

## Coil migration – a rare complication of endovascular exclusion of visceral artery pseudoaneurysms and aneurysms

JRA Skipworth<sup>1</sup>, C Morkane<sup>1</sup>, DA Raptis<sup>1</sup>, L Kennedy<sup>1</sup>, K Johal<sup>1</sup>, D Pendse<sup>2</sup>, DJ Brennan<sup>2</sup>, S Olde Damink<sup>1</sup>, M Malago<sup>1</sup>, A Shankar<sup>1</sup>, C Imber<sup>1</sup>

<sup>1</sup>Department of Hepatopancreaticobiliary Surgery and <sup>2</sup>Department of Interventional and Vascular Radiology, University College London Hospital, London, UK

### ABSTRACT

**INTRODUCTION** We describe a case of metallic, angiographic coil migration, following radiological exclusion of a gastroduodenal artery pseudoaneurysm secondary to chronic pancreatitis.

**PATIENTS AND METHODS** A 55-year-old man presented to the out-patient clinic with chronic, intermittent, post-prandial, abdominal pain, associated with nausea, vomiting and weight loss. He was known to have chronic pancreatitis and liver disease secondary to alcohol abuse and previously underwent angiographic exclusion of a gastroduodenal artery pseudoaneurysm. During subsequent radiological and endoscopic investigation, an endovascular coil was discovered in the gastric pylorus, associated with ulceration and cavitation. This patient was managed conservatively and enterally fed via naso-jejunal catheter endoscopically placed past the site of the migrated coil. This patient is currently awaiting biliary bypass surgery for chronic pancreatitis, and definitive coil removal will occur concurrently.

**CONCLUSIONS** Literature review reveals that this report is only the eighth to describe coil migration following embolisation of a visceral artery pseudoaneurysm or aneurysm. Endovascular embolisation of pseudoaneurysms and aneurysms is generally safe and effective. More common complications of visceral artery embolisation include rebleeding, pseudoaneurysm reformation and pancreatitis.

### KEYWORDS

Coil migration – Pseudoaneurysm – Visceral artery

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### CORRESPONDENCE TO

James Skipworth, UCL Division of Surgical and Interventional Sciences, 4th Floor, Medical School Building, 74 Huntley Street, University College London, London, WC1E 6AU. E: j.skipworth@ucl.ac.uk

### Introduction

Visceral artery pseudoaneurysms or aneurysms (VAPA) of the splenic,<sup>1</sup> gastroduodenal,<sup>2, 5</sup> hepatic,<sup>2</sup> gastroepiploic,<sup>4</sup> superior mesenteric<sup>5</sup> or inferior mesenteric<sup>6</sup> (or any visceral branch of the coeliac axis, inferior mesenteric, superior mesenteric or renal arteries) arteries can form secondary to a variety of congenital, traumatic and inflammatory pathologies. Visceral artery aneurysms are found in 0.01–0.2% of routine autopsies but are being increasingly found incidentally in our ageing population;<sup>7</sup> whereas visceral artery pseudoaneurysm formation is a rare but potentially fatal complication occurring in less than 2% of cases of chronic pancreatitis (CP),<sup>8</sup> and even less frequently following acute pancreatitis and hepatopancreaticobiliary (HPB) surgery,<sup>9</sup> vasculitis or other inflammatory processes.<sup>10</sup> Massive haemorrhage into the gastrointestinal (GI) tract or peritoneal cavity from VAPAs can result in death in 20–40% of cases.<sup>9, 11, 12</sup> Whereas spontaneous thrombosis has been described rarely,<sup>4</sup> VAPAs usually require treatment in the form of surgical,<sup>15</sup> endovascular,<sup>14</sup> or combined approaches.<sup>5</sup>

We describe a case, and review all similar reports, of coil migration following endovascular exclusion of a visceral artery pseudoaneurysm.

