vibrational angioplasty in the percutaneous intraluminal recanalization of long infrainguinal chronic total occlusions (CTO).
Material and Methods: The Crosser CTO Recanalization System is a mechanical recanalization device that uses high-frequency vibrational energy to disrupt and channel through fibrocalcific plaque without harming the vessel wall, thus assisting in the recanalization of an occluded artery. In 32 diabetic patients (22 men; median age 71 years, range 58-80) with critical limb ischemia owing to long (median length 26 cm, range 21-32) infrainguinal CTOs resistant to conventional guidewire techniques.
Results: The Crosser CTO Recanalization System was successful in intraluminally crossing the occlusion in 24 (75%) patients in <5 minutes (mean 4:03 minutes). The safety endpoint (distal lumen guidewire position with no vessel perforation or dissection) was achieved in all successful cases.
Conclusion: In our preliminary experience, the Crosser CTO Recanalization Catheter decreased crossing time, was safe, and achieved a high rate of intraluminal recanalization of long infrainguinal CTOs.

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Iatrogenic complications of peripheral vascular interventions: a pictorial review

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Learning objectives: 1. To recognise important intra- and post-procedural complications arising from peripheral endovascular interventions. 2. To recognise risk factors for complications, and how to avoid them. 3. To understand management techniques.
Background: Patients with peripheral vascular disease are often elderly with multiple co-morbidities and frequently present with acute medical conditions, such as critical limb ischaemia, requiring urgent interventions. Further, they often suffer from extensively diseased vessels, may be suboptimally cooperative with the procedure, and may have altered vascular anatomy from prior surgery or interventions. This combination understandably places them at increased risk for procedural complications. Recognising and managing these problems at an early stage is very important for a good outcome.
Clinical Findings/Procedure Details: We reviewed case records of our peripheral intervention cases over the last 5 years, and selected examples of important complications that the interventionist should be familiar with. These include access site complications, perforation, distal embolization, pseudoaneurysm, traumatic arterio-venous fistulas and dissections. We discuss the relevant imaging features of these conditions, and outline our management. We hope the reader will be able to benefit from these lessons learnt in hindsight.
Conclusion: Complications arising from peripheral interventions are sometimes unavoidable, but early recognition and appropriate management is important to mitigate adverse effects. In this pictorial review, we aim to share our experience and learning points.

P-407

When and where to stop? Real-time microcirculation monitoring during BTK interventions as a potential new option for feedback

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Learning objectives: To find a real time, functional, easy-to-use method for monitoring and guiding BTK interventions, it should be mandatory to optimise our procedures (cost, time, overmanipulation). Real-time PO2 monitoring on the foot is not fast enough for guiding of revascularisation procedures. Real time, no-contact, microcirculation monitoring by LASCA (LAser Speckle Contrast Analysis) with no disposable or single-use-only elements is a potential optimal method for functional guidance.
Background: During the last decade, we have learnt to move and manipulate in the BTK region. Although we are ready to decrease the number of major amputations due to CLI but we have no data about the macro-economical cost/benefit value of our BTK interventions. Our time-consuming and very expensive procedures are guided only by non-functional, angiographic feedback.
Clinical Findings/Procedure Details: Since 10.2010 to 01.2011 we performed real-time microcirculation monitoring with PERICAM system in 24 consecutive BTK interventional procedures. We have found significant difference in 17 cases between the angiographic result and the mincrocirculatory changes after the procedure. Of 13 cases with multisteps manipulation followed by good morphological results we had significant worsening of foot-microcirculation, probably caused by microembolism not visible on angio. In seven cases where the procedure was guided by the microcirculatory parameters were 30 minutes shorter and were followed by full clinical restoring.
Conclusion: PERICAM system seems to be a doctor-friendly functional potential guiding system for optimization of BTK intervention. We suggest to perform further examinations and scientific studies to prove the value of real time no contact microcirculation examinations to use side by side with angio.

P-408

Advanced below-the-knee revascularization techniques

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Learning objectives: To illustrate advanced below-the-knee (BTK) recanalization techniques.
Background: In the last years, percutaneous transluminal angioplasty (PTA) has emerged as an important therapeutic option in patients with critical limb ischemia (CLI) due to below-the-knee (BTK) atherosclerotic disease. In this context, however, standard antegrade revascularization technique is often inadequate to treat long or calcified occlusions, and high procedural failure rates are reported in literature. Recently, new advanced techniques, such as subintimal arterial flossing with antegrade-retrograde intervention (SFARI), trans-collateral, pedal-plantar loop and pedal or distal tibial retrograde puncture techniques have been developed, together with dedicated guidewires, balloon catheters and atherectomy devices, to improve the procedural success of BTK angioplasty.
Clinical Findings/Procedure Details: A comprehensive guide to advanced recanalization strategies is illustrated, through examples of challenging BTK revascularization procedures, focusing on the rationale for the selection of the most effective strategy.
Conclusion: In our experience, the selection of the most appropriate advanced recanalization strategy may be useful in complex BTK procedures to obtain an improvement of technical success, especially when antegrade revascularization from the femoral route is considered unfeasible or fails.

P-409

A guide to the recanalization of foot arteries: from angiographic anatomy to the angiosome concept

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Learning objectives: To understand the anatomical and functional aspects of pedal circulation, and the role of angiographic imaging in planning and performing recanalization of distal tibial and foot arteries.
Background: Infra-genicular atherosclerotic disease is the most common cause of critical limb ischemia (CLI), a condition manifested by rest pain, nonhealing ulcers and gangrene. In literature, recent data suggest that obtaining direct blood flow to the area of the ischemic lesions, usually located in the foot and toes of the affected limb, is an effective therapeutic option to heal the wounds and avoid major amputations. In recent years, with the introduction of new techniques and dedicated materials, the endovascular recanalization of pedal arteries has become a technically feasible procedure.
Clinical Findings/Procedure Details: The purpose of this poster is to illustrate: 1. the technical aspects regarding angiographic imaging of the foot. 2. the angiographic anatomy of the pedal arteries. 3. the angiosome theory, to correlate the anatomy with the functional aspect of foot circulation. Finally, examples of pedal artery

recanalization, performed to restore direct blood flow to the area of the ischemic wound, are provided with special attention to advanced recanalization techniques.
Conclusion: Knowledge of the angiosome theory that combines the anatomical with the functional aspects of pedal circulation is fundamental to perform an effective revascularization strategy in the below-the-knee district and obtain the best clinical result from the intervention.

P-410

UltraSound (US)-guided angio-seal deployment in antegrade femoral arterial access: technical aspects and tips and tricks

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Learning objectives: To learn how to deploy safely the angio-seal vascular closure device (St. Jude Medical Inc., MN, USA) in antegrade femoral artery puncture, using US-guided technique for arterial puncture and angio-seal deployment.
Background: Vascular closure devices offer the advantages of immediate hemostasis, even despite intense antithrombotic regimens, less consumption of hospital staff time, early ambulation and hospital discharge. In our institution, a mean of 900 vascular closure devices are annually deployed in antegrade femoral accesses. In this context, to avoid the most serious potential device-related complications, such as acute arterial occlusion secondary to the entrapment of the anchor and intraarterial deployment of the collagen plug, or ineffective hemostasis with hematoma and pseudoaneurysm formation, angio-seal devices are deployed under US guidance. To be sure of the correct placement the puncture site is routinely evaluated using US and Doppler immediately after the deployment.
Clinical Findings/Procedure Details: The purpose of this poster is to illustrate: 1. the US vessel evaluation and the identification of the correct puncture site. 2. The US-guided angio-seal deployment. 3. Examples of challenging deployments. 4. Endovascular treatment of acute femoral arterial occlusion secondary to entrapment of the anchor and intraarterial deployment of the collagen plug.
Conclusion: In our experience, the use of US-guided technique permits a safe angio-seal deployment, even in the most challenging antegrade accesses.

P-411

Retrieval of a misplaced 13F-dialysis-catheter from the subclavian artery using an undersized 8F-closure-device (AngioSeal) with endovascular balloon-fixation of the anchor

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A combined use of an undersized collagen-based vascular closure system with an anchor (AngioSeal 8F) is described with the use of an endovascular balloon fixation of the anchor for the safe removal of a large dialysis catheter (13F) from the subclavian artery.

P-412

A new vascular access: transgluteal hypogastric artery aneurysm embolization

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An 80-year-old male with a left hypogastric artery aneurysm that kept growing after treatment with an endograft and coils. As the stent graft blocked the natural entry path, a superior gluteal artery access was performed.

P-413

Percutaneous removal of a displaced angioseal

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During emergency re-intervention of a patient with cardiac disease, a previously placed angioseal footplate became dislodged, embolising to the CFA bifurcation. This was successfully retrieved percutaneously using a gooseneck snare, introduced across the bifurcation.

P-414

Endovascular stent-graft treatment of a traumatic posterior tibial artery pseudoaneurysm

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Post-traumatic posterior tibial artery pseudoaneurysm in a young man was treated by endovascular approach using a stentgraft. Due to the small caliber of the vessel, a coronary stentgraft was implanted. Contrast-enhanced US follow-up confirmed arterial patency and the pseudoaneurysm exclusion.

P-415

Symptomatic stenosis of a Lusoria artery: endovascular treatment with the stenting

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The authors describe a case of the right digital ischemia due to microembolization from the stenosis of the Lusoria artery. Diagnosis was made by CT angiography and the lesion was successfully treated with angioplasty and stent implantation.

P-416

Interventional treatment of cystic adventitial disease

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We report two cases of cystic adventitial disease treated with balloon angioplasty of popliteal artery and percutaneous ethanol injection in external iliac venous wall after failure of surgical treatment in both cases. There are long-term follow-up results, too.

P-417

Aorto-caval fistula formation due to use of the outback re-entry catheter

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A case of retrograde subintimal iliac angioplasty/stent, resulting in an aorto-caval fistula, due to use of the outback re-entry catheter. The patient was managed conservatively without further complication. We recommend the re-entry wire position be clearly determined before further intervention.

P-418

Transbrachial recanalisation of an occluded brachiocephalic trunk

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Transbrachial revascularisation of the brachiocaphalic trunk may be a therapeutic option in symptomatically occluded BCT and left CCA.

P-419

Accidental BTK glubran embolization successfully resolved with a carotid filter device

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We treated a 5-cm isolated right hypogastric artery aneurysm with Glubran™ embolization. Unfortunately some glue beads overflowed the hypogastric artery and caused BTK embolization. We advanced a Filter Wire™ carotid filter device and could retrieve the glue.

Radiation safety

P-420

A review of the clinical outcomes of implementing optimized radiation dose techniques for temporomandibular joint (TMJ) treatments utilizing C-arm CT

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Purpose: The development of C-arm cone-beam CT (C-arm CT) has remarkably improved anatomic visualization capabilities for interventional radiology (IR) procedures. We previously reported our progress in optimizing TMJ treatments utilizing C-arm CT, based on measurements of anthropomorphic phantoms. This study is a review of the clinical outcomes of the implementation of the phantom-predicted techniques.
Material and Methods: The IR staff members use optimized TMJ C-arm CT techniques (short rotation time, low receptor dose) which were custom-programmed on to the imaging console. C-arm CT automatically determines and inserts the proper thickness of the copper filtration (Cu) based on patient attenuation during live C-arm CT rotations. We retrospectively reviewed exam reports from C-arm CT rotational TMJ studies between October 2007 and March 2010. We extracted patient age and dose-area-product (DAP) from each rotation and reviewed information such as the dose options and thickness of Cu.
Results: 24 rotations (Group A) were performed prior to the implementation of the optimized TMJ C-arm CT protocol, 62 were performed after (Group B). The average age was: Group A, 12.7+4.8y (87%>10y), Group B, 13.6+4.1y (85%>10y), and the average DAPs were 357.9 and 19.1 microGym2, respectively. The difference in average DAPs reflects a radiation dose reduction of 95% using the optimized techniques, close to the 94% predicted by our phantom study. The optimized dose is approximately half the radiation dose from that of a conventional low dose TMJ CT with the same z-direction collimations.
Conclusion: Implementation of the optimized radiation dose techniques has significantly reduced doses to our IR patients receiving TMJ treatments utilizing C-arm CT.

P-421

The effect on operator hand dose of using needle guidance devices during cone-beam CT combined with real-time fluoroscopy-guided puncture procedures

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Purpose: Real-time fluoroscopy guidance using cone-beam CT overlay with dedicated needle path planning software (Philips Allura Xper FD20) is a promising new interventional technique. Disadvantage is operator radiation dose. We evaluated the effects on radiation hand dose and puncture accuracy using needle guidance devices in combination with this interventional technique.
Material and Methods: Fluoroscopy time, hand dose (active personal dosimeter (Unfors EDD-30)) and accuracy were measured for each needle guidance device by four interventional radiologists (IR) on a phantom (CIRS) with internal targets (size 2.3mm). The freehand technique was compared to needle holders (Seestar (AprioMed); Simplify (NeoRad)) and laser guidance (SimpliCT (NeoRad)) ceiling-mounted (Portegra2-arm (Mavig)). The laser guidance was used

either alone or in combination with needle holders. Each device and combination was used three times by each IR. Needle paths were equally difficult.
Results: Lowest fluoroscopy time to reach the target was 31s [14-67] for SimpliCT and the combination SimpliCT-needle holders (all data presented as median[ranges]). Freehand and needle holders alone was twice as high (62s [31-137]). Using SimpliCT and combination SimpliCT-needle holders resulted in the lowest operator hand dose: 33µSv [6-82] per procedure. This compared to 275µSv [20-603] for freehand, 298µSv [80-875] and 167µSv [43-465] for SeeStar and Simplify, respectively. For both fluoroscopy time and dose, laser-guided procedures are significantly lower than non-laser-guided procedures ($p<0.01$). Accuracy needle-to-target was ±1mm for all needle devices.
Conclusion: Laser guidance, alone or in combination with needle holders, achieves superior results of both reduced fluoroscopy time and operator radiation dose while affording good accuracy.

P-422

Staff doses in interventional radiology. A national survey

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Purpose: To present staff dose data for interventionalists after analysing the values collected during a four-year national follow-up program.
Material and Methods: A program to improve radiation safety in interventional radiology (IR) started in 2006. It was promoted by the national Society of Vascular and IR and involved 10 public hospitals and 28 interventional radiologists. Monthly occupational dose values were compiled and analysed together with the workload. Only doses reflecting regular use of the dosimeters were used. Participants were also asked to fill in a questionnaire on the use of personal dosimeters and radiological protection tools.
Results: 1133 dose values under the apron, 280 over the apron and 856 from hand dosimeters were received at the central database. 35% of the interventionalists did not use the dosimeter properly, so their records were excluded from the analysis. Most professionals remained in the control room during the acquisition of the DSA series. The use of the ceiling suspended protection screen was irregular. The mean workload resulted in 50±16 (1 standard deviation) procedures per month. Monthly doses for radiologists (median and 3rd quartile values) resulted in 0.2 and 0.4 mSv under apron, 1.6 and 2.8 mSv over apron and 4.9 and 13 mSv in hands. Maximum monthly values of 13 mSv under apron, 19 mSv over apron and 63 mSv in hands were measured.
Conclusion: Most dose values are under the regulatory dose limits but some registered high values should be avoided. Optimization actions have been proposed using CIRSE Guidelines.

P-423

Patient dose values in interventional neuroradiology. Impact of a low dose protocol

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Purpose: To evaluate the impact on patient dose reduction of a low dose protocol in neuroradiology.
Material and Methods: A low dose protocol was implemented in a neuroradiology laboratory with a biplane X-ray system with flat detectors, performing around 500 procedures per year (mainly cerebral arteriography CA and cerebral embolizations CE). The new protocol consisted in reducing by 30-40% the dose per frame in fluoroscopy and in DSA images (measured on phantoms). The image quality was tested and maintained its diagnostic value. The patient dose reports were transferred to a central database and dose data for procedures performed with the standard protocol and with the low dose protocol were analyzed. Samples of 113 CA and 48 CE were used. Median doses were investigated for both protocols for the total kerma area product (KAP), the KAP for fluoroscopy (KAPf) and the KAP for DSA images (KAPi).
Results: The reduction in KAP median values using the low dose protocol compared to standard protocol resulted in 37%-47% for CA and CE, respectively (61 vs. 38 Gy·cm^2 for CA and 351 vs 185 Gy·cm^2 for CE). Reductions in median KAPf/min resulted in 29% (CA) and 11% (CE), and KAPi/image in 40% (CA) and 24% (CE).
Conclusion: The introduction of a low dose protocol available for interventionalists and used during part of the procedures resulted in a reduction in patient doses ranging from 20–40% without significant detriment to the diagnostic information during the clinical practice.

P-424

Experience on the use of SIR-CIRSE guidelines for patient radiation dose management in neuroradiology

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Purpose: To present the experience and results of the application of the SIR-CIRSE guidelines for patient radiation dose management in neuroradiology.
Material and Methods: The Guidelines approved in 2009 by the SIR Safety and Health Committee and the CIRSE Standards of Practice Committee have been applied in a university hospital over the last two years to identify patients with potential skin injuries after procedures over thresholds requiring follow-up: peak skin dose >3 Gy, reference point air kerma >5 Gy, kerma area product >500 Gy.cm2 or fluoroscopy time >60 min. X-ray system (biplane with flat detectors) was under a quality assurance program and patient dose records were archived individually according to the national regulations.
Results: A total of 325 procedures (43% therapeutic, mainly cerebral embolizations) were included in the database during 2009 and

383 (40% therapeutic) during 2010. Out of these samples, and after analysing each dose report individually, during 2009, 20 patients (6.2%) were included in a follow-up program for potential skin injuries, while in 2010, after introducing several optimization actions, only 6 patients (1.6%) required the follow-up. The maximum patient dose values measured in a single procedure were 1405 Gy.cm2 and 10.8 Gy (cumulative skin dose). 11 patients resulted with radiation injuries.

Conclusion: The application of the SIR-CIRSE Guidelines allowed standardizing the selection criteria to include certain patients in a follow-up program. Several optimization actions were initiated during 2010 and the percentage of patients with risk of skin injuries has substantially decreased.

P-425

Extremity and eye lens doses in interventional cardiology and radiology procedures

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Purpose: The present study is part of the ORAMED project and aims at the development of methodologies for better assessing and reducing exposures of medical staff for procedures resulting in potentially high extremity and eye lens doses, such as interventional radiology/cardiology (IR/IC).

Material and Methods: A common protocol was used for the measurements of eye lens and extremity doses. 1140 measurements were performed in 40 European hospitals. The procedures monitored are: CA, PTCA, pacemaker implantations (PM), radiofrequency ablations, embolizations and angiographies (DSA) and angioplasties (PTA) of lower limbs (LL), renal arteries (Re), carotids (Ca) and brain (B).

Results: For the IC procedures the highest doses in all anatomic sites were found for PM. For the IR procedures the highest values were recorded for embolizations and DSA/PTA LL procedures. The extremity annual dose limit was exceeded in a few cases for fingers and legs. According to the latest data on radiation-induced cataract, special attention should be given to the eye lens doses, as in 9% of the cases the 3/10th of the actual annual limit was exceeded. For the effect of protective equipment, it was found that the ceiling and table shield can reduce the eye and leg doses up to 7 and 5 times, respectively.

Conclusion: A series of recommendations were drawn from the ORAMED measurement campaign, the most important of which is the proper use of the protective equipment that can be achieved by proper training of the medical staff in radiation protection issues.

P-426

Real-time personal dose feedback as a radiation safety teaching tool

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Learning objectives: Can the Philips Doseaware system be used as a teaching tool to provide real-time insight in personal dose contribution during interventional x-ray procedures and can the effect of system settings and radiation protective measures be made visible?

Background: The number, complexity and length of interventional x-ray procedures are steadily increasing, contributing to higher radiation exposure of personnel (radiologists, radiographers and technicians). Especially the flexibility that modern interventional x-ray systems offer leads to a large number of adjustable system settings. The effects of these settings on personal dose, however, are not always clear. Current personal dose meters used in radiation safety training sessions do not always allow real time monitoring of the actual personal dose rate or do not allow comparison of different meters and/or situations simultaneously.

Clinical Findings/Procedure Details: The Philips Doseaware system consists of up to 8 personal dose meters wirelessly connected to a central display unit showing actual dose rate. This system was used in a Philips FD20 interventional x-ray suite with a water phantom to create scatter comparable to clinical procedures. The most common factors resulting in staff dose, like fluoro modes, tube position and angulation, table height and use of protective devices, were evaluated to give insight in their relative contributions.

Conclusion: These teaching sessions clearly demonstrated that real-time feedback of personal dose per role in an interventional x-ray suite elevated the understanding of relative dose contribution with respect to common parameters in interventional procedures and might lead to a reduction in personal dose.

P-427

Improving interventional practice with real time information on staff radiation doses

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Learning objectives: To recognize that staff radiation risks may be significant during interventional procedures. To understand that optimization requires the consideration of both, patient and staff radiation doses. To identify optimization strategies to reduce patient and staff radiation doses.

Background: The International Commission on Radiological Protection (ICRP) and the coming European Directive on Basic Safety Standards consider staff radiation risks together with patient doses, in the optimization of medical procedures. This new consideration is especially relevant in interventional radiology.

Clinical Findings/Procedure Details: A real time personal dosimetry system (DoseAware) informing staff on cumulative occupational radiation doses and dose rates, during interventional fluoroscopy-guided procedures, permits verifying the level of scatter radiation during the operation in angiography suites. Since 2000, interventional X-ray systems have shown patient doses inside the angiography room, but displaying staff doses in real time was only made possible in 2010. Both parameters (staff and patient doses) recorded during interventional procedures enable to avoid pitfalls and to improve the protection in a proactive way. Strategies to reduce patient and staff doses are easily introduced: low dose operation modes, short fluoroscopy and image acquisition runs, collimation, good geometrical factors, appropriate use of protection tools, etc.

Conclusion: Staff dose audit in real time during interventional procedures allows correcting situations of high radiation risk for staff while avoiding high dose operation modes for patients and thus improving the global optimization.

Renal and visceral artery intervention

P-428

Multimodal approach in the percutaneous treatment of visceral aneurysms: a single center experience

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Purpose: To evaluate the effectiveness of percutaneous treatment in visceral aneurysms.
Material and Methods: We treated 38 patients with 44 visceral aneurysms (17 spleen, 9 renal, 5 gastro-duodenal, 4 liver, 3 pancreatic-duodenal ulcers, 2 left gastric, 2 superior mesenteric, 1celiac tripod, 1adrenal gland); 10/41 were ruptured. Saccular aneurysms (14) were treated with embolization using metallic coils; fusiform aneurysms (13) were treated with "endovascular exclusion"; aneurysms perfused by a terminal branch (12) were treated with afferent artery embolization. Four aneurysms were treated with stent-graft and 2 aneurysms were treated with thrombin injection and embolization with coils under ultrasound guidance. The follow-up was performed with ECD and/or angio-CT after 1, 6 and 12 months, then annually.
Results: In 44/44 of visceral aneurysms we obtained an immediate exclusion. Complications occurred in 20% of procedures (1 stent-graft occlusion and 8 splenic ischemia). In follow-up, we observed 3/44 (6.2%) reperfusion, all subsequently successfully treated with endovascular procedure. The primary technical success was 93.2% of the secondary technical success was 100%.
Conclusion: In 44/44 of visceral aneurysms we obtained an immediate exclusion. Complications occurred in 20% of procedures (1 stent-graft occlusion and 8 splenic ischemia). In follow-up, we observed 3/44 (6.2%) reperfusion, all subsequently successfully treated with endovascular procedure. The primary technical success was 93.2% of the secondary technical success was 100%.

P-429

Stent collapse after uncovered abdominal aortic stenting in sub-/acute complicated Stanford type B dissection

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Purpose: To evaluate technical feasibility and outcome of stent placement in sub-/acute complicated Stanford type B dissection.
Material and Methods: 12 patients (1 female, range 44-71 years) with aortic dissection suffering from severe gastrointestinal malperfusion and claudication underwent uncovered stent placement (diameter 7-25 mm, length 40-100 mm) into the aorta to achieve sufficient visceral and peripheral perfusion. Additional stents were placed into the visceral arteries in 3 patients.
Results: Thoracoabdominal stent placement yielded considerable clinical improvement in 11 of 12 patients. Additional stents (up to four) were placed in seven patients (1 celiac, 1 mesenteric, 2 renal, 6 iliac). Follow-up CTA showed near complete collapse of four stents (diameter 9-25 mm, length 100 mm) after one week. Catheterization and balloon dilatation of all four stents was possible. But all cases showed re-collapse on follow-up CTA. However, duplex-ultrasound and CTA showed perfusion of the superior mesenteric artery in all patients. Follow-up ranged from 3 months up to 3 years (average 1.7 years). During this time one patient required an iliaco-mesenteric bypass for treatment of chronic mesenteric ischemia, one month after stent placement. All other patients did well without further interventional or surgical therapy.
Conclusion: Thoracoabdominal stent-placement in sub-/acute complicated Stanford type B dissection is technically feasible and can be considered as a minimal-invasive therapy achieving similar clinical results as compared to the literature data after placement of endografts. Stent size should be adapted to the diameter of the true aortic lumen to avoid stent collapse.

P-430

Percutaneous ablation of renal cell carcinoma in patients with solitary kidney

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Purpose: To evaluate feasibility and effectiveness of thermal ablation with microwave and/or radiofrequency (MWA) for treatment of renal cell carcinoma (RCC) in patients with solitary kidney.
Material and Methods: 13 patients (3 males, 10 females; mean age 56.6 years) were enrolled. All patients had a solitary kidney because of a previous nephrectomy. Including criteria were high surgical risk or potential risk of renal failure after surgery. Exclusion criteria were tumor size >50mm and tumor location close to the renal pelvis. 21 tumors (5mm-40 mm, average 16.8 mm) were treated under combined US and CT guidance, with conscious sedation. In 8 cases radiofrequency thermal ablation (Radionics, Valleylab) was used; in the other 5 Microwave (Amica, Hospital Service) ablation was performed. Success was assessed through contrast-enhanced CT, CEUS and MR examination, defined as no contrast enhancement in the treated area. All patients' renal function was monitored the day before and after and at 1 month follow-up.
Results: During the follow up (1, 3, 6 and 12 months) only one patient (1/12, 8.3%) developed a slight haematoma in the peri-renal space in the following 48 hours; the patient was treated conservatively because the bleeding spontaneously stopped. No transfusion was needed. Furthermore, the 3-month CT scan follow-up of the same patient showed a 25-mm residual area of disease within the previously treated area. None of the patients developed renal failure. All the other patients showed non-recurrent disease in the follow up.
Conclusion: Renal thermal ablation is a safe and effective therapeutical option in patients with solitary kidney affected by RCC, who cannot undergo surgical resection.

P-431

Uncontrolled hypertension and acute left ventricular failure caused by non-specific aortoarteritis: outcomes of endovascular treatment in the acute setting

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Purpose: To evaluate the feasibility and efficacy of emergency endovascular management of the aorta or renal artery stenosis in treating uncontrolled hypertension, acute left ventricular failure (LVF) and ventricular dysfunction (VD), in patients with non-specific aortoarteritis.
Material and Methods: 47 patients [28 females, age range, 4-19 years (mean, 11.6)] were treated. The disease was clinically active in 22 patients. All procedures were performed by percutaneous transfemoral route after obtaining an informed written consent. Paired t-test was used to evaluate outcomes.

Results: The stenosis was located in the descending thoracic aorta in 24 (group-A) and in the renal artery (group-B) in 23 patients. Angioplasty was technically successful in all, without complication. Clinical improvement in terms of resolution of LVF and control of blood pressure (BP) was seen in all patients. In group A, the stenosis decreased from 84± 14% to 35±14% [p<0.0001] and gradient reduced from 68±20 to 16±14 mm Hg [p<0.001] . At 3 months, LV ejection fraction had improved from 24±8 to 52±10% (n= 12) [p<0.001]. In group B, stenosis decreased from 86±12% to 20±14% [p<0.0001] and BP decreased from 174±24/103±10 to 140±20/86±6 mm Hg [p<0.01]. At 3 months, ejection fraction improved from 29±6 to 36±14% (n=11) [p=0.07]
Conclusion: Endovascular management is feasible, safe and shows good short-term results in emergency treatment of uncontrolled hypertension, LVF and LV dysfunction in patients with non-specific aortoarteritis. The influence of disease activity on angiographic restenosis rate at longer term follow-up needs further evaluation.

P-432

Inferior pancreaticoduodenal artery aneurysms associated with occlusive lesions of the celiac axis: a distinct clinical syndrome diagnosis, treatment options, outcomes and review of the literature

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Purpose: To describe the presentation, treatment and outcomes for 14 patients with inferior pancreaticoduodenal (IPDA) artery aneurysms associated with coeliac axis occlusive lesions and to review the literature for similar cases.
Material and Methods: Over a period of 12 years, 14 patients (10 females:4 males) of age range 26-50 years (mean age 46) were diagnosed with IPDA aneurysms and celiac axis occlusion or stenosis on computed tomography (CT) and angiography. Outcome data were collected between 3 and 48 months (mean 24) and a literature search including the following key terms was conducted: celiac stenosis/occlusion, high flow aneurysm, IPDA aneurysm.
Results: All patients presented with abdominal pain. Arcuate ligament compression was the cause of celiac stenosis in ten cases, local dissection with a history of abdominal trauma in three and atheroma in one. Eight patients were treated by aneurysm embolisation and celiac origin stenting, four by aneurysm embolisation alone, one by celiac bypass alone and one by celiac stenting plus laparoscopic division of the arcuate ligament. Follow-up CT or ultrasound demonstrated that all aneurysms remained excluded and all patients were well. The two aneurysms treated by celiac recanalisation alone spontaneously thrombosed within 9 months. The 42 case reports in the literature confirm the findings of this cohort.
Conclusion: IPDA aneurysm secondary to celiac occlusive disease represents a distinct clinical syndrome. Treatment is necessary due to potential small size and is best achieved by a combination of surgery and/or stenting to the celiac axis and aneurysm embolisation when necessary.

P-433

Quantifying increased hepatic arterial flow with test balloon-occlusion of the splenic artery in liver transplant recipients with splenic steal syndrome: quantitative digital subtracted angiography correlation with arterial Doppler parameters

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Purpose: There are no objective criteria for diagnosing splenic steal syndrome (SSS). The purpose of this study is to quantify hepatic arterial flow in liver transplant recipients with suspected SSS pre- and post-test balloon-occlusion of the splenic artery utilizing Doppler ultrasound (DUS) and quantitative digitally subtracted angiography (Q-DSA). A secondary aim is to correlate these two modalities.
Material and Methods: Consecutive liver transplant recipients (01/2008-03/2010) were evaluated retrospectively. Suspected SSS cases were tested with DUS and Q-DSA pre- and post-balloon test-occlusion of the splenic artery. Mean arterial velocity and flow were calculated from DUS. Q-DSA was performed on a prototype workstation (iFlow, Siemens). Regions of interest highlighting the splenic and hepatic parenchyma were drawn on pre- and post-splenic artery occlusion angiograms. Density measurements over time were recorded as a slope, peak density and time-density product (area under curve). These Q-DSA parameters were compared to arterial velocity and flow rate by DUS.
Results: 5 suspected SSS (2.6% of transplants, N=5/193) were found. Four of the 5 underwent test-balloon occlusion with DUS and Q-DSA. By DUS, hepatic arterial velocity and blood flow increased by 1.6-1.8 and 1.7-2.6 folds, respectively. By Q-DSA, the hepatic arterial flow rate, total arterial flow, and peak contrast density increased by 1.1-12.8, 1.5-7.6, and 1.3-5.3, respectively.
Conclusion: Splenic artery occlusion in liver transplants with SSS doubles the hepatic arterial flow (+1.7-2.6 folds) by DUS. Q-DSA parameters evaluated correlate qualitatively but not quantitatively but generally overestimate the increased hepatic arterial flow measured by DUS.

P-434

Role of Ardian Symplicity system in renal denervation in the treatment of arterial hypertension resistant to conventional therapy

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Purpose: Therapy-essential hypertension is based on reducing sympathetic hyperactivity with drugs, but only in 65% satisfactory blood pressure levels were obtained. Some patients with "uncontrolled hypertension" take at least three antihypertensive drugs and yet have blood pressure >160/90 mmHg. The aim of this study was to assess the efficacy and safety of percutaneous treatment with Ardian system in the treatment of patients with resistant essential hypertension.
Material and Methods: From September 2010 to February 2011, 18 patients affected by uncontrolled essential hypertension underwent catheter-based renal denervation. Angio-CT was performed to evaluate renal anatomy and to plan the procedure. Ecocolor Doppler

and resistive index of both renal arteries, estimated GFR and pressure Holter were done previously, at 30 and 90 days after the procedure. Blood-pressure lowering effectiveness was evaluated by Student's *t* test.
Results: In the treated patients, baseline mean office blood pressure was 171/102 mmHg (SD 34/21), (mean 4-7 antihypertensive medications); mean GFR was 92.6 ml/min/1.73 m^2 (SD 15). Office blood pressure after procedure was reduced by -24/-15 and -23/-12 mmHg at 1 and 3 months. In all patients, medical therapy was reduced in both number and drugs dosage. No complications were observed.
Conclusion: The therapeutic sympathetic renal denervation is an innovative, fast and safe percutaneous procedure for the treatment of hypertension refractory to conventional therapy. The clinical and procedural efficacy has been demonstrated by the achievement of significant reductions in blood pressure, without significant complications. Despite the encouraging results, confirmation on prospective randomized studies to definitively validate the technique is mandatory.

P-435

Treatment of in-stent atheromatous renal artery restenosis in 51 patients

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Purpose: To assess the management of in-stent renal artery restenosis in our center.
Material and Methods: A single-centre retrospective analysis: 53 restenosis and 2 occlusions in 51 patients (mean age = 68.4 years) found by systematic follow-up after a mean delay of 7 months (range 5-11) in 37 patients vs. in 14 patients (initially lost to follow up because of initial correct clinical results) because of clinical or biological anomalies after mean delay of 39 months (range 11-121).
Results: Forty-nine in-stent balloon angioplasties (89.1%) were successfully performed. Stent-in-stent was necessary in 5 cases. There was 1 failure. Patency rate after a mean delay of 12.4 months (3-64) in 35 patients was 63.2% (38 stents) with 14 second IRAS. There was 33.3% second restenosis after conventional balloon angioplasty and 60% after stenting. Renal function was improved in 30% of the cases, stabilized for 50%; there was a blood pressure benefit for 52.9% at 12.7 months (3-64) after revascularization. In treatment of second IRAS, there was one failure (7.1%), 9 conventional balloon angioplasties, 3 cutting balloons, 1 secondary stenting. Follow-up after 10.6 months (4-22) concerned 7 stents and showed again recurrent instent stenosis in 5 patients (71.4%). Two were treated with conventional balloon angioplasty, 2 by cutting balloon and one drug-eluting stent, with 50% of patency on follow-up.
Conclusion: The in-stent revascularization by conventional methods has reduced morbidity, but its efficiency is imperfect. The iterative treatment of restenosis remains undefined.

P-436

Endovascular treatment of wide-necked saccular renal artery aneurysms: embolization efficacy of IDC-18 and GDC-18 360° coils with balloon remodeling technique

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Purpose: To report the efficacy of IDC-18 and GDC-18 360° coils with balloon remodeling technique in the embolization of wide-necked saccular renal artery aneurysms (RAAs).
Material and Methods: Four patients with wide-necked saccular RAAs (range 20-22 mm in diameter) were treated. One RAA was located in the main renal artery (mRA), two in the mRA bifurcation and the other one in the mRA trifurcation. The angioplasty balloon catheter was placed over the neck of the aneurysms extending to the distal branch to protect the parent artery from coil protrusion by temporary balloon occlusion. A macrocatheter was advanced into the aneurysm, through which IDC-18 coils were placed in two cases and GDC-18 360°coils in the other two cases. The procedure was finalized when the aneurysm was fully packed with the coils and there was no more contrast filling visible in the sack.
Results: In four patients, the wide-necked saccular aneurysms were excluded without coil protrusion, migration in the parent artery or sacrifice of any branch arteries. For occlusion of the aneurysm, seventeen IDC-18 coils (10-30 mm in diameter and 10-20 cm in length) were placed in one, sixteen IDC 18 coils (18-30 mm in diameter and 20 cm in length) were in the other one. Remaining two obtained dense packing with each six GDC-18 360°coils (9-20 mm in diameter, 20-40 cm in length). One-year follow-up showed no aneurysm recanalization or arterial obstruction in all cases.
Conclusion: Balloon remodeling technique utilizing IDCs and GDCs is technically feasible and safe in the treatment of a wide-necked saccular RAAs. GDC-18 360°coils is more effective than IDC-18 coils in the embolization of wide-necked aneurysm. Further follow-up is needed for long-term results.