### Case report

A 55-year-old man with known diagnoses of alcohol-related liver disease (Child-Pugh Grade B) and CP was routinely reviewed in the hepatopancreaticobiliary (HPB) outpatient clinic. During the consultation he complained of chronic abdominal pain that was significantly exacerbated post-prandially and associated with nausea, vomiting and weight loss. He was known to have multiple liver disease and CP-related complications, including biliary obstruction and previous placement of a common bile duct (CBD) stent; splenic and abdominal varices; splenic and portal vein occlusion; a dilated pancreatic duct; duodenal obstruction secondary to a large cyst in the head of the pancreas; a pseudocyst (Fig 1); and a large gastroduodenal artery (GDA) pseudoaneurysm (Fig 1).

The GDA pseudoaneurysm had been discovered on routine computed tomography (CT) follow-up for CP 10 months

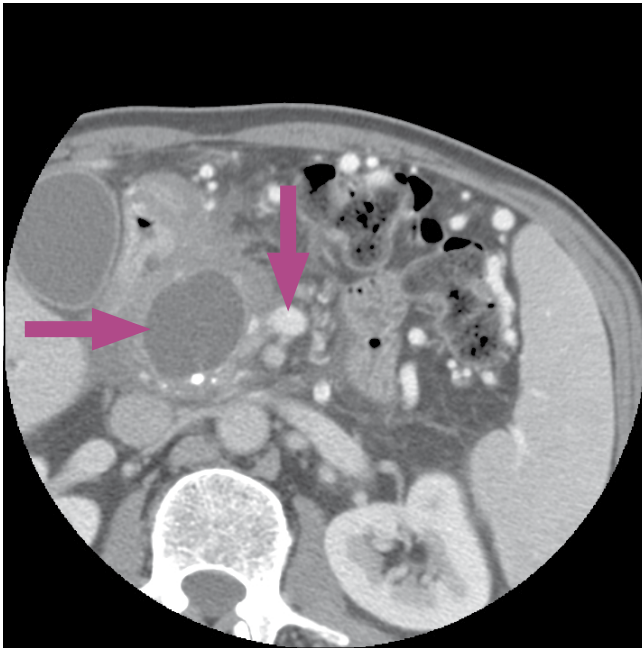


Figure 1 Computed tomography images reveal a large pancreatic pseudocyst (horizontal arrow) and associated gastroduodenal artery pseudoaneurysm (vertical arrow).



Figure 2 Angiographic image, following endovascular coiling, reveals multiple coils (arrow) in a successfully excluded gastroduodenal artery pseudoaneurysm.

prior to his current presentation. The pseudoaneurysm had been managed by endovascular insertion of 20 x 3mm metallic coils and thrombin injection, via a small, discrete neck. Angiography one day post initial endovascular exclusion revealed a residual 20% sac requiring further endovascular management with 12 x 3mm metallic coils, following which complete exclusion of the pseudoaneurysm was confirmed (Fig 2). His other past medical history included diabetes and steatorrhoea but he had now been abstinent from alcohol for over a year.

Examination in the outpatient clinic revealed spider naevi, epigastric and right upper quadrant tenderness, a palpable liver edge and evidence of significant weight loss. He was directly admitted for further investigation of his symptoms.

Blood tests revealed no gross abnormalities. However, a Gastrograffin follow-through revealed significant pyloric outlet and duodenal obstruction (Fig 3) with duodenal dilatation, which was confirmed on endoscopic retrograde cholangio-pancreatography (ERCP). Also revealed on ERCP was a metal coil in the pyloric region, associated with ulceration and cavitation, that could not be removed endoscopically (Fig 4). A sphincterotomy was performed, a new CBD stent inserted and a naso-jejunal (NJ) catheter passed. No fistula or direct pathway for migration between the GDA pseudoaneurysm and the pylorus was convincingly demonstrated on ERCP or follow-up CT.