P-437

Tips and tricks of transcatheter coil embolization of visceral arterial aneurysms with case presentations of various lesions

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Learning objectives: 1) Definition of working angle for safe and effective embolization. 2) How to access the aneurysms. 3) Coil selection on framing, filling and finishing. Essential knowledge of various devices. 4) Adjunctive techniques (Balloon assist technique and stent assist technique).
Background: In this presentation, tips and tricks of each process of embolization are explained with actual strategy and angiographical movies of various lesions, such as celiac artery, hepatic artery, splenic artery, gastroduodenal artery, superior mesenteric artery and renal artery.
Clinical Findings/Procedure Details: Working angle should be defined to visualize the relation between dome, neck and parent artery clearly. Planning of approaches to the aneurysms is crucial, which closely relate the stability of microcatheter and usage of adjunctive techniques. Guiding sheaths allow the simultaneous use of multiple catheters or adjunctive techniques with single access. Balloon catheter is useful not only for prevention of coil migration but also for stabilization of microcatheter during coil placement and for temporal occlusion in case of unexpected intraoperative rupture. Knowledge of advanced mechanism of various coils is essential for adequate coil selection on framing, filling and finishing. This report includes some unique cases such as: aneurysm of gastroduodenal artery caused by secondary hemodynamic change after treatment of celiac trunk aneurysm. Aneurysm of renal artery embolized using double microcatheter with single vascular access from brachial artery due to iatrogenic bilateral femoral artery occlusion.
Conclusion: Detailed anatomical analysis, cautious planning, knowledge of devices and advanced technique are essential to bring good outcomes on coil embolization of visceral arterial aneurysms.

P-438

Interventional treatment of visceral artery aneurysms

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Learning objectives: To describe the interventional management of visceral artery aneurysms (VAAs). To report the indications and the techniques in relation to the type of aneurysm. To highlight their advantages and drawbacks and illustrate them step by step.
Background: VAAs, although uncommon, can present with life-threatening haemorrhage and a mortality rate ranging between 10 and 25%. Treatment options have significantly evolved over the past decade ranging from open surgical repair to interventional management. Open surgical repair is the standard treatment, durable with excellent long-term results, but it is associated with morbidity and mortality rates of approximately 10% and 5%, respectively, but substantially higher in the emergency setting. Interventional methods have emerged as promising therapies to treat visceral artery aneurysms.
Clinical Findings/Procedure Details: Based on a retrospective review of the VAAs treated with interventional techniques in our department, and on a literature search, we provide details on when and how to treat patients with VAAs, tips and tricks, how to avoid complications, and how to manage them when they occur.
Conclusion: Interventional techniques such as embolization, stent grafting, stent-protected coiling and multilayer stents are successful in the treatment of VAAs with minimal morbidity and mortality.

P-439

Interventional radiology in splenic trauma

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Learning objectives: To revisit the classification of splenic injury. To identify correctly patients suitable for endovascular treatment. To discuss appropriate access, embolic agent and procedural steps.
Background: Interventional radiology is rapidly replacing surgery in the treatment of specific trauma patients. The provision of such a service requires prompt classification of splenic injury, correlated with patient stability to ensure rapid appropriate treatment. It is imperative that radiologists are aware of the indications and contra-indications for endovascular treatment of splenic injury.
Clinical Findings/Procedure Details: We present a detailed classification of splenic trauma with supporting cross-sectional imaging. We identify common angiographic appearances and discuss the merits of particular embolic agents.
Conclusion: The expansion of interventional radiology and the ability to treat traditionally surgical traumatic conditions via a minimally invasive technique necessitates that all radiologists are aware of the indications and limitations of endovascular treatment in trauma patients, which is concisely covered by this pictorial review.

P-440

Segmental arterial mediolysis of superior mesenteric artery: endovascular treatment and 6-month follow-up with cardiatis multilayer stent

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We describe a case of superior mesenteric pseudoaneurysm, caused by segmental arterial mediolysis, treated by deployment of cardiatis multilayer stent.

P-441

Life-threatening multiple capsular branches hemorrhage after renal artery's bilateral stenting: conservative treatment

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A 63-year-old nephropathic woman collapsed after bilateral renal artery's stenting. Contrast-enhanced-CT showed bilateral multifocal perinephric capsular branches hemorrhages, related to reperfusion syndrome rather than to multiple guidewire perforations. Transient embolization (sponge) was performed. Renal function was recovered (2 months follow-up).

P-442

SILK flow diverter in the treatment of a fusiform splenic artery aneurysm

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We successfully treated a fusiform splenic artery aneurysm by endovascular implantation of a Balt SILK flow diverter. The aneurysm was completely excluded, the splenic artery remained patent.

P-443

Renal stent strut fracture

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A patient with subtotal occlusion of the right renal artery underwent PTA and stent placement. In time stent occlusion occurred, mandating recanalisation and stent in stent placement. Follow-up angiography showed massive stent strut fracture. Underlying causes are discussed.

P-444

Endovascular treatment of a wide neck common hepatic artery aneurysm with new cardiatis multilayer stent

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In a 63-year-old woman, a 20-mm wide neck aneurysm of common hepatic artery was successfully treated with deployment of a cardiatis multilayer stent. Three-month follow-up CTA showed complete obliteration with shrinkage of aneurysmal sac.

P-445

Covered stent treatment of life threatening pulmonary artery pseudoaneurysm

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We present a case of a 59-year-old female affected by non-small-cell lung cancer, with recurrent pulmonary infections who developed a life threatening left pulmonary artery pseudoaneurysm. A covered stent was used for the successful exclusion of the pseudoaneurysm.

P-446

Collateral route coil embolization of a gastro-duodenal artery aneurysm

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We present a case of gastro-duodenal aneurysm in a symptomatic patient treated by endovascular coil embolization, through pancreaticoduodenal artery for concomitant celiac trunk stenosis. Follow-up CT showed successful exclusion of the aneurysmal sac while maintaining the peripheral visceral blood supply.

P-447

Successful embolization of the bleeding iatrogenic renal pseudoaneurysm in a patient with severe iodine allergy using CO2 and a minimal amount of Omniscan as a contrast material

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A man with iodine allergy was treated after renal tumor resection due to a massive hematuria. Using only a special technique of CO2 injection with minimal amount of Omniscan as a contrast material, the source of bleeding in the kidney was found and embolized.

P-448

Current management of extrahepatic arterioportal fistulas: report of a case treated with a stent graft

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Extrahepatic arterioportal fistulas (APF) are rare but recognized complications of abdominal surgery or trauma to the visceral arteries. We present a case of APF from the proximal branch of the common hepatic artery, which was managed with a single covered stent.

P-449

A rare cause of obstructive jaundice: endovascular management of superior mesenteric artery (SMA) pseudoaneurysm

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Injuries to the mesenteric vessels can be lethal and challenging complications of penetrating and blunt abdominal injury. We describe a case of SMA pseudoaneurysm secondary to penetrating injury causing obstructive jaundice and treated by an endovascular stent graft.

P-450

Endovascular treatment of ruptured celiac trunk aneurysm

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Visceral aneurysm accounts for few cases of true aneurysms. We report a patient with sudden onset of back pain diagnosed with a ruptured isolated celiac trunk aneurysm on angioCT. Endovascular repair was performed with excellent post-operative results after 3-year follow-up.

P-451

Complete common hepatic artery dissection after covered stent placement in non-surgical candidate: what to do?

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50 y/o Chinese female S/P laparoscopic robotic-assisted Whipple procedure for choledochal cyst admitted for abdominal pain. Angiogram was performed to rule out ischemia. Results: GDA pseudoaneurysm caused slow grade leak and covered stent was placed with resultant total common hepatic artery dissection.

P-452

New catheterization method for iatrogenic superior mesenteric artery dissection

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A new catheterization method was successfully performed on a patient with severe pain due to the iatrogenic superior mesenteric artery dissection by making a bypass through the false lumen. The patient was completely relieved from pain due to the dissection.

P-453

The role of transarterial embolization in the management of kidney hypervascular lesions: is it an addition or an alternative to surgery?

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We present three cases in which transarterial embolization has been used, respectively: -in a high risk patient as the unique treatment for kidney cancer, -before enucleoresection of a renal lesion in order to prevent intraoperative bleeding, -and in a bleeding angiomyolipoma.

P-454

Acute ischemic renal failure: percutaneous management

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To report the cases of 4 patients with ARF due to thrombosis or thromboembolism of a unique renal artery. Early arterial flow restoring (<40h since anuria started) using percutaneous thromboaspiration, selective thrombolysis (<24h) and/or stenting allowed to save the kidney.

P-455

"Have you ever seen...?" Acalculous cholecystitis resolving post-mesenteric revascularisation

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We report two young patients who presented with acalculous cholecystitis and acute mesenteric ischaemia. Both conditions were treated with endovascular revascularisation of their celiac axis, suggesting hypoperfusion as the likely cause of their cholecystitis.

TIPS and portal vein intervention

P-456

Portal vein embolization (PVE) in 40 cases of "two-stage hepatectomy" for liver metastases from colorectal cancer: a single centre experience

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Purpose: Most patients with colorectal liver metastases (CLM) present with unresectable disease at diagnosis, while only 15-25% are eligible for surgery. The best strategy to address the issue of non-resectability is the use of a multidisciplinary approach: liver function analysis, CT liver volume study, advanced surgical techniques, PVE. Our aim was to evaluate the efficacy of PVE in obtaining an adequate future remnant liver volume (FRLV) in 40 cases of "two-stage hepatectomy".
Material and Methods: Between January 2007 and December 2010, 40 patients with multiple bilobar CLM underwent two-stage hepatectomy. In each patient CT volumetric assessment of hepatic volumes was calculated before PVE and after 4 weeks. PVE was performed using a combined US and fluoroscopy-guided technique, with prevalent ipsilateral percutaneous transhepatic approach, after retrograde catheterization (4 Fr catheter) via a peripheral portal branch. After a preliminary portography, PVE was obtained using a combination of polyvinyl alcohol particles (300-500 µm, Cook), platinum coils of various size and fibrin glue.
Results: PVE was successfully performed without complications in 30/30 patients. The mean FRLV at the time of the procedure and after 4 weeks was, respectively, 412.7 cc (±189.56) and 573.78 cc (±180.25) with an average increase of 50.7% (±32.95). During the postoperative course of the second intervention, only 2 patients showed mild and transient signs of liver failure.
Conclusion: In patients with multiple lobar CLM and eligible for two-stage hepatectomy, PVE is an effective treatment with a low rate of complications, in order to prevent postoperative hepatic failure.

P-457

Quantitative analysis of digitally subtracted portography before and after portal vein embolization: a feasibility study for predicting subsequent left hepatic hypertrophy

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Purpose: To evaluate feasibility of comparing quantitative analysis of digitally subtracted angiography (QA-DSA) of the left lobe before and after right lobe portal vein embolization (PVE) as a potential predictive tool of subsequent left lobe hypertrophy.
Material and Methods: Three patients underwent right PVE to induce left lobe hypertrophy prior to right lobectomy. Pre- and post-main portal vein pressures and QA-DSA were compared to CT-volumetry pre- and post-PVE. QA-DSA was performed on a prototype workstation (iFlow, Siemens). Regions of interest (ROIs) highlighting the parenchyma of right and left lobes and left and right portal veins were drawn on pre- and post-portal venograms. Density measurements over time were recorded as a slope, peak density and time-density product (area under curve).
Results: Patient #1: left lobe parenchymal QA-DSA and left portal vein QA-DSA parameters increased by 73-109% and 19-55%, respectively. Portal pressures and volumes increased by 163% and 62%. Patient #2: left lobe parenchymal and left portal vein QA-DSA parameters increased by 55-81% and 3-49%, respectively. Portal pressures and volumes increased by 133% and 39%. Patient #3: left lobe parenchymal and portal vein QA-DSA parameters changed by 31-33% and -2 to +7%, respectively. Portal pressures and left-lobe volumes increased by 70% and 38%.
Conclusion: Quantitative analysis of portal vein DSA images correlate with hepatic volume increases. Potentially, test balloon-occlusion of right portal vein may enable QA-DSA analysis prior to irreversible PVE. Analysis of parenchymal contrast uptake parameters appear to correlate better with increased hepatic volumes compared to left portal vein or portal pressure parameters.
Disclosure: Dr. Kowarschik is employed by Siemens AG, and is involved in the design and implimentation of the iFlow software used in analysing our data. Dr. Matsumoto serves as a consultant to Siemens AG.

P-458

Interventional management of patients with symptomatic portal hypertension secondary to obstruction of splanchnic veins

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Purpose: To evaluate interventional management of patients with symptomatic portal hypertension secondary to obstruction of splanchnic veins.
Material and Methods: 27 patients, 16 males and 11 females, with symptomatic portal hypertension, secondary to splanchnic veins obstruction, were treated using percutaneous methods. Causes, methods used and results were retrospectively evaluated.
Results: Obstructions were localized to the main portal vein (n=25), intrahepatic portal veins (n=8), splenic vein (n=4) and mesenteric veins (n=4). Interventional treatment included recanalization (n=22),

pharmacological thrombolysis (n=2) and mechanical thrombectomy (n=6). Shunt embolization (n=3). Partial embolization of the spleen was done in 5 patients. Additional placement of a new TIPS was necessary in ten patients, while an existing occluded TIPS was revised in two patients. During the follow-up ranging between 2 days and 58 months, revision was necessary in 5 patients. Immediate improvement in presenting symptoms was achieved in 23 patients (85%).
Conclusion: Interventional procedures can be of value in majority of patients with obstruction of splanchnic veins with subsequent improvement of symptoms. Treatment should be customized according to the site and nature of obstruction.

P-459

Percutaneous portal vein embolisation for extended hepatic resection: volume gain and achievement of operability in 85 patients

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Purpose: Percutaneous portal vein embolisation is an established procedure for the induction of segmental liver hypertrophy in primarily irresectable liver malignancies. The purpose of this study was to assess the increase of the left-lateral segmental volume and the achievement of operability in patients with intended extended right hepatectomy.
Material and Methods: Portal vein embolisation was performed in 85 patients with primarily irresectable liver malignancies. A mixture of histoacyl/lipiodol was placed in the complete course of all accessible portal branches of segments 4-8 by subxiphoidal left-sided (71%) or lateral right-sided (29%) approach. CT was used for volumetry before and every of 3-4 weeks after embolisation until the patients reached the necessary future remnant liver size (prospected remnant weight of at least >0.8% body weight). The clinical definition of operability was determined by this volume gain, but also by tumor development, secondary CT findings, and the general state of health.
Results: After a mean interval of 32 days a left-lateral segmental volume gain of 138 ml (59%) was found, with a hypertrophy rate of 4.3 ml/d (2.1%/d). In 52 of 85 patients (61%) complete tumor resection by extended right hepatectomy was successfully performed. Continuous inoperability in 33 patients was caused by tumor progression, new manifestation in the future liver remnant, or new extrahepatic metastases in 56% of these cases, only 9% were due to insufficient volume gain.
Conclusion: Portal vein embolisation is a promising preoperative interventional procedure for the induction of segmental liver hypertrophy to achieve operability in initially inoperative patients.

P-460

Nine years' experience in transhepatic angioplasty of portal vein stenosis after liver transplantation in children

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Purpose: To evaluate the nine years' experience of a single center in transhepatic treatment of portal vein stenosis after pediatric liver transplantation concerning its efficacy and safety.
Material and Methods: From 2002 to 2011, 15 children with portal vein (PV) stenosis underwent transluminal angioplasty (PTA) with balloon dilation or stent. The indication to use the stent was reserved in case of PTA failure by recoil or restenosis. Patients' body weights ranged from 9.3 to 46 kg (mean 15.5 kg). PV patency and complications related to the procedure were evaluated in all children.
Results: Technical and clinical success was achieved in all cases with no significant complication. Eleven patients (11/15; 73.3%) were successfully treated by single balloon dilation. Four patients (4/15; 26.7%) needed stent placement: in one of them, stent was indicated during the same procedure due to PTA failure (recoil); the other three developed portal hypertension due to PV restenosis 2 months, 8 months and 28 months after the first PTA and they had to be submitted to a new procedure with stent placement. The follow-up time ranged from 3 to 9 years (mean, 6.7 years).
Conclusion: The use of balloon dilation as a primary intervention to treat PV stenosis was safe and effective in these children. Balloon-expandable stent was used with good results in case of unsuccessful balloon dilation or recurrence of stenosis.

P-461

Percutaneous revascularization of occluded Meso-Rex-Shunts in two cases

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Purpose: We report on two rare cases of postoperative occlusion of Meso-Rex Shunts. In one case (male, 5 years) portal vein aplasia was diagnosed, the second case (female, 7 years) suffered from congenital portal vein thrombosis. Both patients received surgery for implementing a portal vein bypass between the mesenteric vein system and the Sinus Rex located at the left portal vein.
Material and Methods: Both patients presented with subtotal stenosis/occlusion in duplex-sonography and were transferred for transhepatic recanalization.
We established a right lateral percutaneous access with a 21-G needle. Successful passage could be established by a 0.014-inch hydrophilic guide wire. After stabilizing the access, a 5 F sheath was placed to implant balloon-expandable stents within the shunt.
Results: Immediate technical success was attained in both patients without residual stenosis. One shunt reoccluded due to a second stenosis. The stented area remained open and underwent reintervention with additional stent angioplasty. The second shunt remained open with the stent covering the stenosis. Both patients received heparin to prevent early stent thrombosis. One patient suffered from pleural bleeding, which was drained and resolved 2 days after intervention.
Conclusion: Bailout stenting in young patients with Meso-Rex Shunts seems to be promising in a bailout situation and for the prevention of re-operation.

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Balloon-occluded retrograde transvenous obliteration (BRTO) of gastric varices in three patients with portal vein thrombosis

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Purpose: Transjugular intrahepatic portosystemic shunt (TIPS) is a well-established treatment for portal hypertension-related gastric varices. However, it may not be suitable for patients with portal vein thrombosis. We retrospectively reviewed the balloon-occluded retrograde transvenous obliteration (BRTO) of gastric varices in three patients with portal vein thrombosis.

Material and Methods: We retrospectively reviewed three patients treated with BRTO of gastric varices from November 2009 to September 2010. Three patients (one man and two women; mean age, 50 years; range, 35-64 years) were analyzed in the study. Indication of BRTO of gastric varices included iatrogenic complete portal vein thrombosis, complete portal vein thrombosis from pancreatitis and partial portal vein thrombosis from Crohn's disease. BRTO of gastric varices was performed in two patients due to prior significant hematemesis and in one patient for prophylaxis due to continuing anticoagulation medications. Technical and clinical success, and clinical outcome were analyzed.
Results: BRTO of gastric varices was successfully performed in all patients without complications. Ethanolamine oleate was used as a sclerosing agent in one patient and 3% sodium tetradecyl sulfate (sotradecol) in two patients. Follow-up CT or MRI images (2-9 months) and endoscopy showed obliteration of gastric varices in all patients. There was no recurrent bleeding from the gastric varices during the follow-up period (4-11 months).
Conclusion: BRTO of gastric varices can be a useful treatment for gastric varices in patients with portal vein thrombosis.

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Interventional radiological procedures (IR) in orthotopic liver transplantation (OLT)

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Purpose: To study therapeutic modalities of IR before and after OLT.
Material and Methods: Between 1998 and 2010, OLT was performed in 74 pts with end-stage liver diseases (65) or hepatocellular carcinoma (HCC) (9). Pre-OLT IR procedures included TIPS (10 pts) and TACE (6 pts). Post-OLT procedures were: dilatation or/and stenting of biliary strictures (7), stenting of IVC (4), balloon dilatation of cava-caval anastomosis (1), partial splenic embolization (PSE) in steel syndrome (1).
Results: All IR procedures were technically successful. There was no mortality or serious complication. There was partial tumor response in all 5 pts with HCC. Three successfully transplanted pts are alive without recurrence in 12-24 mo. After TIPS, 5 pts received OLT, 3 are on the waiting list, and 2 died of liver failure 5 and 7 mo later. Satisfactory drainage was achieved in all 7 pts with post-OLT biliary strictures. Clinical symptoms and liver function improved in all three pts with venous strictures. After PSE, steal syndrome regressed rapidly. All pts are asymptomatic and well in 5-40 mo after IR treatment.
Conclusion: IR procedures play an important role before and after OLT.

P-464

Comparison of coil embolization and sclerotherapy of collateral veins during balloon occluded retrograde transvenous obliteration: its long-term effect for gastric varix

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Purpose: We compared the long-term effect for gastric varix obliteration between coil embolization and sclerotherapy of collateral veins during BRTO.
Material and Methods: Between February 2004 and November 2008, Of 48 patients with gastric varix bleeding successfully treated with BRTO, 23 patients who underwent embolization of collateral veins during BRTO were enrolled in this study. In sixteen patients, collateral veins were embolized with the use of microcoil (group 1). Sclerosing agent (5% ethanolamine oleate + lipiodol) was used in the remaining 7 patients (Group 2). Recurrence and rebleeding of gastric varix were evaluated by endoscopy or CT (mean follow-up period: 30 months). For statistical intergroup comparison of gastric varix recurrence, Fisher's exact test was used.
Results: Gastric varix recurred in 4 patients (17.4%) and rebleeding occurred in 2 (8.7%). Recurrence (57.1%, p=0.001) and rebleeding (28.6%, p=0.029) of gastric varix occurred in only group 2. Gastric varix recurred 3, 12, 19, 23 months after procedure, respectively. CT finding within 6 months in recurred patients was partial or complete thrombosis without lipiodol uptake in gastric varix, and then gastric varix recurred on follow up CT.
Conclusion: Coil embolization of collateral veins during B-RTO may promote complete obliteration of gastric varix, and provides lower recurrence and rebleeding rates of gastric varix than sclerosing agent on long-term follow-up.

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Intrahepatic portosystemic shunts by innovative transhepatic approach

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Purpose: Occasionally, certain anatomical variants of the vascular anatomy may preclude transjugular intrahepatic portosystemic shunts (TIPS). Moreover, creation intrahepatic portosystemic shunts by a conventional transjugular approach has a high risk of bleeding in patients with serious hepatatrophy. The aim of this study was to present an innovative transhepatic approach for creating intrahepatic portosystemic shunts in the setting of these types of anatomic challenges, and to assess the feasibility and efficacy of this creative technique.
Material and Methods: Eight patients accepted intrahepatic portosystemic shunts by innovative transhepatic approach. Under fluoroscopic guidance, the portal vein (PV) was punctured with a small Chiba needle. A 0.018-inch guidewire was advanced through the needle into the PV lumen. A 6-French sheath was inserted over the wire. Then, the hepatic vein or inferior vena cava was punctured with a 20-gauge, 20-cm Chiba needle through the sheath. Another 0.018-inch guidewire was advanced through the needle into the right internal jugular vein and then snared out of body. A 0.035-inch, 260-cm-long Glide-wire was then introduced through the transjugular sheath and manipulated into the MPV and then into the superior mesenteric vein after which the TIPS procedure is completed in the standard transjugular fashion.
Results: The procedure was technically successful in all patients. All patients showed patent TIPS during the follow-up period (range 2-12 months) on color Doppler scanning. There were no serious procedure-related complications in all patients.
Conclusion: The procedure of intrahepatic portosystemic shunt by transhepatic approach is safe and effective for the treatment of portal hypertension with exceptionally challenging anatomy. It is an available supplement for conventional TIPS.

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Transjugular intrahepatic portosystemic shunt in portomesenteric thrombosis

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Purpose: To assess the efficacy of transjugular intrahepatic portosystemic shunt (TIPS) in the presence of portomesenteric thrombosis.
Material and Methods: A retrospective review was made from 2001 to 2010 of 168 patients undergoing TIPS creation using Viatorr stent-graft was performed, selecting 17 patients (age 55.8-y, 29-70) with portomesenteric thrombosis. Thrombosis was classified by location (portal trunk, right and left branches and mesenteric vein) and extent (100%, 50-99%, <50%). Indications for TIPS were variceal hemorrhage (n=12) and refractory ascites (n=5). Technical success was defined as an adequate graft placement and a portosystemic pressure gradient (PPG) lower than 12 mmHg after the procedure; clinical success as the improvement of the condition indicating TIPS; and TIPS dysfunction as a portosystemic pressure gradient higher than 12 mmHg or no permeability on imaging studies. Patient survival and shunt patency were calculated according to the Kaplan-Meier method. Mean time follow-up was 19 months. Death or absence of updated clinical data were the end points of the follow-up, which was performed by Doppler ultrasound (n=12), CT (n=8) and portography (n=4).
Results: The technical and clinical success was 94% and 88%, respectively. Primary unassisted patency rates at 1, 6 and 12 months were 100% (n=17), 94% (n=15), and 86% (n=7), respectively. New onset or worsening encephalopathy was developed in 17% (n=3). Thirty-day mortality rate was 12% (n=17).
Conclusion: The results suggest that TIPS for the management of ascites and variceal hemorrhage in the presence of portomesenteric thrombosis is a feasible alternative therapy.

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Transjugular intrahepatic portosystemic shunts in liver transplant recipients

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Purpose: To report our experience of transjugular intrahepatic portosystemic shunt (TIPS) in liver transplant recipients with complicated portal hypertension.
Material and Methods: A retrospective review of transplant recipients undergoing TIPS creation was performed over a 10-year period. We analyzed the following parameters: evolution of portosystemic gradient (PSG) after TIPS, primary patency rates, appearance of encephalopathy and survival rates.
Results: Ten liver transplant recipients underwent TIPS creation. TIPS was created with uncovered stent (Wallstent). The indication for TIPS was refractory ascites (n=8), variceal bleeding (n=1) and veno-occlusive disease (n=1). Mean time from transplantation was 47.4 months (range, 3-144 months). The technical and clinical success rate was 100%. PSG decreased from 14.9 ± 3.4 mm Hg to 6.8 ± 2.6 mm Hg. No complications were observed during procedure. Encephalopathy developed in three patients (30%). During the follow-up (average: 29 months; range, 1-120 months), three episodes of TIPS dysfunction were observed, and were successfully treated by means of angioplasty (n=1), stent placement (n=1) and angioplasty and stent placement (n=1). The resultant primary patency rates at 3, 6 and 12 months were 100%, 85% and 64%, respectively. The survival rates were 77% and 55% at 6 and 24 months, respectively.
Conclusion: In our experience TIPS is an effective technique in liver transplant recipients with recurrent portal hypertension.

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Comparison of percutaneous portal vein embolization, portal vein ligation and portal vein occlusion combined with ipsilateral hepatic artery cannula implantation prior to major liver resection

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Purpose: To evaluate the results of percutaneous portal vein embolisation (PVE), portal vein ligation (PVL) and portal vein occlusion (PVE, PVL) combined with hepatic artery cannula implantation prior to extended hepatectomy.
Material and Methods: Between 2004 and 2011, hundred and four patients presenting with multiple or large liver metastases or large hepatocellular carcinoma were included. The estimated residual liver volume (FLR) of these patients after the planned extended hepatectomy was less than 30% (normal liver), or 40% (cirrhotic liver). To increase the FLR, portal vein occlusion techniques (25 PVE, 79 PVL alone, or PVL combined with hepatic artery cannula implantation into the ipsilateral hepatic artery - PVL+can) were performed. They were evaluated with MDCT including volume assessment, before and 8 weeks after these procedures.
Results: 86/104 patients became resectable (PVE; PVL; PVL+can; 70,2%; 81,8%; 93,3%). FLR increase 8 weeks after PVE, PVL or PVL+can was 17%, 16%, 19%, the complication rate of the various portal occlusion techniques were 0%; 3%; 13%, respectively. At least 4 segments were resected during hepatectomy. Overall postoperative morbidity and mortality rates were 9% and 3%, respectively. Complication and mortality rates did not differ in the 3 groups.
Conclusion: Patients with previously unresectable liver tumors can benefit from resection after all kind of portal occlusion techniques. Although complication rate of portal occlusion combined with hepatic artery cannula implantation is higher, more patients become resectable due to higher increase rate of FLR in this group.

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Small intestinal varices treated with transcatheter embolization

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Learning objectives: To understand the efficacy of transcatheter embolization for the treatment of small intestinal varices. To understand the hemodynamic profile of the small intestinal varices using MDCT.
Background: The small intestinal varices are rare ectopic varices. They were often caused by chronic liver disease such as liver cirrhosis and portal vein thrombus. The history of abdominal injury and abdominal operation were also found. The treatment of small intestinal varices has been performed by surgery.
Clinical Findings/Procedure Details: Between November 2007 and January 2011, three patients (all female; age from 60 to 72) with small intestinal varices were treated in our institute. The diagnoses were confirmed by endoscopy and/or abdominal enhanced dynamic

CT. Two cases had liver cirrhosis and one had autoimmune hepatitis. Two cases had history of abdominal operation (the ovariectomy and small intestinal resection due to the traffic accident). MDCT before procedures showed ileal varices with dilated vein as an afferent vein and right ovarian vein as an efferent vein. B-RTO (balloon-occluded retrograde transvenous obliteration) was administered in all cases. Two varices were sufficiently obliterated by B-RTO alone, while one was insufficient and was treated successfully by additional PTS (percutaneous transhepatic sclerotherapy) 7 days after first B-RTO. In all cases, no complication was found.
Conclusion: Transcatheter embolization is feasible and effective procedure for the small intestinal varices.

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Techniques for endovascular shunt reduction in the management of TIPS-induced hepatic encephalopathy

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Learning objectives: To describe the endovascular techniques available for transjugular portosystemic shunt (TIPS) reduction in the management of TIPS-related hepatic encephalopathy (HE) to review our personal institutional experience, and to highlight the advantages and pitfalls of these techniques.
Background: HE is a potentially serious complication following TIPS, occurring in 20-40% of patients. Most patients are successfully managed with conservative medical therapy. However, 3-7% of patients will suffer from HE which is refractory to medical therapy. These patients require further intervention through endovascular shunt reduction, endovascular complete shunt occlusion or, where possible, the use of liver transplantation.
Clinical Findings/Procedure Details: Several endovascular techniques have been described which act to reduce flow by increasing turbulence within the shunt lumen. Each technique will be described in detail, highlighting our own experience, with a discussion of the advantages and potential pitfalls of each procedure. 1. The constrained stent technique/suture technique. 2. The parallel stent technique. 3. The stent within a stent technique. 4. The use of adjunct embolisation in combination with constrained stents.
Conclusion: Each of the three main methods described have been successfully employed in our institution. The use of the constrained stent (suture technique) technique and the parallel stent technique are the preferred methods for the management of TIPS-related HE refractive to medical therapy. The overall choice of technique should ultimately be based on operator experience and personal preference.

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Trans-TIPS transvenous antegrade obliteration of duodenal varices after failed transjugular intrahepatic portosystemic shunt (TIPS) decompression: technique and a word of caution

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Learning objectives: To describe the technique and the experience of trans-TIPS transvenous obliteration of duodenal varices (DV) and review the limited literature.
Background: Obliteration of duodenal varices with sclerosant has been reported via transhepatic and systemic access.
Clinical Findings/Procedure Details: Case #1: 28-year-old female liver transplant recipient presented with bleeding DV. Patient underwent a successful TIPS; however, continued to bleed. 11 months later, patient underwent a trans-TIPS transvenous obliteration of the DV utilizing 3% sotradecol-lipiodol-air mixture. Coils and amplatzer plugs were used to "trap" the sclerosant within the varix. While initially successful, a self limiting duodenal bleed occurred at 4 months and endoscopy showed the plug eroding into the duodenum lumen. Patient was managed conservatively. The patient has not bled for another 18 months. Case #2: 48-year-old male had enlarging high risk DV after a BRTO of his gastric varices despite having a patent TIPS. Patient underwent a portogram demonstrating DV being drained by portal collaterals entering the liver and by portosystemic collaterals. A trans-TIPS balloon occluded transvenous obliteration was performed utilizing 3% sotradecol-lipiodol-air mixture as a sclerosant. The balloon was used to occlude the main portal vein-end of the DV and coils were deployed to occlude the intrahepatic-end of the varices at the hepatic hilum outside the wall of the duodenum. Endoscopic ultrasound proved complete obliteration of DVs.
Conclusion: TIPS may not be successful in decompressing DVs. When utilizing bulky metallic embolic agents to augment transvenous sclerosis of DV it is best, if feasible, to deploy them in collaterals outside the duodenal wall.

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First reported discovery of liver necrosis caused by a successful balloon-occluded retrograde transvenous obliteration (BRTO) for gastric varices

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A 78-year-old woman with gastric varices was successfully treated with BRTO; however, contrast-enhanced CT the following day showed liver necrosis. This is the first case report of liver necrosis caused by BRTO.

P-473

Another way to perform transjugular portosystemic shunt reduction

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We treated a transjugular portosystemic shunt (TIPS)-induced refractory hepatic encephalopathy by reducing the internal lumen with an auto-expandable covered stent-graft constrained by an amplatzer vascular plug within the TIPS. The procedure increased portosystemic gradient and the patient had clinical improvement.

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Transcatheter coil embolization of a congenital portosystemic hepatic vein shunt before percutaneous transhepatic portal vein embolization

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A 60-year-old woman with hepatocellular carcinoma was scheduled for percutaneous transhepatic portal vein embolization (PTPE) of the right hepatic vein before right hepatectomy. As portography detected a congenital portosystemic between hepatic vein shunt, she first underwent transcatheter coil embolization.

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Successful treatment with duodenal varices using combined sclerotheraphy using percutaneous transhepatic obliteration (PTO) and balloon-occluded retrograde transvenous obliteration (B-RTO)

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We performed combined sclerotheraphy using PTO/BRTO for duodenal varices with multiple supply and drainage veins visualized by percutaneous transhepatic venography on cone beam CT.

P-476

Recurrent encephalopathy ameliorated by lienorenal shunt reduction

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Patient had recurrent episodes of encephalopathy due to large lienorenal shunt. A self expandable nitinol stent reshaped into an hour glass by tying a 4.0 Prolene was deployed in the shunt followed by coils between vessel wall and stent.

P-477

Acute extensive portal, superior mesenteric and lineal venous thrombosis treated with transcatheter superior mesenteric artery urokinase infusion therapy

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A 55-year-old man with protein S and protein C deficiency underwent a left hemicolectomy; after 18 days he developed an acute extensive portal, superior mesenteric and lineal venous thrombosis successfully treated with transcatheter superior mesenteric artery urokinase infusion therapy.

P-478

Gastric varix draining into portopulmonary venous anastomosis: treatment with percutaneous transhepatic sclerotherapy

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Portopulmonary venous anastomosis (PPVA) is a potential channel for systemic arterial embolization during embolization of gastroesophageal varix. A 67-year-old male with gastric varix draining into PPVA was successfully treated with percutaneous transhepatic sclerotherapy.

P-479

Transjugular intrahepatic portosystemic shunt (TIPS) in patients with refractory variceal bleeding and portal vein thrombosis. A case report

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A 44-year-old-female with HCV-related cirrhosis and portal cavernoma was admitted for epigastric pain and hematemesis for recurrent variceal bleeding. TIPS was successfully performed with a "rendez-vous" trans-splenic approach. Follow-up at one month showed correct patency of the shunt.

P-480

Have you ever seen massive extravasation at B-RTO for isolated gastric varices?

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B-RTO has been an effective and safe interventional procedure for gastric varices. However, we encountered the massive extravasation during B-RTO but finally succeeded the procedure. We will show the cause of extravasation and how to get over this.

P-481

Multi-access, multimodality recanalisation of a TIPS shunt

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A 33-year-old female underwent a standard 10mm x 6mm TIPSS. CT portal venogram confirmed the stent thrombosed post-procedure. We successfully recanalised the stent via transjugular and transhepatic approaches and deployed a 10x8mm TIPSS stent with post-deployment angioplasty and angiogram.

Urinary tract intervention

P-482

Nephron-sparing targeted radiofrequency ablation of angiomatous components of angiomyolipoma (AML) - proof of concept study

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Purpose: Renal AMLs are prone to spontaneous bleeding. Active management should preserve renal function but partial nephrectomy or selective embolisation may endanger non-target normal renal tissue. In theory, radiofrequency ablation (RFA) may be used to ablate only angiomatous areas, sparing normal renal tissue. However, fat is a poor electrical conductor and RFA may not achieve ablative temperatures.
Material and Methods: This is a study to evaluate the technical feasibility of ablating large-volume fatty tumours. 4 patients with large AMLs (7.3 – 32 cm) at risk of haemorrhage and renal failure studied. Under CT guidance, principally angiomatous areas ablated (StarburstTM XLi saline cooled probe). Multiple ablations (4-7 cm diameter) undertaken in each case. 3D tumour volume analysis

carried out pre and post procedure, to calculate angiomatous/total volume fraction.
Results: No intra-procedural major complications. Target temperature > 95^0C achieved in all. Ablated areas have become less vascular and fattier. Soft tissue/tumour volume fraction has decreased from mean 0.26 (range 0.14-0.48) to 0.16 (0.04-0.34); p = 0.04. Mean follow-up period 3 years, no patient has had renal haemorrhage. Global renal function is stable. No significant change in size of AMLs (p = >0.05).
Conclusion: The concept that RFA can be used to successfully and safely ablate large volumes of renal AMLs has been proved. Problems with impedance and poor conductivity in fat are overcome by the use of saline-cooled probes with modulation of target temperature. Large-volume ablations are feasible in fatty renal tumours. We are continuing to recruit patients.