A duodenal stent was subsequently endoscopically inserted and the patient's symptoms gradually resolved. He was discharged home well after 17 days as an in-patient, with NJ feeding and dietician care. However, in the longer term, conservative management with duodenal and biliary

stenting failed to successfully relieve the patient's symptoms, particularly following NJ-catheter removal and commencement of normal food intake. Therefore, despite the high risk associated with surgery, definitive management in the form of simultaneous biliary and gastric bypass is being considered following satisfactory pre-operative assessment (possibly including cardiopulmonary exercise testing) and, once his nutritional condition improves, surgical removal of the coil will take place concurrently.

## Review methods

A computerised literature search of PubMed was made for all reports of coil migration following endovascular management of arterial pseudoaneurysms and aneurysms, with particular emphasis upon visceral arteries, and utilising the key-words: pseudoaneurysm, aneurysm, visceral artery, coil, and migration in various combinations. All reports written in English, or with an English abstract that contained pertinent information, were included.

This approach led to the review of seven reports of coil migration following endovascular treatment of visceral artery pseudoaneurysms or aneurysms (Table 1).

## Review results

Two reports describe coil migration following endovascular exclusion of pancreatitis-related pseudoaneurysms. Takahashi *et al*<sup>15</sup> describe the incidental intra-operative finding of a coil in the stomach, which migrated via an endoscopically confirmed gastropseudocystic fistula, three weeks after endovascular coiling of a large splenic artery pseudoaneurysm

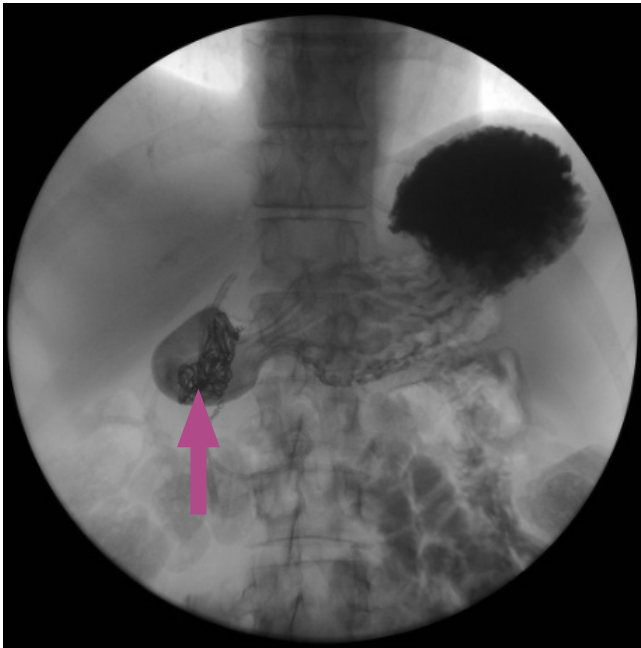


Figure 3 Gastrograffin follow-through images reveal the migrated endovascular coil (arrow) and contrast delay at the gastric outlet.

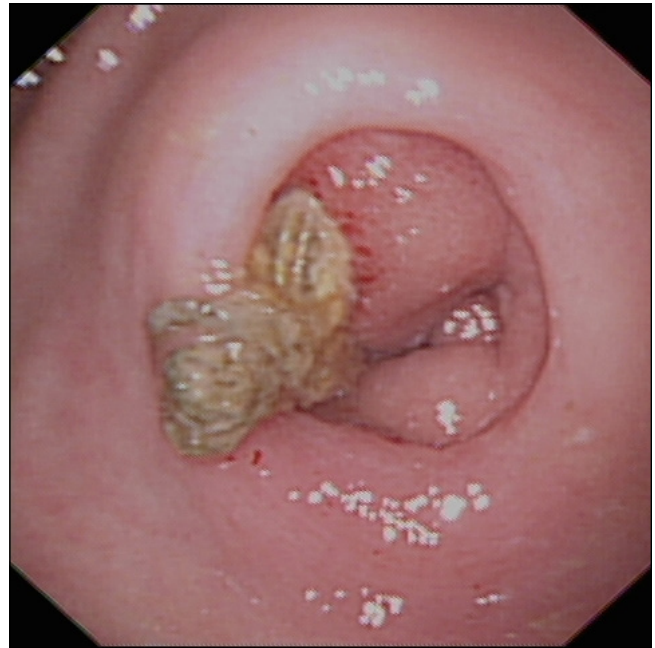


Figure 4 Oesophagogastroduodenoscopic images reveal an endovascular coil extending through the pyloric region of the stomach.