P-483

Iatrogenic ureteric injuries: imaging features and role of interventional radiology in management

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Learning objectives: 1. To illustrate the imaging findings of iatrogenic ureteric injuries, with emphasis on multi-slice CT, MR and nuclear medicine. 2. To discuss the role of interventional radiology in its management.
Background: Ureteric injuries are common following abdominal, pelvic or laparoscopic surgery and are often undiagnosed at the time of the operation. We present six cases of post-operative ureteric injuries in the form of a pictorial review, describing the aetology, presentation and outcome following radiological intervention.
Clinical Findings/Procedure Details: (Surgical procedure - presentation - diagnosis - management) Case 1: Laparoscopic laser diathermy - abdominal swelling - partial ureteric disruption and urinoma - percutaneous drainage of urinoma, nephrostomy and retrograde ureteric stent Case 2: Laparoscopic egg harvest - pelvic pain - partial ureteric disruption - nephrostomy and antegrade ureteric stent Case 3: Total abdominal hysterectomy and bilateral salpingo-oophorectomy - loin pain - ligation of lower ureter - nephrostomy and antegrade ureteric stent Case 4: Vaginal hysterectomy - leaking urine per vagina - partial ureteric disruption and ureterovaginal fistula - nephrostomy and antegrade ureteric stent
Case 5: Anterior-posterior resection - leaking urine per perineum - complete ureteric transection and uretero-cutaneous fistula - nephrostomy and ureteric re-implantation Case 6: Laproscopic sacroplexy - loin pain - complete ureteric transection and urinoma - percutaneous drainage of urinoma, nephrostomy and ureteric re-implantation
Conclusion: The role of intervention radiology in the management of iatrogenic ureteric injury includes reduction of urine leakage, drainage of urinoma and ureteric stenting to allow ureter to heal. Surgical re-implantation is reserved for cases where stenting failed.

Venous intervention and IVC filters

P-484

Low energy of endovenous laser ablation of the great saphenous vein under ultrasound-guided femoral block anesthesia is safe and effective as a day case procedure

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Purpose: To assess clinical outcomes, complication rates, and unit energy applied using 980 nm diode endovenous laser treatment at average 11 watts energy applied for symptomatic great saphenous vein (GSV) reflux disease. In addition, assess the efficacy and safety of ultrasound-guided femoral block anesthesia for day case surgery.
Material and Methods: Sixty consecutive ablation therapies with a 980 nm diode endovenous laser at average 11 watts under u/s-guided femoral block were studied. The patients were followed with clinical evaluation and color flow duplex studies up to 10.18 months.
Results: Technical success was 100%. 0% recanalization was noted; 90% clinical improvement was achieved. There was no major complication, 0% developed deep venous thrombosis and 0% of patients developed hematoma or nerve damage post nerve block. Six patients (10%) required admission suffered from decrease of motor power for more than 6 hours due to effect of femoral block that required one day hospitalization. No adjuvant narcotic analgesic required for all cases in first 48 hours.
Conclusion: Endovenous low energy laser ablation treatment of GSV using a 980 nm diode laser at average 11 watts with average 40 J/cm in continuous mode with safe and effective, resulting in 0% recanalization and low minor complication rates. Ultrasound-guided femoral block appears as a good and safe anesthetic option for day case surgery with low risk of complications.

P-485

Multiple approaches to recanalize ilio-femoral vein obstruction

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Purpose: To summarize the various approaches for recanalization of ilio-femoral vein obstruction with endovenous techniques.
Material and Methods: Herein, we retrospectively reviewed our single center data of ilio-femoaral vein obstruction recanalized using endovenous techniques – catheter-directed thromlysis and/or PTA w/o stents. The approaches of endovenous manipulation were analyzed, and the relative complications were recorded. The indications, advantages and disadvantages were analyzed.
Results: From April 2000 to December 2010, a total of 196 ilio-femoral venous obstruction were recanalized using endovenous techniques in our center. In total, five approaches were applied in our cohort, and there was a learning curve of endovenous approach modification in our hands. In the beginning of our practice, common femoral vein cut-down was dominantly applied for insertion of sheath due to thrombi here, but bleeding and lymphatic leakage were commonly encountered due to systemic thrombolysis. Then we developed the second approach – exposure of great saphenous vein for sheath insertion, proved simple and safe, providing enough length for endovenous procedures, but still requiring a cut-down. For mini-invasiveness, in the last couple of years, we preferred puncture approaches, popliteal vein puncture is most common used, ankle great saphenous vein puncture is another choice, distal part

femoral vein puncture is sometimes used.
Conclusion: Recanalization of obstructed ilio-femoral vein is of great significance for symptomatic patients. From cut-down to puncture, from upper location puncture to lower location puncture, there were at least five approaches can be selected for endovenous therapy. The approach should be selected individually. We nowadays prefer popliteal vein puncture for most cases, ankle great saphenous puncture is also one of our preferences.

P-486

Transcatheter embolization with fibered coils and 3% sodium tetradecyl sulfate foam for 121 adolescent patients with varicocele in the free-standing intervention clinic

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Purpose: To report the results of treatment of the 121 adolescent patients with varicocele with use of coils and 3% sodium tetradecyl sulfate (STS) foam in the free-standing intervention clinic.
Material and Methods: From December 2007 to December 2010, 121 adolescent patients (mean age, 16.4 years; range, 10-19 years) with symptomatic varicocele, surgical recurrence or over grade III disease underwent embolization with coils and STS foam. The gonadal vein (GV) was catheterized using right antecubital venous access with 4F cobra catheter. First coil was placed distally in the GV and 3% STS foam was injected during compression for minimal injection into the pampiniform plexus. Our standard follow-up, consisting of ultrasound and physical examination, was performed 1 week, and 3-12 months. We evaluated the technical success rate, complication, and recurrence and also calculated the fluoroscopic time and procedure time.
Results: The technical success rate was 95% (115 of 121 patients). The results of 106 patients (87.6%) who underwent follow-up US revealed incomplete occlusion of the reflux in the scrotum in 8 (7.5%) patients. Four of 8 patients underwent re-embolization successfully; the other 4 patients were referred to urologist. Five patients had about 48 hours of scrotal discomfort as a result of pampiniform phlebitis and one patient had a skin allergy to sclerosant. Mean procedure time was 15 minutes (range, 6.5-44 min) and mean fluoroscopic time was 7.4 minutes (range, 2.9 - 26.4 min).
Conclusion: Transcatheter embolization with coils and 3% STS foam is a safe and effective procedure for adolescent patients with varicocele.

P-487

Single center experience with the option inferior vena caval filter

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WITHDRAWN

P-488

A strategy for improved recovery of retrievable inferior vena cava filters: they will not come out if they do not come back

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WITHDRAWN

P-489

Clinical safety and effectiveness of "option" inferior vena cava filter

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Purpose: To evaluate the safety and effectiveness of the "option" inferior vena cava (IVC) filter during implantation and short-term follow-up.
Material and Methods: The "Option" IVC filter (Angiotech® Pharmaceuticals Inc, Vancouver, BC) is FDA approved for the prevention of pulmonary emboli. The data of 113 patients (69 M; age: 19-93 Y, mean 58y) who had an option filter implanted between July 2009 and August 2010 were reviewed. 19/113 (17%) presented with symptoms of pulmonary embolism (PE), 16 (14%) with deep vein thrombosis (DVT), and 16 (14%) with both. Indications for filter placement were contraindication to anticoagulation (n=61; 54%), prophylaxis/added protection (n=49; 43%), and failure of anticoagulation (n=3; 3%). Procedure-related and follow-up data were reviewed for filter-related complications and recurrent PE.
Results: 22/113 (19%) filters were implanted using intravascular ultrasound (IVUS) guidance, 84/113 (74%) using fluoroscopy, and 5/113 using both IVUS and fluoroscopy (5/113, 4%). One filter was deployed in the common iliac vein on IVUS and was repositioned to infrarenal IVC under fluoroscopy. There were no other procedure-related complications. During clinical follow-up (median 3, range: 0-15 months), two patients had CT-confirmed post-filter PE. Follow-up abdominal CT, available in 26, showed filter leg penetration of >3mm in one and non-occlusive filter thrombus in another. None had IVC occlusion. 16/113 (14%) had post-filter DVT. 18/113 (16%) died during follow-up. Ten filters were successfully retrieved (mean implantation – 4, range: 0-11 months).
Conclusion: The "option" inferior vena cava filter appears to be safe and effective during implantation and short-term follow-up.

P-490

Improving IVC filter retrieval rate with institution of clinical follow-up through an IVC filter clinic

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Purpose: To determine the baseline retrieval rate of IVC filters at our institution and to see if this rate can be improved by instituting follow-up in all patients who received IVC filters. We established an IVC filter clinic and identified and contact all patients who have received retrievable inferior vena caval filters in the past 6 months to determine if retrieval is indicated.
Material and Methods: Electronic medical record search was done to: determine baseline retrieval rate, identify all patients who have received retrievable inferior vena caval filters between August 1, 2009 and December 31, 2009. Patients and/or referring physicians were contacted and clinical charts were reviewed. Relevant patients were seen in clinic and undergo filter retrieval if indicated. Attending physicians, fellows, technologists, and nursing participated in follow-up .
Results: Prior to intervention, 16% (13/82) of filters were removed (baseline retrieval rate). We were able to obtain follow-up on an additional 61 patients. 46 were not candidates for filter retrieval for a variety of reasons, including inability to anticoagulate. 15 (18%) additional patients were contacted for filter removal that otherwise would have not been seen.

Conclusion: Retrieval rate improved by 15% to 33% with the establishment of an IVC filter clinic and institution of routine follow-up on all patients who received filters. This has resulted in better patient outcomes and possibly decreases the institution liability. The majority of patients were not candidates for retrieval which raises the question of whether we should be inserting permanent filters in a higher number of patients.

P-491

First option for the treatment of the acute left iliofemoral venous thrombosis: thrombolysis or dilatation? Analysis of 45 cases

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Purpose: To evaluate the efficacy and complications of two different procedures in the interventional treatment of acute left iliofemoral venous thrombosis.
Material and Methods: Fourty-five patients with acute left iliofemoral venous thrombosis were divided into 2 groups. Twenty one cases as group A were treated with catheter-directed thrombolysis (CDT) in the left iliofemoral vein from the popliteal vein. Balloon dilatation or stent implantation was applied if there were residual stenosis after thrombolysis. In group B 24 cases were treated with balloon dilatation firstly in the vein and thrombus, then followed by CDT therapy. Stent implantation was applied if there were residual stenosis . The optional filter was inserted in the inferior vena cava and removed within two weeks for all patients.
Results: In groups A and B, balloon dilation was applied in 18 and 24 cases (P=0.09), and the stents were placed in 11 and 16 cases individually (P=0.24). The mean urokinase dosage used in two groups were (427.14 ± 49.71)×104 vs 315 ± 62.48)×104 units, which had significant difference (P<0.001). The thrombus was found in the cava filters in 2 or 8 cases individually. The edema reduction rates of the legs were (71 ± 19)% and (81 ± 12)% after a week (P=0.03), (98 ± 3)% and (99 ± 2)% after a month (P=0.26). The bleeding complications occurred in 7 and 2 cases (P=0.042) among 2 groups.
Conclusion: In the treatment for acute left iliofemoral venous thrombosis, balloon dilatation followed by thrombolysis could reduce the amount of urokinase and the incidence of complications.

P-492

Usefulness of IVUS in diagnosis of chronic cerebrospinal venous insufficiency and multiple sclerosis

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Purpose: Chronic cerebrospinal venous insufficiency (CCSVI) is a cerebrospinal venous disease that recently has been considered related to multiple sclerosis. Diagnosis may be performed by Doppler ultrasonography and angiography. One limit of angiography is the lack of visualization of venous wall aspects. We investigated in our study the usefulness of IVUS to detect CCSVI anomalies.
Material and Methods: From September 2010 and January 2011, 13 patients with multiple sclerosis and CCSVI, evaluated by Doppler US, were enrolled in this study. Venography was performed through a left transfemoral retrograde access with 5 Fr introducer sheet. Venography and IVUS control was performed at ileo-lumbar level, bilateral jugulars and azygos vein.
Results: All patients showed a stenosis of at least one vein. In all cases IVUS confirmed flebographic control. IVUS allowed to evaluate anomalous valve movement that was not evident at flebographic control in 5 patients (38%). 4 patients (31%) had an anomalous membrane of azygos vein. Moreover, a double lumen aspect was present in some cases.
Conclusion: IVUS is a useful device to detect venous anomalies in CCSVI. Particularly it allows a complete evaluation of valve movement that could not be performed with flebographic control. Moreover, it is fundamental to evaluate the Azygos vein structure that could not be showed clearly with US Doppler.

P-493

Comparative study of ultrasound-guided foam sclerotherapy and subfascial endoscopic perforator surgery

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Purpose: Varicose veins of the lower limb are being treated with a number of modalities, mostly by surgical methods. Present study was conducted to compare foam sclerotherapy with surgical treatment of varicose veins.
Material and Methods: The study was conducted in Deen Dayal Upadhyay Hospital, Delhi, on total of 60 patients randomized into two groups of 30 patients each. Both the groups were comparable in terms of preprocedural clinical parameters. After the completion of the study the patients were followed for mean period of more than one year by clinical examination and Doppler study.
Results: The symptomatic and clinical outcomes achieved in both the groups were similar. Foam sclerotherapy was easily administered, well tolerated, safe procedure which was done without risks of anaesthesia and surgery; moreover, no hospitalization was needed. Patients returned to their activities the very next day.
Conclusion: The ultrasound-guided foam sclerotherapy was found to be effective and durable method of treatment of varicose veins and the associated complications. As alternative to subfascial endoscopic perforator surgery along with stripping, foam sclerotherapy may lead to fewer skin and wound healing complications. It also results in no loss of daily activities because of hospitalization, a factor of great importance in our patient group.

P-494

Influence of pressure changes produced by respiratory movements and Valsalva's maneuver in inferior vena cava diameter in patients with IVC filter. Prospective study in 20 patients

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Purpose: To study the pressure of IVC in normal breathing and in Valsalva's maneuver and its correlation with vena cava cross-sectional area in patients with a Günther Tulip IVC filter (GT).
Material and Methods: Twenty patients scheduled for filter retrieval were studied by CT in normal breathing and Valsalva's maneuver, measuring two IVC diameters in 3 different places (at renal veins junction, 3 cm above and 3 cm below). Venous pressure was taken at the renal veins junction during filter retrieval via right jugular vein, taking 3 different measures in normal breathing and Valsalva's. Inclusion criteria were: indication for filter retrieval, informed consent, >18 y.o. and normal pulmonary artery pressure (measured previous to filter retrieval). Exclusion criteria were: history or signs of right heart failure, vena cava thrombosis or sedation. All patients were instructed to perform a Valsalva maneuver. Pressures

and cross-sectional areas were statistically correlated.
Results: No complications were recorded. Mean age of the sample was 54.9 (range 20-77) and 50% were men. Mean area in normal breathing was 1704.52±271.58 mm2 and in Valsalva's maneuver 360.49±244.81 mm2 showing a mean decrease of 79%. Mean venous pressure in normal breathing was 8.2±3.9 mmHg and in Valsalva's 92±30 mmHg, showing a mean increase of 1022%. There was a high correlation coefficient between size decrease and pressure increase (r=0.87).
Conclusion: Respiratory movements have a strong influence in the diameter and venous pressure of IVC, specially Valsalva´s maneuver that greatly decreases the cross-sectional area and increases the pressure. These data may be important to prevent IVC filter migration/perforation.

P-495

Procedural complexity and complications associated with multiple PICC line insertions in pediatric patients: the tip of the iceberg

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Purpose: With increasing sophistication of medical therapies, the need for central venous access devices (VAD) has grown. PICCs are suitable for medium duration therapies. Thromboses, occlusions, stenoses & collaterals are encountered in children undergoing repeat PICCs, frequently in the axillary/subclavian vein. The purpose is to indirectly determine the effects on the venous system from PICCs in children, by reviewing patients with multiple PICC insertions (1st, 2nd, 3rd etc.) for evidence of procedural difficulties or complications with subsequent PICCs, and to assess the scale of the problem if present.
Material and Methods: Retrospective review of children who had their 1st PICC placed between 2005 and 2007. Subsequent PICCs were compared to each prior PICC. Patient demographics, procedural data and complications were collected and analyzed using IR and Vascular Access database, PACS, and patient charts.
Results: 1st time PICCs (n=1,274), 2nd time PICCs (n=167), 3rd (n=52) and 4th– 8th (n=32). Successive PICCs were associated with progressively increased difficulty of access, demonstrated by increase in procedural length (p<0.01), fluoroscopy time (p<0.001) and interventional costs (p<0.001). Incidence of procedural difficulties (venous stenosis, spasm, extravasation, collaterals, need for venogram) also increased in number and frequency for subsequent PICCs (p=<0.001).
Conclusion: Increased procedural complexity and complications were found with each successive PICC insertions. Although a valuable VAD in children, PICCs are associated with adverse sequelae on the venous system. Further prospective imaging studies needed to directly assess their effects on venous patency.

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Ultrasound-guided femoral nerve block for endovenous laser treatment of the great saphenous vein

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Purpose: To prospectively evaluate the feasibility, safety and outcome of ultrasound (US)-guided femoral nerve block during laser ablation of the great saphenous vein insufficiency.
Material and Methods: Thirty consecutive patients (age range 19 to 56 years) with unilateral or bilateral great saphenous vein insufficiency with no other truncal vein insufficiency had laser ablation of the great saphenous vein. We performed US-guided femoral nerve block to provide anesthesia for the procedure. Fifteen mL of 1% lidocaine was administered around each femoral nerve under US guidance. Tumescent anesthesia was applied under US-guidance to every patient after the femoral block. However, tumescent anesthesia did not contain local anesthetic. Pinprick test was performed at 7 levels along the great saphenous vein after femoral nerve block 5, 10 and 20 minutes after the block and the pain levels were measured. A patient satisfaction score was filled after the procedure by each patient.
Results: US-guided femoral nerve block caused anesthesia of all levels along the great saphenous vein except the first level at the groin (saphenofemoral junction region or level 1) and the ankle area (level 7). Seven patients required additional intravenous sedation in addition to femoral nerve block. Patient satisfaction was excellent after the procedure.
Conclusion: US-guided femoral nerve block could be a very good alternative to other methods of anesthesia for endovenous laser treatment of the great saphenous vein insufficiency. The method was simple, easy to perform and obtained very good results. Anesthesia at the groin and ankle points was sometimes insufficient.

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Inferior caval vein torsion following modified piggyback orthotopic liver transplantation: percutaneous treatment by primary stenting

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Purpose: To evaluate the Gianturco-Rosh Z-stent placement for patients with inferior caval vein torsion after modified piggyback orthotopic liver transplantation (OLT).
Material and Methods: From November 2003 to September 2010, 7 patients developed clinical, laboratory, ultrasound (US) or computed tomography (CT) findings suggestive of caval stenosis, after a mean period of 7 days from modified piggyback OLT. In all patients the inferior caval vein angiogram showed a stenosis due to torsion of the inferior vena cava at the anastomosis site and a significant caval venous pressure gradient. All 7 patients were treated with primary stenting, and in two cases a caval angioplasty post stent placement was necessary.
Results: In all patients, stents were successfully positioned at the caval anastomosis and the venous gradient pressure was reduced (mean value from 10 to 2 mmHg). Signs and symptoms resolved in all patients. One patient died 98 days after stenting for biliary complications and one required a stenting of a suprahepatic vein. Clinical, US and CT follow-up average was 37 months without evidence of recurrence or complications.
Conclusion: Primary stent placement for inferior cava vein stenosis due to torsion of the anastomosis, in patients who underwent to modified piggyback OLT, is safe, effective and durable. This bare stent guarantees successive interventions. The use of proper stent length and trans-jugular approach avoids recurrence and complication such as migration.

P-498

Management of pelvic varicosities with ultrasound-guided foam sclerotherapy without antegrade embolization

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Purpose: To investigate the value of ultrasound-guided foam sclerotherapy (US-GFS) without antegrade coil embolization of the ovarian/hypogastric veins in the management of pelvic vein insufficiency.
Material and Methods: During a 5.5-year period, 54 patients (104 legs) underwent (US-GFS) for varicosities secondary to pelvic vein insufficiency (PVI). In all patients (49 F, 5 M), there were dilated, tortuous and refluxing veins that originated from the pelvis and extended along the leg. In 34 legs, there was also reflux in the great (GSV) or small saphenous veins (SSV), which was secondary to the PVI. In another six legs, there was additional reflux in the perforating veins (n = 3) and GSV (n = 3), which was independent of the PVI. In all patients, PVI and the resulting varicosities were treated with (US-GFS). If present, the incompetent truncal and perforating veins were treated with endovenous laser ablation (ELA). Patients were followed up clinically and with color Doppler ultrasound at 1, 3, 6 and 12 months.
Results: US-GFS and ELA were technically successful in all cases. In 34 legs, one treatment session was performed, while in 70 multiple (2-4) US-GFS sessions were necessary. Complications included transient hyperpigmentation (72 legs), skin necrosis (1 leg) and transient visual disturbances (2 patients). During the follow-up, only four patients required coil embolization of the gonadal/pelvic veins due to persistent PVI.
Conclusion: Lower extremity varicosities due to PVI can be successfully treated with US-GFS alone. This approach may eliminate the risk and high cost of the antegrade coil embolization in the vast majority of cases.

P-499

Tumescent-augmented sclerotherapy: a new method in the treatment of large varicose veins

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Purpose: Large varicose veins are difficult to treat with standard liquid or foam sclerotherapy, since they require a higher sclerosant dose and concentration and the complication rate may be higher due to the presence of excessive blood in the vein lumen. The purpose of our study was to investigate the value of perivenous injection of tumescent solution to increase the effectiveness of ultrasound-guided foam sclerotherapy (US-GFS) for large varicose veins.
Material and Methods: During a 28-month period, tumescent-augmented sclerotherapy (TAS) was performed in 90 legs of 61 patients for large (1-3 cm) varicosities due to saphenous or perforating vein insufficiency. In all patients, after the incompetent saphenous or perforating veins were ablated with endovenous laser, multiple butterfly needles or IV cannulas were placed into the large varicosities. Then, these veins were collapsed by US-guided perivenous tumescent injection and the US-GFS was then performed using a 1-3% polidocanol foam. Patients were followed up clinically and with color Doppler ultrasound at 1, 6 and 12 months.
Results: TAS was technically successful in all patients. Complications included mild hyperpigmentation (n = 42) and skin necrosis (n = 1). Superficial thrombophlebitis did not occur. Postoperative pain and tenderness were minimal in all patients. During the follow-up, recanalization was seen in three legs with very large (2-3 cm) varicosities, due to recurrent truncal vein reflux, which was successfully treated with US-GFS.
Conclusion: TAS is highly safe and effective in the treatment of large varicosities. By reducing the vein size and emptying the blood content, it may increase the effectiveness and decrease the complication rate of standard US-GFS.

P-500

Prevalence of internal jugular vein abnormalities on contrast-enhanced MR phlebography in patients with multiple sclerosis in comparison to control group

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Purpose: To assess the prevalence of internal jugular vein (IJV) stenosis in patients with multiple sclerosis (MS) in comparison to control group (CG).
Material and Methods: MR studies of 100 patients imaged with contrast-enhanced 3DT1GRE sequence (1.5T Siemens, Avanto) were retrospectively reviewed. The study group consisted of 50 patients with confirmed MS (18 men, 32 women; mean age-47.3) and 50 patients in control group (22 men, 28 women; mean age-44.8) referred for MRI for the following indications: suspected intracranial tumor (n=18), epilepsy (n=12), suspected vascular disease (n=10), headaches (n=2), other (n=8). The presence of internal jugular vein stenosis was assessed by two radiologists experienced in MR imaging, separately for the upper, middle and mid-lower segment (distal, lower IJV was not included in examination in CG and was not evaluated). Cases of interobserver disagreement were resolved by consensus. Data were compared between groups using U Mann-Whitney test.
Results: In the upper segment of IJV 46 stenoses (compression by C1 lateral mass) were noted in MS patients and 52 in CG ($p>0.05$); in the middle section of IJV there were 20 stenoses (carotid compression) in the MS group, compared to 22 in the CG ($p>0,05$) and in the mid-lower portion of IJV 17 stenoses (compression by sternocleidomastoid muscle) was seen in MS patients and 3 in CG ($p<0,05$).
Conclusion: There was no statistical significance in the prevalence of stenosis in the upper and middle segments of IJV, between the MS and the control group. In the mid-lower part of IVC the stenoses were significantly more frequent in the MS group.

P-501

Long-term results of percutaneous transluminal angioplasty for anastomotic stenosis of hepatic vein after living donor liver transplantation

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Purpose: To evaluate retrospectively the long-term results of percutaneous transluminal angioplasty (PTA) for anastomotic stenosis of hepatic vein after living donor liver transplantation.
Material and Methods: Between August 1997 and December 2010, 56 patients (23 men, 33 women; median age, 8 years) with a history of living donor liver transplantation, who were confirmed to have anastomotic stenosis at hepatic venography and manometry, underwent PTA. The interval between the transplantation and the initial PTA was three to 98.3 months (median, 18 months). Patients who developed recurrent stenosis during follow-up were re-treated with PTA with or without expandable metallic stents. Patency was analyzed by using Kaplan-Meier analysis. Follow-up periods after the initial PTA ranged from one to 160 months (mean ± standard deviation, 61.0 months ± 53.2 months).
Results: A total of 134 PTA sessions were performed in all 56 patients. A major complication was noted in a session of a 15-year

man, where a metallic stent had migrated into the right atrium. During the follow-up periods, 29 patients showed no recurrent stenosis after the initial PTA. But 27 patients had recurrent stenosis and were re-treated with PTA, 11 of whom underwent metallic-stent placement. Fifty-two patients had patency of hepatic vein, but four developed obstruction of hepatic vein. The primary (event-free), primary assisted, and secondary patency at 1-, 3-, 5-, 10-years after the initial PTA were 54.6%, 48.7%, 48.7%, 43.3%, respectively, 93.7%, 87.0%, 87.0%, 87.0%, respectively, and 93.7%, 91.3%, 91.3%, 91.3%, respectively.
Conclusion: PTA may be an effective treatment for anastomotic stenosis of hepatic vein after living donor liver transplantation.

P-502

IVC filter retrieval: closing the loop

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Purpose: To evaluate inferior vena caval (IVC) filter retrieval practice after implementation of an actively managed retrieval program. This study followed an audit on IVC filter retrieval rate in the two major Hospitals in Edmonton, The University Hospital of Alberta and The Royal Alexandra Hospital.
Material and Methods: A previous audit on IVC filter retrieval rates carried out in 2008 revealed a low retrieval rate (including attempted retrieval) of 36%. A number of recommendations to improve this through follow-up were set up. A total of 107 filters were inserted in an 18-month period from January 2009 to July 2010 with follow-up for at least six months. The records of these patients were reviewed to determine how many were potentially retrievable, the actual number retrieved and the technical success rate.
Results: A total of 69 filters were thought to be indicated for retrieval (65%).The actual number of filters retrieved (or attempted) was 48 (70%).The combined technical success rate was 98%. There were six patients (13%) who had large thrombus in the filter preventing retrieval; of these only two (4%) were not retrieved due to persistent thrombus on a second later attempt.
Conclusion: The technical success of the IVC filter retrieval rate compares favourably to the published data. A significant improvement in the attempted IVC filter retrieval was seen following implementation of an active follow-up program.

P-503

Endovenous laser ablation in the treatment of truncal saphenous insufficiency: single-center experience with at least one-year follow-up

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Purpose: To evaluate the efficacy and safety of endovenous laser ablation (EVLA) of the incompetent truncal saphenous veins with at least one-year follow-up.
Material and Methods: From January 2007 to January 2011, only 220 patients (308 legs, 378 vessels) with truncal saphenous incompetency treated with EVLA and completely observed during at least one-year period were included into the study. All patients were symptomatic (C2-C6) regarding CEAP classification. The target vein was accessed under ultrasound guidance using micropuncture system and after tumescent anesthesia, laser ablation using a 980 nm diode laser was executed. Scheduled follow-up including duplex ultrasound and clinical examinations were performed before the procedure, at 1st week, and 1st, 3rd, and 12th months, and annually after the procedure. Patients were evaluated for lumen recanalization, deep venous thrombosis, skin burns, nerve injury, dynamics of clinical symptoms according to patient satisfaction and venous clinical severity score (VCSS).
Results: Successful access was achieved in 98.2% of patients because of dissection in one and long lasting spasm in 3 patients. EVLA was succeeded in 99.5% of patients due to the device failure in one patient. Lumen recanalization was detected in 4 patients (1.8%). No major complications were found at the follow-up examinations. The symptom relief was confirmed in 93.6% of patients and reduction of VCSS values was established in 91.4% of patients.
Conclusion: EVLA is an effective and safe procedure for treating truncal saphenous incompetency. This technique provides intended clinical outcome presented as relief of the dominant symptoms in majority of patients during at least one-year follow-up period.

P-504

Initial experience treating chronic cerebro spinal venous insufficiency (CCSVI): preliminary results in 15 patients

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Purpose: To evaluate feasibility, tolerance and initial response to balloon angioplasty in patients with multiple sclerosis (MS) and imaging confirmed CCSVI.
Material and Methods: Fifteen patients with MS (8 women) were selected for this treatment (7 relapsing-remitting, 8 secondary progressive). After informed consent, the evaluation consisted in neurologic (EDSS, MSIS 29, fatigue, heat tolerance and sleepiness scale), laboratory and cervical color Doppler ultrasound (CDU) tests. Internal jugular veins (IJV), azygos phlebography and manometry were performed with standard technique previous to angioplasty. Initial follow-up from 3 months consisted in neurologic and CDU control. Complications described were related to angioplasty. Definitions include: positive, absent and mixed response.
Results: Angioplasty was feasible in 15 cases and 3 patients suffered minor complications without neurologic effect. CDU showed 2 Zamboni´s criteria of CCSVI in most of the affected IJV and excellent phlebographic correlation in 27/30 studied IJVs. Four, 6 and 5 patients had phlebographic Zamboni´s type A, B and C. Before treatment, patients presented with mean EDSS scores of 5.5 to 6 and 10 of them improved scores in scales after angioplasty at 3 months. Seven over 26 treated IJVs had restenosis in 6 patients. One case had positive response despite restenosis, 3 patients relapsed neurologic disabilities after angioplasty. The other 2 patients did not reply to angioplasty.
Conclusion: CCSVI has close relation with MS and venous angioplasty can be used safely with excellent tolerance to improve MS symptoms. In some patients, disabilities relief after balloon angioplasty may be limited because of restenosis and/or other still unknown mechanism.

P-505

Endovenous laser ablation of the incompetent anterior accessory great saphenous vein: single-center experience

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Purpose: To evaluate the efficacy and safety of endovenous laser ablation (EVLA) of the incompetent anterior accessory great saphenous vein (AAGSV) (infrequent but important disorder for interventional radiology department) in symptomatic patients (C2-C6) regarding CEAP classification.
Material and Methods: From January 2007 to January 2011, 29 legs

(27 patients) with AAGSV incompetency documented by duplex Doppler ultrasound studies were treated with EVLA using a 980 nm diode laser. The AAGSV was accessed under ultrasound guidance using micropuncture system and after tumescent anesthesia, laser ablation was executed. Scheduled follow-up including duplex ultrasound and clinical examinations were performed before the procedure, one week, and one, three, six, twelve months, and then annually after the procedure (mean follow-up, 13 months). Patients were evaluated for lumen recanalization, deep venous thrombosis (DVT), skin burns, nerve injury, and dynamics of clinical symptoms according to patient satisfaction and venous clinical severity score (VCSS).
Results: Successful access was performed in all patients, and all treated AAGSVs were occluded immediately after laser ablation. Lumen recanalization detected in one patient (3.7%) three months after procedure was successfully treated with repeated EVLA . Major complications such as DVT, paresthesia or skin burning were not found at the follow-up ultrasound and clinical examinations. The symptom relief was confirmed in 93.1% of patients according to reduction of VCSS values.
Conclusion: Our intermediate-term results demonstrate that the EVLA is effective and safe procedure for treating AAGSV incompetency. This technique provides intended clinical outcome with low rate of lumen recanalization.

P-506

Iliofemoral venoocclusive disease: special reference to vascular remodeling

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Learning objectives: 1. To review and illustrate the anatomy of the iliofemoral venoocclusive disease (IVD). 2 To demonstrate the primary and secondary diseases of IVD in relation with circulation of arteriovenous vasculatures. 3. To demonstrate the catheter-directed treatment of IVD.
Background: When iliofemoral vein occlusion with many causes occur, several vascular changes will be seen as a result of vascular remodeling.
Clinical Findings/Procedure Details: The contents of our exhibit are (a) anatomy (iliofemoral vein anatomy and pathology), (b) primary IVD, (c) Secondary IVD caused by inflammation, tumor, pregnancy and iatrogenic etiology, (d) pathological disease (remodeling or arteriovenous fistula) caused by IVD (e) Catheter-directed treatment of IVD.
Conclusion: The major teaching points of this exhibits are: 1. IVD are caused by primary and secondary etiologies. In particular, secondary IVD are affected by circulation of arteriovenous vasculatures. 2. Various iatrogenic IVD are also illustrated and discussed about endovascular treatment.

P-507

Adrenal venous sampling: tips for technical success

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Learning objectives: Adrenal venous sampling (AVS) is a widely accepted gold standard for the diagnosis of primary aldosteronism; however, sampling of the right adrenal vein is especially difficult. Herein, we discuss several points that would ensure precise and safe catheterization of the adrenal vein.
Background: Primary hyperaldosteronism is the most common treatable cause of secondary hypertension and is more common than previously believed. As a result, AVS is being performed more frequently at some institutions; however, precise catheterization of the adrenal vein poses several problems especially right side.
Clinical Findings/Procedure Details: Dynamic contrast-enhanced multi-detector computed tomography (MDCT) with multi-planner and 3D reconstruction can be useful to clarify the adrenal venous anatomy and to achieve selective catheterization. Special 3D reverse-shaped catheters are useful for achieving rapid and stable catheterization; moreover, side-hole microcatheters are useful for draining sufficient amount of venous blood. In some cases, super-selective blood sampling from the adrenal vein branch is possible with the microcatheter. The most common minor complication associated with adrenal venous catheterization is extravasation. This complication can be avoided by gentle maneuver and low-pressure contrast injection.
Conclusion: Dynamic contrast-enhanced CT is mandatory for performing AVS. The use of special 3D reverse-shaped catheters and side-hole microcatheters is advisable for draining sufficient amount of blood from a precise venous branch.

P-508

Utilising the radiologist: working together to modernise and improve outcomes in venous thoracic outlet syndrome

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Learning objectives: To understand modern management of venous thoracic outlet syndrome.
Background: Venous thoracic outlet syndrome (vTOS) is a rare, sometimes debilitating, condition affecting young people. A combined radiological and surgical approach is required for successful treatment of the disease. The aim of this study was to quantify the management and mid-term outcomes of patients treated for vTOS over a seven-year period.
Clinical Findings/Procedure Details: A retrospective case-note review of all patients undergoing first rib resection at a regional vascular unit between 1/1/2002 and 31/12/2009. Treatment pathways were identified and outcomes recorded as freedom from symptoms and venous patency. Analysis was by Kaplan Meier survival curves and Mantel Cox Log Ranking, quantifying outcome by time from symptoms to presentation, method of initial treatment and time to definitive surgery. 35 patients were identified with vTOS. 91% of patients had patent veins when discharged from clinical follow-up and were symptom free at a median of 44 months follow up. Of patients treated with immediate catheter-directed thrombolysis (CDT), early surgical decompression and appropriate balloon angioplasty, 100% were free of symptoms at a median of 24 months. Patients treated within 7 days of symptoms (94.7 Vs 85.7, $p = 0.060$), with catheter-directed thrombolysis (94% Vs 87.5% $p = 0.702$) and excision of first rib in less than 30 days (100% Vs 85.7%, $p = 0.002$) had improved symptom-free rates at follow up.
Conclusion: The availability and utilisation of early catheter-directed thrombolysis and balloon angioplasty are integral in achieving venous patency, freedom from symptoms and freedom from thrombus recurrence in patients with vTOS.

P-509

An IR approach to central venous stenoses and occlusions

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Learning objectives: 1. To review various diagnostic options available for investigation of patients with central venous stenoses. 2. To develop a systematic approach to treat central venous stenoses. 3. To understand how to safely modify the basic approach to deal with difficult occlusions.
Background: Central venous stenoses and occlusions have historically been associated with malignancy. In the era of dialysis and cardiac pacemakers, benign stenoses are becoming increasingly common. More recently, suggestions that central venous stenoses may be associated with disease processes such as multiple sclerosis has fueled further interest in their treatment. For these reasons, an approach to dealing with central venous stenoses is becoming critical to the interventional radiologist armamentarium.
Clinical Findings/Procedure Details: 1. The advantages and disadvantages of multiple diagnostic modalities to evaluate central venous stenoses including venography, ultrasonography, and CT venography are reviewed. 2. Illustration of a systematic approach to central venous angioplasty and stenting including access points, safety measures, and the "body floss" technique to secure passage through tight stenoses is presented. 3. Case examples of modifications to the approach used to cross difficult occluded segments, concentrating on sharp recanalizations with stiff wires and needles using fluoroscopic targets or CT guidance, are also shown. 4. Possible complications are discussed.
Conclusion: Developing a safe and systematic approach to dealing with central venous stenoses is critical especially in challenging cases. By understanding this approach and how it can be modified, these cases can be treated successfully without compromising patient safety.