secondary to acute pancreatitis. Shah *et al*<sup>16</sup> document the passage of two steel-wire coils from an embolised splenic artery pseudoaneurysm secondary to alcohol-related pancreatitis, via the GI tract, to be discovered in the patient's stool three weeks following embolisation. Similarly to our case, no clear communication or fistula was definitively demonstrated by Shah *et al*.

Two further reports describe the sequelae of coil migration in patients who underwent embolisation of hepatic artery pseudoaneurysms – the first occurring following a difficult open cholecystectomy in a patient who later presented with ascending cholangitis resulting from coil migration into the CBD;<sup>17</sup> and a further report describing the development of pancreatitis following coil erosion into the CBD in a patient who had undergone a difficult surgical dissection during cholecystectomy for acute acalculous cholecystitis.<sup>18</sup> Other reports describe coil migration from a coeliac trunk aneurysm, via an aortogastric fistula and leading to fatal upper GI haemorrhage;<sup>19</sup> from a renal artery aneurysm, through the renal collecting system to be passed via the urinary tract;<sup>20</sup> and from a pulmonary artery aneurysm into the bronchus.<sup>21</sup>

Further identified reports describe endovascular coil migration following the embolisation of a pseudoaneurysm, aneurysm or vascular abnormality from various non-visceral arterial sites including through the middle ear in a patient who had undergone embolisation of an internal carotid pseudoaneurysm;<sup>22</sup> from a superior gluteal vessel following embolisation of a haematoma;<sup>25</sup> and multiple reports of migration from intracranial aneurysms to alternate sites within the intra-cerebral circulation.<sup>24–29</sup>

## Discussion

Pseudoaneurysm formation of the GDA is a well-recognised complication of CP<sup>30</sup> and a therapeutic endovascular approach is one of the major modalities employed during pseudoaneurysm management.<sup>31</sup> We report the case of a patient in whom a coil used to embolise a GDA pseudoaneurysm migrated into the gastric pylorus, resulting in gastric ulceration and possibly contributing to outlet obstruction secondary to CP and pancreatic pseudocyst. This unique case represents only the eighth documented report of coil migration following endovascular exclusion of a visceral artery pseudoaneurysm or aneurysm (Table 1). Of note is the fact that the majority of authors were unable to effectively demonstrate a clear route of migration between the sites of coil insertion and resultant migration.

Endovascular methods of VAPA exclusion depend upon lesion size, location and flow rates. The most commonly employed endovascular techniques include embolisation, stent insertion and thrombin injection, all of which aim to exclude the VAPA from the circulation, while simultaneously preserving distal blood flow. A combination of materials, including metallic coils, gelfoam, hydrogel particles, acrylic glue or a combination of these, can now be used for embolisation.<sup>1</sup>

Afferent arterial embolisation can be employed in instances of pseudoaneurysm or aneurysm formation from visceral arteries with no significant collateral supply.<sup>3</sup> However, VAPAs with a well-established collateral supply<sup>5</sup> and high flow<sup>14</sup> usually require embolisation of proximal and distal branches to enable successful exclusion and prevent backflow from the collateral circulation and thus may be capable of preventing the subsequent migration of coils.<sup>15</sup>

TABLE 1 A summary of reports documenting the migration of endovascular coils from visceral arteries