P-510

Bilateral and simultaneous inferior petrosal sinus sampling for ACTH-dependent Cushing's syndrome

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Learning objectives: To estimate the efficacy and safety of bilateral inferior petrosal sinus sampling (BIPSS) with desmopressin stimulation for the differential diagnosis of ACTH-dependent Cushing's syndrome.
Background: Seventy-three patients with proved ACTH-dependent Cushung's syndrome either without adenoma on MRI or negative overnight 8 mg suppression dexamethasone test underwent BIPSS. ACTH sampling was performed in postcava, right and left petrosal sinuses twice before and three times after desmopressin stimulation. Diagnosis was confirmed by histology. We used bilateral femoral vein acces, two 5F and 4F introducers, and two 4f multipurpose catheters. BIPSS included 5 time sampling:-5th min, 0 min with entering sol. of desmopressin and sampling on 3-5-10 min after stimulation.
Clinical Findings/Procedure Details: Bilateral catheterization was performed in 64 patients and in 9 cases the positioning of catheter was in petrosal sinus and jugular vein from one side due to individual anatomy. The histological confirmation has been available in sixty cases, including 10 ACTH ectopic syndromes and 50 Cushing's disease. False negative results were found in 6 cases of Cushing's disease, no false positive tests were demonstrated in patients with ACTH-ectopic production. Consequently, the sensitivity of BIPSS with desmopressin stimulation is 88% and specificity 100%. Desmopressin injection has improved sensitivity from 84% to 88%.
Conclusion: BIPSS with desmopressin stimulation is a safe and effective diagnostic procedure in ACTH-dependent Cushing's syndrome.

P-511

Endovenous laser ablation and foam sclerotheraphy of incompetent perforating veins of thigh: a prospective short-term analysis of 17 cases with chronic venous insufficiency

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Learning objectives: To evaluate the efficiency of endovenous laser ablation (EVLA) and foam sclerotheraphy of incompetent perforating veins of thigh.
Background: A total of 18 perforating veins of 17 patients (8 males, 9 females) with chronic venous insufficiency were treated between September 2009 and February 2011 in an outpatient conditions. The average age was 41 years (range 28 – 65). Clinical, etiology, anatomy and pathophysiology (CEAP), venous clinical severity score (VCSS) and patient complaint score (PCS) were used for evaluating the symptoms and signs of the patients and efficiency of treatment.
Clinical Findings/Procedure Details: All patients underwent a clinical examination and color Doppler ultrasonography. CEAP clinical stage of patients was C2 53%, C3 29%, C4 12% and C5 6%. VCSS was between 3 and 10 and PCS between 1 and 12. Anatomic localizations of the incompetent perforating veins (iPVs) were posteriolateral 9, posterior 3, posteriomedial 2, anterior 1, anteriolateral 1 and medial 1. Average diameter of the veins was 4,46 mm (range 2,5 – 8 mm), average length of the vein 86,6 mm (range 12 – 120 mm). The perforating veins were cannulated with 4F micropuncture set and tumescent local anaesthesia was given by ultrasonography guiding. An 980-nm diode laser was used to deliver 10 -15 W power. Mean total energy delivered was 371J (range 230 – 820J). Foam sclerotherapies were done immediately or 15 to 30 days after EVLA. Examination of the all patients was planned at 1 week, 1 month, 3 months and 1 year after treatment. All of the iPVs were totally occluded except two. There was no major complication detected and all of the patients recovered clinically.
Conclusion: Endovenous laser ablation and foam sclerotherapy combination for treating incompetent perforating veins is a safe and technically feasible method. It is less invasive and more hopeful than surgery.

P-512

Success for adrenal vein sampling: evaluation of anatomical variants of adrenal vein on MDCT

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Learning objectives: Anatomic variants of adrenal vein.
Background: We have realized that there are more patients of primary aldosteronism than ever expected, and the true incidence is closer to 5%-10% of patients of hypertension. Adrenal vein sampling (AVS) is considered the only reliable technique to distinguish between unilateral and bilateral autonomous production of aldosterone.
Clinical Findings/Procedure Details: This retrospective study includes 122 patients with confirmed primary aldosteronism who underwent AVS at our hospital during the period between July 2007 and December 2010. The success rate for the control period was 89% (108/122). The procedure was considered successful when

samples with concentration of adrenal/concentration of IVC >2 were obtained from both adrenals. In all cases, rapid cortisol assays were performed without ACTH stimulation. We evaluated anatomical variants on MDCT of all cases. In our cases, the right adrenal vein forms a common trunk with an accessory hepatic vein in 10% (13/122).
Conclusion: Although little variation in adrenal vein anatomy exists, variants do occur, and their recognition is critical in achieving technical success.

P-513

New frontiers in the endovascular management of iliofemoral deep vein thrombosis

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Learning objectives: 1) Understand the prevalence, distribution and sequelae of ilio-femoral deep venous thrombosis (DVT). 2) Understand the current treatment options for DVT including pharmacological, and endovascular techniques. 3) To appreciate the growing role, techniques, risks and outcomes of mechanical thrombectomy and catheter-directed thrombolysis.
Background: Systemic anticoagulation has been the basis of treatment in patients with deep venous thrombosis (DVT). Although effective in preventing thrombus propagation, it has minimal, if any, effect on preexisting thrombus. Post-thrombotic syndrome (PTS) can affect up to 60% of patients with DVT. Early thrombectomy can minimize the risk of PTS and valvular dysfunction, which contributes to a significant proportion of morbidity in these patients, particularly affecting the younger patient population. Current endovascular treatment options allow the removal of extensive thrombus burden therefore minimizing both acute and long-term complications of DVT.
Clinical Findings/Procedure Details: A review of the current therapeutic endovascular options and devices available for aspiration thrombectomy, catheter-directed thrombolysis, endovascular stenting and the various mechanical thrombectomy devices. We explain the importance of correct patient selection, techniques involved, outcomes and complications based on our tertiary referral centre experience.
Conclusion: The incidence of DVT and its two major complications of pulmonary embolism and post-thrombotic syndrome are significant. Current endovascular treatment options such as mechanical thrombectomy and catheter-directed thrombolysis have been shown to minimise both early and long-term morbidity.

P-514

Congenital anomalies of the IVC and their relevance to interventional radiology

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Learning objectives: 1. To describe the embryogenesis of the IVC. 2. To describe the spectrum of congenital anomalies IVC and how they arise as a result of the embryonic variations. 3. To discuss the relevance of these anomalies to the practice of diagnostic and interventional radiology.
Background: The advent of cross-sectional imaging has led to the detection of an increasing number of congenital anomalies of the inferior vena cava (IVC) and its anomalies in asymptomatic patients. The embryogenesis of the IVC is a complex one, involving the formation of anastomosis between three primitive paired venous systems, namely the posterior cardinal vein, the subcardinal vein and the supracardinal vein. Variations in anastomosis between these vessels give rise to several anomalies of the IVC, which have significant clinical implications.
Clinical Findings/Procedure Details: We schematically review the described cases so far and using contrast enhanced multidimensional images, we present several representative cases that we have experienced in our institution over five years that have been detected incidentally. Examples include left sided IVC, double IVC, left retroaortic renal vein, circumaortic renal vein, azygous and hemiazygous continuatuion of the IVC and circumcaval ureter.
Conclusion: Awareness of these congenital variations is important in order to correctly interpret cross-sectional images to avoid misdiagnosis of retroperitoneal and mediastinal masses and to alert interventional radiologists and other clinicians of potential sources of complications in the pre-procedural setting.

P-515

Spectrum of congenital and acquired abnormalities of the inferior vena cava: what an interventional radiologist should know

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Learning objectives: To illustrate the embryological development of the inferior vena cava (IVC) and its common variants. To demonstrate the spectrum of abnormalities affecting the IVC on imaging and discuss implications for IR procedures.
Background: Anatomy of the IVC and the intra-abdominal venous system is highly variable due to the complicated fusion of primitive veins during embryological development. Anatomical variants of the IVC are relevant to vascular procedures, hence awareness of common variants and their implications is of considerable importance to interventional radiologists. Perhaps of greater significance is the fact that such venous anomalies can give rise to symptoms along with potentially serious complications.
Clinical Findings/Procedure Details: Congenital anomalies such as left IVC, double IVC, absent IVC, azygous and hemiazygous continuation of IVC, Mega IVC and syndromic associations are illustrated. Acquired pathologies affecting the IVC are also demonstrated, including hypovolemic shock, aortocaval fistula, retroperitoneal fibrosis and tumors. Clinical implications and imaging pitfalls are discussed with a particular emphasis on the importance for interventional radiologists.
Conclusion: A range of congenital and acquired abnormalities can affect the IVC. This comprehensive review illustrates the significance of these pathologies, discusses their imaging features and emphasizes the implications for interventional procedures.

P-516

Successful removal of an IVC filter after inadvertent snaring and entanglement of one of the filter legs

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Attempted transjugular IVC filter removal complicated by the snare inadvertently getting entangled on a filter leg. We describe a novel technique in which the snare was subsequently used to straighten and properly align the filter, allowing for successful retrieval.

P-517

Gastric varices embolization via left inferior phrenic vein and adrenal vein

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A 72-year-old woman had severe gastric varices whose drainage veins were the left adrenal vein and the inferior phrenic vein. Balloon occluded retrograde venous embolization was performed via both left adrenal vein and inferior phrenic vein. Then, gastric varices disappeared.

P-518

Transvenous removal of intracaval cement deposition after vertebroplasty

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During lumbar vertebroplasty a local transvenous deposition of cement into the inferior caval vein occurred. We successfully removed the arrow-like and fractured cement fragments by an inguinal transvenous approach.

P-519

Endovascular closure of a mesenterico-caval venous bypass using an amplatzer vascular plug

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A mesenterico-caval venous bypass-induced refractory hepatic encephalopathy was treated by endovascular occlusion using a single vascular plug II. The patient fully recovered from encephalopathy. Main complication was an early asymptomatic partial thrombosis of the superior mesenteric vein, treated by anticoagulants.

P-520

Successful transcatheter closure of a large patent ductus venosus with the amplatzer vascular plug II

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Patent ductus venosus is a rare form of congenital portosystemic shunt from the fetal umbilical vein to the inferior vena cava. This reported case is the first successful occlusion of a large patent ductus venosus with the AVP II.

P-521

Recurrent right extremity venous thrombosis after insertion of stent in the common iliac vein of the left lower extremity

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I report three cases of endovascular treatment for controlateral recurrent venous thrombosis in the right lower extremity after insertion of stent in the common iliac vein of the left lower extremity by catheter-directed thrombolysis and stent insertion with balloon expansion.

P-522

Have you ever seen that dilatation of preexisting venous collateral pathways as a possible treatment option in patients with Budd–Chiari syndrome

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We report only use of angioplasty for hepatic venous and the accessory hepatic vein for long segmental occlusion of the inferior vena cava in one Budd–Chiari syndrome case, rather than opening the IVC, in case with a well-developed intrahepatic collateral.

P-523

Congenital aneurysmal dilatation of intrahepatic inferior vena cava treated by percutaneous balloon angioplasty

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A 17-year-old female presented with claudication of right leg. On CT, there was large lobulated aneurysmal dilatation of intrahepatic inferior vena cava with severe stenosis at its end. We performed three times of percutaneous balloon angioplasty of the stenotic lesion.

P-524

Bilemia: an unusual complication after transjugular liver biopsy

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Patient presented with portal hypertension with normal bilirubin levels. Transjugular liver biopsy was performed and three days later he showed total bilirubin levels of 62.43 mg/dL. Ultrasound discarded bile duct dilatation. Angiographic control with a transjugular showed a biliary-venous fistula.

P-525

Stenting across right atrium for treatment of thrombosis in superior and inferior vena cava in a patient of liver cancer after right hepatectomy

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The case of a patient with extensive thrombosis in superior and inferior vena cava after right hepatectomy for hepatocellular carcinoma is reported. Transatrial stent placement from left brachiocephalic vein, superior vena cava to inferior vena cava was successfully performed.

P-526

Pericardial perforation during central venous catheter placement. Optimal treatment?

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Perforation of pericardium is a very rare and potentially fatal complication of the placement of central venous catheters. We present a case where an early recognition allowed for successful surgical treatment. Review of literature and treatment options follows.

P-527

Challenging cava duplication during IVC filter placement

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We report an inpatient 68-year-old female admitted with hemorrhagic stroke presenting, 20 days after, a left ilio-femoro-popliteal DVT. Duplication of IVC and an anomalous posterior cardiac drainage were detected. The challenging approaches for this successful objective will be discussed.

P-528

Ultrasonographic-guided balloon dilation of the vena hepatica after pediatric liver transplantation

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Hepatic vein stenosis was diagnosed by ultrasonography in a child after LTX. The stenosis could not be verified by venography, therefore ultrasound was used for balloon placement. The stenosis was successfully dilated at low X-ray dose.

P-529

A near death experience following simple central venous catheter insertion

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Central venous injury, resulting in life threatening haemothorax, is a rare complication of central venous catheter insertion. We present such a case and discuss the attempted endovascular therapy and management used in our unit for this and other similar cases.

Others

P-530

Sonographic-guided percutaneous liver biopsies in children

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Purpose: To evaluate the safety and efficacy of sonographic-guided percutaneous core-needle liver biopsy in infants and children.
Material and Methods: A retrospective analysis was performed of all patients who underwent sonographic-guided percutaneous core-needle liver biopsy over a 6.5-year period by pediatric interventionalists at a single tertiary center. Data collected included patient demographics, indications for procedure, types of anesthesia, procedure technique, sample adequacy, pathologic results and procedure-related complications.
Results: 594 procedures were performed in 466 patients; mean 11.3y. Indications included grading of chronic hepatitis (18.8%), abnormal liver enzymes (18.3%), evaluation of transplanted liver (18.3%), iron overload (15.1%), miscellaneous diffuse parenchymal abnormalities (10.6%) and focal lesions (9.1%). The procedures were performed under sedation (53%) or general anesthesia (47%). A non-coaxial core biopsy technique (68%) and 16G needle (78%) were used in the majority. Subcostal approach (n=260; 44%) was most often used and the right lobe (75%) most frequently biopsied. Tract embolization was infrequently used (7%). Diagnostic yield was obtained in 593 biopsies (99%) from an average 2.4 cores in patients with diffuse disease (91%) and 6.5 cores in focal disease (9%). Nine patients (1.5%) experienced a major complication including pneumothorax (n=1), abdominal wall pseudoaneurysm (n=1) and symptomatic bleeding (n=7). Four of these required transfusions, 2 were admitted for observation and 1 required surgical evacuation. There were no procedure-related deaths. Minor complications (n=26; 4.4%) included asymptomatic subcapsular hematoma (n=20) and stable small hemoperitoneum (n=6).
Conclusion: Sonographic-guided percutaneous core liver biopsy is a safe and effective procedure with high diagnostic yield and very low complication rate.

P-531

C-arm cone-beam CT combined with a new electromagnetic navigation system for the guidance of percutaneous needle biopsies: initial clinical experiences

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Purpose: To evaluate the efficacy of C-arm fluoroscopic cone-beam computed tomography (CACT) in combination with a new electromagnetic tracking (EMT) system for needle guidance during percutaneous biopsies.
Material and Methods: Between 03-07/2010 53 patients were biopsied because of thoracic (n=19) and abdominal (n=34) lesions. CT-like images of the anatomical region of interest (ROI) were generated using a flat-panel-based angiography system. These images were transmitted to an EMT system. A coaxial puncture needle with a sensor in its tip was connected with the navigation system and tracked into an electromagnetic field created via a field generator. Data generated within this field were merged with the CACT images. On a monitor both the anatomical ROI and needle tip position were

shown to enable precise needle insertion into the target. Through the coaxial needle biopsy specimens for the histologic evaluation were extracted. Histologic outcome, number of core biopsies/patient, total procedure time, dose-area product, fluoroscopic time, and complications were recorded.
Results: CACT-/EMT-guided biopsies showed a diagnostic accuracy of 91%, sensitivity of 88%, specificity of 100%, PPV of 100%, and NPV of 72%. Four core biopsies/patient were obtained. Total procedure time was 9 ± 5 min (range, 3 - 23 min), fluoroscopic time was 0,8 ± 0,4 min (range, 0,4 - 2 min). The mean dose-area product (cGy cm^2) was 7373 (range, 895 - 26904). The rate of complications (1 pneumothorax, 2 hemoptyses) was 6%.
Conclusion: CACT combined with EMT appears to be an effective technique for the guidance of percutaneous biopsies with a low rate of therapeutically relevant complications.

P-532

Glubran 2 Seal: an experimental arterial closure device in endovascular interventional radiological procedures

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Purpose: Glubran 2 Seal is an experimental arterial closure device that relies on the use of Glubran 2 to seal the track of the puncture without affecting the arterial wall. The aim of this study was to evaluate the safety and the efficacy of Glubran 2 Seal, as closure device after endovascular interventional radiological procedures.
Material and Methods: The study included 97 patients, in whom haemostasis of the puncture site was obtained using Glubran 2 Seal, at the level of the common femoral artery (85 patients, 87.7%) or at the level of a PTFE, vein or Dacron bypass (12 patients, 12.3%). Among them, 32 patients (33%) had an anterograde puncture, while 65 (67%) cases had a retrograde puncture. The sheath francheage ranged from 5F to 8F. Twenty patients (20.6%) had just undergone intraarterial fibrinolysis infusion therapy.
Duplex ultrasound was performed in all cases 24 hours after the procedure.
Results: The closure device was successfully applied in all cases, with no major complications. In 9.3% of the patients a prolonged compression (for more than 2 minutes) was necessary. In 6 patients (6%) echimosis of the groin was observed. No other minor complications were recorded.
Conclusion: Glubran 2 Seal is a safe and effective closure system after percutaneous puncture. It is simple to use and can be indicated also in calcified arteries, antegrade punctures and in patients under thrombolytic therapy.

P-533

Implementing a modified World Health Organisation surgical safety checklist for interventional radiology procedures

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Purpose: As part of the WHO 'Safe Surgery Saves Lives' campaign, a surgical safety checklist was introduced worldwide in 2009. Studies have found implementation of such checklists significantly reduced mortality and morbidity. It is therefore assumed that this is applicable to interventional radiology (IR) procedures. A modified version of the checklist for IR was introduced in the UK composed of 29 checks (to be conducted before and after a procedure). We report the initial uptake of the checklists and changes made to improve compliance.
Material and Methods: A retrospective study was conducted during 06/06/2010-06/07/2010 and 15/12/2010-31/01/2011 and all available WHO checklists were analysed. The correct site marking check was sub-analysed. Following the initial audit period, educational sessions, e-learning and departmental guidelines were introduced to improve compliance. A comparison of the two study periods was made to assess for an improvement in uptake.
Results: Comparison of the two study periods (A vs. B) revealed; 47 of 104 (45.2%) vs. 106 of 125 (85.0%) of procedures had a WHO checklist recorded. Of these 2.2% vs. 49.5% had all 29 checks fully completed. 76.6% vs. 83.0% had the correct safe site marking appropriately recorded.
Conclusion: The checklist is simple to complete, but involves a cultural change within busy IR departments to achieve 100% compliance. Initial poor uptake and resistance can be improved, by implementing changes similar to the ones outlined, and, in particular, empowering the nursing staff to lead and oversee its completion. A repeat study is planned to investigate potential errors avoided by implementing the checklist.

P-534

CT-guided lung biopsy: analysis of risk factors for pneumothorax and pulmonary hemorrhage

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Purpose: To analyze the risk factors for pneumothorax and pulmonary hemorrhage in patients undergoing CT-guided lung biopsy.
Material and Methods:
From April 2006 to June 2009, n = 236 patients (mean age, 65 years; range, 18-88 years) presented with suspicious pulmonary lesions and underwent CT-guided biopsy. Retrospectively, the data were evaluated to determine risk factors concerning pneumothorax and pulmonary hemorrhage. The following variables were defined: age, table time, intervention time, lesion diameter, distance of skin level-lesion/pleural level-lesion, pleural passages, lesion adjacent to pleura/interlobium/greater vessels, intraparenchymal lesion, lesion location, conventional/fluoroscopic CT guidance and gender. Mann-Whitney and Pearson's chi-square tests and logistic regression analysis were performed.
Results: Complication rates were: total, 35% (82/236); pneumothorax, 17% (41/236); pulmonary hemorrhage, 23% (55/236). In the Mann-Whitney test, age ($p = .510$) and distance to skin level ($p = .367$) were non-significant variables, and table time ($p = .008$), diameter ($p = .001$), distance to pleural level ($p = .012$), pleural passages ($p < .001$) and intervention time ($p < .001$) were significant. In Pearson's chi-square tests, gender ($p = .077$), intraparenchymal lesion ($p = .002$), lesion adjacent to pleura ($p = .002$)/interlobium ($p < .001$)/greater vessels ($p<.001$), CT guidance ($p = .063$), location ($p = .582$) and age ($p = .934$) were significant. In the logistic regression analysis, relevant variables (odds ratio) for developing complications were adjacent greater vessels (9.525), conventional CT guidance (2.722), diameter (.210) and pleural passages (11.465); for developing pneumothorax greater vessels (.296) and pleural passages (20.885); for developing pulmonary hemorrhage greater vessels (32.157), diameter (.280) and pleural passages (4.618).
Conclusion: Pleural passages and adjacent greater vessels were found to be risk factors with considerable impact on developing pneumothorax and/or pulmonary hemorrhage in CT-guided lung biopsy. Derived from the calculated data, a comprehensive risk analysis of relevant variables is presented.

P-535

Complications encountered in the treatment of benign thyroid nodules with ultrasonography-guided radiofrequency ablation: a multicenter study

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Purpose: To evaluate the clinical aspects and various imaging features of complications after radiofrequency ablation in patients with benign thyroid nodules.
Material and Methods: Fourteen thyroid centers, members of Korean Society of Thyroid Radiology, were enrolled in this study. They completed a questionnaire regarding number and types of major and minor complications related to procedure. We evaluated various factors related to complications based on patients and treatment sessions. From June 2002 to September 2009, we treated 1533 nodules of 1449 patients (mean age 41.6 years, range 9-81) with benign thyroid nodules who had cosmetic or symptomatic problems. Cool-Tip RF System and internally cooled electrode with 1, 1.5 and 2 cm active tip were used.
Results: The prevalence of complication was 3.3% (48 complications). The major complications were voice changes (n=14), brachial plexus injury (n=1), tumor rupture (n=3), abscess formation (n=1) and permanent hypothyroidism (n=2). The minor complications were hematoma (n=15), skin burn (n=4) and vomiting (n=9). All patients recovered spontaneously except for those with permanent hypothyroidism (n=2); follow-up loss (n=2) and surgery (n=1). The size of the nodules ranged from 2 to 20 cm and total treatment sessions were 2184. Mean radiofrequency energy delivered was 55.9 W and the mean procedure time was 13.7 min. Most complications were detected within 2 days and only five cases were reported 30 days after treatment. Complications reported were significantly higher in the first session ($p=0.031$) and in early follow-up periods ($p<0.01$). Nodule size, radiofrequency energy and treatment sessions showed no significance.
Conclusion: RF ablation is a relatively low-risk procedure for the treatment of benign thyroid nodules.

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Necrotizing-hemorrhagic pancreatitis: percutaneous therapy and management

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Purpose: Necrotizing hemorrhagic pancreatitis, especially when secondary to biliary disease, has high morbidity and mortality. Percutaneous approach represents, in selected cases, the first choice to avoid fatal sepsis that may occur after pancreatic abscesses. Better results are obtained with a correct management of the drainages.
Material and Methods: During the last six years we treated twelve patients (10 M and 2 F). Under CT-guide we positioned multiple drainage catheters in all patients. We chose the largest bore catheters (until 30 F). Percutaneous approach was performed using the Seldinger's technique. Catheters were removed after 30-180 days (average 110). CT follow-up was performed every 7-14 days except in case of catheter dislocation and/or obstruction. The drainages were kept in light aspiration and vigorously washed with saline three times/day. Catheters were removed when silent for at least seven days after CT.
Results: No major complications were observed and all patients were discharged in good health. Eight catheters needed substitution (6 occluded and 2 dislocated) with larger ones.
Conclusion: Daily catheter washing is mandatory; we usually flushed saline by the smaller catheter and aspirated gross necrotic tissue fragments and suppurating fluid by the bigger one(s). We use the largest catheter-bore at the first time to avoid occlusion and facilitate the emptying of fluid collections. Percutaneous drainage of necrotizing hemorrhagic pancreatitis is, in selected cases, the most efficient technique, as long as carefully and precisely managed, to avoid the high mortality rates that characterize major surgery.

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Pericardial effusion drainage using the simple 'trocar' and the Seldinger technique: single center experience

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Purpose: To present our experience in the treatment of pericardial effusions using both the trocar and the Seldinger techniques under CT guidance and prove their efficacy.
Material and Methods: Over a 2-year period, 47 drainages were performed under CT-guidance on 47 patients (mean age 60 years, age range 45-85, 30 females, 17 males) suffering from symptomatic pericardial effusion. The inclusion criterion was an echocardiographically or CT-proved pericardial effusion. Six patients (12.7%) had small effusions (<100 ml), thirty-one (65,9%) had moderate-sized effusions (100 to 500 ml) and ten (21.2%) had large effusions (>500 ml). Fine needle aspiration (FNA) was used in patients with small effusions for diagnostic as well as therapeutic purposes. Twenty patients (42.5%) with moderate-sized effusions were treated with the placement of an 8F pigtail catheter, using the trocar technique. The rest of the patients (ten-44.6%) underwent pericardiocentesis using the Seldinger technique. Effusions were completely aspirated, by hand or by gravity.
Results: All the procedures were performed successfully. No major complications occurred. We observed pneumothorax in two patients (4%) that required no specific interventions, except monitoring and appropriate follow-up. Both CT-guided methods, simple trocar technique and Seldinger-technique, were equally effective.
Conclusion: CT-guided pericardiocentesis using trocar and Seldinger techniques are equally safe and effective alternatives in patients with clinically significant pericardial effusion, which cannot be treated surgically or under ultrasound guidance.

P-538

Percutaneous drainage catheter placement with real-time fusion imaging technique of ultrasonography and computed tomography

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Purpose: To evaluate the usefulness of real-time fusion imaging of ultrasonography (US) and computed tomography (CT) images (real-time US-CT fusion imaging) in percutaneous drainage catheter placement.
Material and Methods: Eighteen symptomatic patients (10 men, 8 women; median age, 65.5 years) with fluid collection or abscess in the abdomen underwent percutaneous drainage catheter placements (bile juice leakage in 11 patients, liver abscess in 3, pancreatic juice leakage in 3, and perihepatic abscess in 1, respectively). All procedures were performed with real-time US-CT fusion

image-guidance, which displays US images and corresponding multiplanar reconstruction CT images in parallel. After examination of the three-dimensional anatomical relationships among the targeted lesion and the other organs prior to puncture, an 18-gauge puncture needle was advanced to the targeted lesion with US-CT fusion image-guidance, then a catheter was placed by the Seldinger technique with fluoroscopic guidance. We evaluated the usefulness with the aim of assessing whether this technique enabled us to achieve precise catheter placement and avoid critical organ injury.
Results: We treated 19 lesions of 18 patients. All drainage catheters were successfully placed into the targeted lesions. The median puncture route length was 4.6 cm (2.0-10.5 cm) on US image. Real-time US-CT fusion image provided objective anatomical visualization, made the targeted lesion more easily detectable, and showed the critical organs which were not clearly depicted on US images. There was no significant complication.
Conclusion: Percutaneous drainage with real-time US-CT fusion image guidance is a useful technique. It provides more objective anatomical information as an adjunct to conventional US images and makes the treatment procedures safer.

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Effects on duration of ablation time by transarterial chemoembolization before radiofrequency ablation

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Purpose: To investigate whether a transarterial chemoembolization performed 1 day before hepatic radiofrequency ablation (RFA) effects the duration of ablation time.
Material and Methods: In group I, 6 target lesions were included (5 patients with liver metastases). The patients underwent superselective transarterial chemoembolization one day prior to RFA. In group II (control group), 4 target lesions (3 patients with liver metastases) underwent RFA without preceding chemoembolization. In all target lesions, we recorded the time until a two-fold roll-off was accomplished without repositioning the needle tip. RFA was performed using a monopolar LeVeen electrode system with an array diameter of 3.5 mm.
Results: In group 1, the average ablation time until reaching a two-fold roll-off was 10.3 min (4.5 – 14.5 min). In the control group, the ablation time averaged 27.4 min (17 – 51 min).
Conclusion: Our initial observations indicate that transarterial chemoembolization performed within 1 day prior to RFA may lead to a significant decrease (p-value = 0.01 by Mann-Whitney-U) in tumor ablation times.

P-540

Treatment of symptomatic simple cysts or seromas by percutaneous hypertonic NaCl and bleomycin sclerotherapy

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Purpose: To examine the feasibility, practical outcome and complications of symptomatic simple epithelial cysts or abdominal seromas treatment by percutaneous hypertonic NaCl and bleomycin sclerotherapy.
Material and Methods: Symptomatic simple cysts of the liver (n=15), adrenals (n=2), kidneys (n=5), and a postoperative seroma were treated percutaneously, with the use of a modified method. Initially, US or CT-guided drainage with a pig-tail catheter 8F was performed. The integrity of the cyst was evaluated under fluoroscopy by injecting 100-150ml contrast, mixed with local anesthetic 24 hours later. Subsequently, two injections and re-absorptions of the same quantity (100-150ml) of hypertonic NaCl 15% solution followed by three-time repetition of the same procedure with the addition of bleomycin were performed and the catheter was removed. All patients were hospitalized for additional 12 hours and underwent imaging follow up three and six months after the procedure.
Results: Total regression of the lesion observed in 19 patients (82,6%) at the three-month follow-up. The remaining four patients had a minimal cystic remnant, with a content less than 10ml, which was not changed at the six-month examination. No immediate or dilated complications were noted, especially regarding episodes of sclerosing cholangitis, haemorrhage, interstitial fibrosis or skin hyperpigmentation.
Conclusion: Percutaneous hypertonic NaCl and bleomycin sclerotherapy, seems to be a successful and safe procedure for the treatment of symptomatic simple cysts or seromas.

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Vascular anatomy of the parathyroid gland and its relevance to interventional radiology

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Learning objectives: 1. To review the normal and variant vascular anatomy of the parathyroid glands. 2. To discuss the relevance of parathyroid vascular anatomy to interventional radiology.
Background: 1. Review the function of the parathyroid gland and causes of hyperparathyroidism. 2. Review of the normal anatomy. a. Location: four parathyroid glands situated posterior to the poles of the thyroid. b. Vascular supply: from the inferior and superior thyroidal arteries. 3. Variant anatomy. a. Ectopic glands: can be found in the mediastinum or neck. b. Vascular supply: occasionally small branch arising directly from the aortic arch, thyroidima. 4. Indications for angiography of the parathyroid gland: localization of parathyroid adenoma followed by localized treatment with transcatheter ablation. 5. Indications for venous sampling: patients with recurrent primary hyperparathyroidism after surgical resection.
Clinical Findings/Procedure Details: Indications for both angiography of the parathyroid gland and venous sampling will be reviewed followed by the technical procedure details for both cases.
Conclusion: Understanding the normal and variant anatomy of the parathyroid gland is crucial for the interventional radiologist to correctly diagnose, locate, and treat patients with primary hyperparathyroidism from a parathyroid adenoma.

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Liver abscess: the role of interventional radiology

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Learning objectives: 1. To discuss the incidence and risk factors associated with the formation of liver abscesses. 2. To review imaging characteristics of liver abscesses on ultrasound, CT, and MRI. 3. To provide strategies for draining liver abscesses, and approaches to minimize their formation after hepatic interventional procedures.
Background: The liver abscess is the most common visceral abscess;

interventional radiologists are increasingly responsible for the treatment of such abscesses. Moreover, liver abscesses can result from interventional hepatic procedures, such as radiofrequency ablation and transarterial embolization. With a growing role as the provider in abscess drainage and the treatment of hepatic neoplasms, interventional radiologists should be aware of the incidence, risk factors, imaging characteristics, and management of liver abscesses.
Clinical Findings/Procedure Details: This poster will review liver abscess frequency and risk factors for assessing patients referred to the interventional radiology department for drainage and for those that emerge as a complication from interventional procedures, discuss the imaging characteristics of liver abscesses, and provide an approach to their drainage.
Conclusion: 1. Rates of liver abscess formation vary based on interventional procedure, and are typically seen with a much higher rate in individuals with bilioenteric anastamosis/biliary stent/sphincterotomy. 2. Imaging modalities are equivalent in the sensitivity of liver abscess detection, but characteristic signs on CT and MRI may help guide management. 3. Although difficult to differentiate between the two etiologies, pyogenic abscesses should be treated with antibiotics plus percutaneous needle aspiration if less than 5cm or drainage if greater than 5cm, whereas amebic abscesses should be treated with antibiotics alone except in refractory cases.

P-543

Treatment of orbital venous and lymphatic malformations with percutaneous sclerotherapy

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Learning objectives: Orbital venous and lymphatic malformations are rare congenital lesions requiring a multidisciplinary approach to treatment. Percutaneous foam sclerotherapy treatment under digital subtraction angiography guidance is safe and effective. Intraocular pressure should be monitored post-procedure. Timely intervention by lateral canthotomy can save eyesight.
Background: This retrospective review evaluated the orbital venous and lymphatic malformations treated at our institution with percutaneous sclerotherapy. The clinical features, radiology findings, treatment details and short-term outcomes are described.
Clinical Findings/Procedure Details: Three males and three females aged between 2 and 26 years were treated at our institution comprising five venous and one lymphatic malformations in the orbital region. The technique of sclerotherapy as well as the sclerosant preparation is described. Sclerotherapy was done in the presence of an ophthalmologist who measured the intraorbital pressure at regular intervals both during and after the procedure. Four patients required lateral cathotomy due to markedly raised intraorbital pressure. All patients were kept on follow up and showed significant resolution of symptoms and signs after the procedure.
Conclusion: Orbital venous and lymphatic malformations are rare lesions which should be treated using a multidisciplinary approach. Percutaneous sclerotherapy with sodium tetradecyl sulfate foam using digital subtraction angiography guidance is a safe and effective method of treatment. Constant monitoring of the intraorbital pressure is required both during and after the procedure to decide about the need for lateral canthotomy to reduce the transiently increased intraorbital pressure.

P-544

Creation by interventional radiology of a tracheo-oesophageal fistula for phonation after loss of the primary post-operative fistula

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[1]Department of Radiology, Waterford Regional Teaching Hospital, Waterford City, Ireland, [2]Department of Head and Neck surgery, Waterford Regional Hospital, Waterford City, Ireland, [3]Department of Head and Neck Surgery, Waterford Regional Hospital, Waterford City, Ireland.

A 61-year-old lady post-laryngectomy inadvertently expelled her voice prosthesis from her surgically created tracheooesophageal fistula. Surgical attempts to recannalise the sinus were unsuccessful. IR created a new fistula by access and upsize under fluoroscopy and a replacement voice prosthesis sited.

P-545

CT-guided drainage of interlobular fissure empyema

A. Maratsos, *N. Economopoulos, G. Stathis, S. Argentos, C. Kontopoulou, E. Alexopoulou;*
2nd Department of Radiology, General University Hospital, Athens, Greece.

We present a case of successful CT-guided chest drain insertion using a Seldinger technique for the treatment of interlobular fissure empyema. This is the first described imaging-guided drainage in such location whereas thoracic surgeon involvement is associated with multiple complications.

P-546

Endovascular removal of an embolised patent ductus arteriosus amplatzer occluding device in a 42-year-old woman

C. Cinar;
Radiology, Ege University Faculty of Medicine, Izmir, Turkey.

Alternative strategy of non-surgical closure of patent ductus arteriosus (PDA) is presently the first line of therapy. Several devices are being used for transcatheter closure of PDA. We performed percutaneous extraction of intravascular PDA occluding device using a nitinol snare loop.

P-547

Sclerotherapy using Trombojet for balloon-occluded retrograde transvenous obliteration (BRTO): a case report

C.H. Kang, *J.R. Juhn;*
Radiology, Inje University Pusan Paik Hospital, Busan si, Korea.

A 56-year-old woman was referred with intermittent hematemesis due to gastric varix. Sclerosant was made of 3% Trombojet™, room air, and contrast media, with a ratio of 1:2:1. Sclerotherapy using Trombojet™ is effective for the treatment of gastric fundal varices during BRTO.

P-548

Treatment of liver hydatid cyst complicated with biliary-cutaneous fistula

***A.M. Dökdök**, K. Karaman, O. Karadeniz;*
Radiology, Anadolu Saglik Merkezi, Kocaeli, Turkey.

A 45-year-old female had a recurrent liver hydatid cyst complicated with biliary-cutaneous fistula years after multiple previous surgery. Successful percutaneous treatment of the cyst ceased the fistula which presumed to be induced by high pressure of the cyst.

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