Author	Age (yrs)	Sex	Diagnosis	PMH	Site of vascular abnormality	Site of coil migration	Time from coil insertion	Management	Outcome
<b>Pseudoaneurysm</b>									
Skipworth <i>et al</i> (2009)	55	M	CP	Liver disease	Gastroduodenal artery	Gastric pylorus	10 months	NJ-nutrition and future surgery	Well
Reed <i>et al</i> (2007) [20]	50	F	PCNL	Renal calculus	Renal artery branch AV fistula	Left uretero-vesical junction	1 year	None – coil passed	Well
Shah <i>et al</i> (2007) [16]	65	F	CP	AP; DM	Splenic artery	Passage per rectum	3 weeks	None-coil passed	Well
Turaga <i>et al</i> (2006) [17]	65	M	Cholecystectomy	Chole	Hepatic artery	CBD	1 year	Open CBD exploration	Well
Ozkan <i>et al</i> (2002) [18]	58	M	CP	Chole	Hepatic artery	CBD	2 years	Open CBD exploration	Well
Takahashi <i>et al</i> (2001) [15]	59	M	CP	AP	Splenic artery	Gastric body	3 weeks	Open surgery (concurrent gastric carcinoma)	Well
<b>Aneurysm</b>									
Dinter <i>et al</i> (2007) [19]	82	F	Upper GI Bleed	Scl; GU	Coeliac trunk	Cardia/ lesser gastric curve	10 years	None	Fatal haematemesis (aorto-gastric fistula)
Abad <i>et al</i> (1990) [21]	18	M	Unknown Aetiology	Unknown	Pulmonary artery	Right basal bronchus of inferior lobe	6 weeks	Open surgery (right inferior lobectomy)	Well

CBD – Common bile duct  
Scl – Scleroderma  
GI – Gastrointestinal

GU – Gastric ulcer  
AP – Acute pancreatitis  
Chole – Acute cholecystitis

CP – Chronic pancreatitis  
PCNL – Percutaneous nephro-lithotomy  
DM – Diabetes  
NJ – Nasojejunal

Narrow-necked pseudoaneurysms or aneurysms are best treated via direct delivery of coils into the sac;<sup>5</sup> whereas wide-necked and large diameter vessels can be treated by stent insertion.<sup>5</sup> Low-flow VAPAs can often be treated with percutaneous thrombin injection alone.<sup>14</sup>

Literature review reveals that percutaneous endovascular embolisation techniques are generally safe and effective,<sup>1, 14</sup> and are capable of achieving definitive haemostasis in 80–95% of emergency cases,<sup>8, 9, 11, 24</sup> particularly when early recognition and treatment takes place.<sup>12</sup> Some studies have therefore described an association of radiological embolisation strategies with a decreased incidence of blood transfusion and length of hospital stay, as well as lower re-bleed and mortal-

ity rates, as compared to surgery, when utilised in the emergency setting.<sup>32</sup>

More common complications following endovascular exclusion include bleeding or re-bleeding, often requiring repeat angiography<sup>16</sup> and surgical intervention for ligation or repair of bleeding vessels<sup>8</sup> and pseudoaneurysm recurrence,<sup>14</sup> both of which mandate careful follow-up. Postembolisation syndrome and infarction can occur in up to 30% of splenic artery pseudoaneurysm or aneurysm exclusions,<sup>35</sup> although clinically significant infarction of the spleen, or other organs, is rare. Other complications of endovascular coiling include catheterisation failure,<sup>34</sup> arterial dissection occasionally requiring angioplasty to prevent propagation and maintain vessel patency<sup>35</sup> and initiation of acute episodes of pancreatitis.<sup>36</sup>

However, most studies to date have investigated the use of angioembolisation in pseudoaneurysms of various aetiologies and the specific applicability of these studies to pseudoaneurysms in CP remains unknown. Udd *et al*<sup>8</sup> attempted to address this specific issue and identified a post-embolisation complication rate of 17%<sup>4, 25</sup> in patients undergoing angioembolisation for bleeding pseudoaneurysms secondary to CP. The complications consisted of one coil being pushed into the main pancreatic duct and requiring endoscopic removal; one dissection of the bleeding artery (which led to bleeding cessation); one coil being pushed into the iliac artery and requiring operative intervention; and one pseudoaneurysm at the angiography inguinal puncture site.

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## References

1. Venkatesh SK, Kumar S, Baijal SS *et al*. Endovascular management of pseudoaneurysms of the splenic artery: experience with six patients. *Australas Radiol* 2005; **49**: 283–288.
2. Basile A, Ragazzi S, Piazza D *et al*. Hepatic artery pseudoaneurysm treated using stent-graft implantation and retrograde gastroduodenal artery coil embolization. *Eur Radiol* 2008; **18**: 2579–2581.
3. Chong WW, Tan SG, Htoo MM. Endovascular treatment of gastroduodenal artery aneurysm. *Asian Cardiovasc Thorac Ann* 2008; **16**: 68–72.
4. Vanlangenhove P, Defreyne L, Kunnen M. Spontaneous thrombosis of a pseudoaneurysm complicating pancreatitis. *Abdom Imaging* 1999; **24**: 491–493.
5. Saito T, Tsuchiya T, Kenjo A *et al*. Successful treatment of pseudoaneurysms of celiac and superior mesenteric arteries by combined endovascular and surgical approach. *J Hepatobiliary Pancreat Surg* 2008; **15**: 444–448.
6. Tulsyan N, Kashyap VS, Greenberg RK *et al*. The endovascular management of visceral artery aneurysms and pseudoaneurysms. *J Vasc Surg* 2007; 276–283; discussion 283.
7. Kanazawa S, Inada H, Murakami T *et al*. The diagnosis and management of splanchnic artery aneurysms. *Scand J Gastroenterol* 1996; **31**: 737–743.
8. Udd M, Leppäniemi AK, Bidel S *et al*. Treatment of bleeding pseudoaneurysms in patients with chronic pancreatitis. *World J Surg* 2007; **31**: 504–510.
9. Balachandra S, Siriwardena AK. Systematic appraisal of the management of the major vascular complications of pancreatitis. *Am J Surg* 2005; **3**: 489–495.
10. Stanley JC, Wakefield TW, Graham LM *et al*. Clinical importance and management of splanchnic artery aneurysms. *J Vasc Surg* 1986; **3**: 836–840.
11. Hyare H, Desigan S, Brookes JA *et al*. Endovascular management of major arterial hemorrhage as a complication of inflammatory pancreatic disease. *J Vasc Interv Radiol* 2007; **18**: 591–596.
12. Zyromski NJ, Vieira C, Stecker M *et al*. Improved outcomes in postoperative and pancreatitis-related visceral pseudoaneurysms. *J Gastrointest Surg* 2007; **11**: 50–55.
13. Upadhyaya PK, Chava S, Bin-Sangheer S *et al*. Delayed rupture of a splenic artery pseudoaneurysm after biliopancreatic diversion. *Obes Surg* 2008; **18**: 890–892.
14. Nicholson AA, Patel J, McPherson S *et al*. Endovascular treatment of visceral aneurysms associated with pancreatitis and a suggested classification with therapeutic implications. *J Vasc Interv Radiol* 2006; **17**: 1279–1285.
15. Takahashi T, Shimada K, Kobayashi N *et al*. Migration of steel-wire coils into the stomach after transcatheter arterial embolization for a bleeding splenic artery pseudoaneurysm: report of a case. *Surg Today* 2001; **31**: 458–462.
16. Shah NA, Akingboye A, Haldipur N *et al*. Embolization coils migrating and being passed per rectum after embolization of a splenic artery pseudoaneurysm, 'the migrating coil': a case report. *Cardiovasc Intervent Radiol* 2007; **30**: 1259–1262.
17. Turaga KK, Amirlak B, Davis RE *et al*. Cholangitis after coil embolization of an iatrogenic hepatic artery pseudoaneurysm: an unusual case report. *Surg Laparosc Endosc Percutan Tech* 2006; **16**: 36–38.
18. Ozkan OS, Walser EM, Akinci D *et al*. Guglielmi detachable coil erosion into the common bile duct after embolization of iatrogenic hepatic artery pseudoaneurysm. *J Vasc Interv Radiol* 2002; **13**: 935–938.
19. Dinter DJ, Rexin M, Kaehler G *et al*. Fatal coil migration into the stomach 10 years after endovascular celiac aneurysm repair. *J Vasc Interv Radiol* 2007; **18**: 117–120.
20. Reed A, Suri R, Marcovich R. Passage of embolization coil through urinary collecting system one year after embolization. *Urology* 2007; **70**: 1222 e17–18.
21. Abad J, Villar R, Parga G *et al*. Bronchial migration of pulmonary arterial coil. *Cardiovasc Intervent Radiol* 1990; **13**: 345–346.
22. Chow MW, Chan DT, Boet R *et al*. Extrusion of a coil from the internal carotid artery through the middle ear. *Hong Kong Med J* 2004; **10**: 215–216.
23. Yuan KC, Hsu YP, Fang JF *et al*. Delayed Hemorrhage Caused by Coil Migration After Transcatheter Arterial Embolization in Patient With Unstable Pelvic Fracture: A Case Report. *J Trauma* 2008; **66**: 267–270.
24. Beattie GC, Hardman JG, Redhead D *et al*. Evidence for a central role for selective mesenteric angiography in the management of the major vascular complications of pancreatitis. *Am J Surg* 2003; **185**: 96–102.
25. Phatouros CC, McConachie NS, Jaspan T. Post-procedure migration of Guglielmi detachable coils and Mechanical detachable spirals. *Neuroradiology* 1999; **41**: 324–327.
26. Kiyosue H, Okahara M, Tanoue S *et al*. Dispersion of coils after parent-artery occlusion of radiation-induced internal carotid artery pseudoaneurysm. *AJNR Am J Neuroradiol* 2004; **25**: 1080–1082.
27. Collignon FP, Friedman JA, Piegras DG *et al*. Transcutaneous coil, stent, and balloon migration following endovascular treatment of a cervical carotid artery aneurysm. Case illustration. *J Neurosurg* 2003; **98**: 1135.
28. Iguchi H, Takayama M, Kusuki M *et al*. Transmucosal coil migration after endovascular management for carotid artery pseudoaneurysm: a late complication. *Acta Otolaryngol* 2007; **127**: 447–448.
29. Dagain A, Nataf F, Page P *et al*. Endovascular coil transfixing a cranial nerve five years after embolisation. *Acta Neurochir (Wien)* 2008; **150**: 705–707; discussion 707.
30. de Perrot M, Berney T, Bühler L *et al*. Management of bleeding pseudoaneurysms in patients with pancreatitis. *Br J Surg* 1999; **86**: 29–32.
31. Brountzos EN, Vagenas K, Apostolopoulou SC *et al*. Pancreatitis-associated splenic artery pseudoaneurysm: endovascular treatment with self-expandable stent-grafts. *Cardiovasc Intervent Radiol* 2003; **26**: 88–91.
32. Bergert H, Hinterseher I, Kersting S *et al*. Management and outcome of hemorrhage due to arterial pseudoaneurysms in pancreatitis. *Surgery* 2005; **137**: 323–328.
33. Piffaretti G, Tozzi M, Lomazzi C *et al*. Splenic artery aneurysms: postembolization syndrome and surgical complications. *Am J Surg* 2007; **193**: 166–170.
34. Mansueto G, Cenzi D, D'Onofrio M *et al*. Endovascular treatment of arterial bleeding in patients with pancreatitis. *Pancreatol* 2007; **7**: 360–369.
35. Mammen T, Joseph P, Sitaram V *et al*. Acute parent artery dissection as a complication of mesenteric endovascular coil embolisation for pancreatic pseudoaneurysm. *Br J Radiol* 2008; **81**: e7–e10.
36. Saltzberg SS, Maldonado TS, Lamparello PJ *et al*. Is endovascular therapy the preferred treatment for all visceral artery aneurysms? *Ann Vasc Surg* 2005; **19**: 507–515.