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ACPGBI

The Association of Coloproctology of Great Britain and Ireland consensus guidelines in emergency colorectal surgery

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Abstract

Aim: There is a requirement for an expansive and up to date review of the management of emergency colorectal conditions seen in adults. The primary objective is to provide detailed evidence-based guidelines for the target audience of general and colorectal surgeons who are responsible for an adult population and who practise in Great Britain and Ireland.

Methods: Surgeons who are elected members of the Association of Coloproctology of Great Britain and Ireland Emergency Surgery Subcommittee were invited to contribute various sections to the guidelines. They were directed to produce a pathology-based document using literature searches that were systematic, comprehensible, transparent and reproducible. Levels of evidence were graded. Each author was asked to provide a set of recommendations which were evidence-based and unambiguous. These recommendations were submitted to the whole guideline group and scored. They were then refined and submitted to a second vote. Only those that achieved >80% consensus at level 5 (strongly agree) or level 4 (agree) after two votes were included in the guidelines.

Results: All aspects of care (excluding abdominal trauma) for emergency colorectal conditions have been included along with 122 recommendations for management.

Conclusion: These guidelines provide an up to date and evidence-based summary of the current surgical knowledge in the management of emergency colorectal conditions and should serve as practical text for clinicians managing colorectal conditions in the emergency setting.

KEYWORDS
colorectal surgery, emergency, guideliness

Patient summary

There is a requirement for the Association of Coloproctology of Great Britain and Ireland (ACPGBI) to regularly prepare an up to date review of the management and treatment of emergency colorectal conditions seen in adults and produce detailed guidelines for general and colorectal surgeons who are responsible for this group of patients. The responsibility for drawing up these guidelines was given to experienced surgeons who are elected members of the ACPGBI's Emergency Surgery Subcommittee. They were invited to contribute various sections of the guidelines, which include diverticular disease, colorectal cancer, postoperative problems and pregnancy, anorectal problems, the open abdomen and stomas.

A document based on published articles in journals that had been properly reviewed and that were understandable, transparent and reproducible, and what they contained, was produced. The evidence was then graded. Each author was asked to provide a set of recommendations which were clear and unambiguous. These recommendations were then submitted to the whole group and scored. They were then refined and submitted to a second vote. Only those that achieved a consensus marked 'strongly agree' or 'agree' after two votes were included in the guidelines.

All aspects of emergency colorectal conditions (except abdominal trauma) have been included along with 122 recommendations. These guidelines provide an up to date review of the current surgical knowledge in the treatment of emergency colorectal conditions and should serve as an important guide for surgeons managing colorectal conditions in the emergency setting. As the guidelines point out, it is impossible for all individuals to be completely up to speed with new developments in all areas of surgery, so up to date guidelines play an essential role. These guidelines will support those surgeons who are required to provide emergency cover for a wide variety of problems when on call and will also act as a clear reference guide for others.

Patients are best served if the profession regularly reviews important patient conditions such as emergency colorectal problems. An up to date review means that new developments, new techniques that are based on research and the experiences of colorectal surgeons from throughout the world are included.

INTRODUCTION

Although guidelines exist for the management of emergency colorectal conditions in adults, there are areas of practice that require up to date review. The Emergency General Surgery (EGS) Subcommittee of the Association of Coloproctology of Great Britain and Ireland (ACPGBI) has therefore commissioned a set of guidelines that are pathology based and cover the most common colorectal emergencies seen in day to day clinical practice.

In 2016 *The Future of Emergency General Surgery—a Joint Document* was produced by the ACPGBI, the Association of Upper Gastrointestinal Surgeons and the Association of Surgeons of Great Britain and Ireland (ASGBI) [1]. It contains 16 key recommendations covering all aspects of emergency general surgery but specifically ambulatory care, early senior decision-making, infrastructure and the importance of a dedicated and recognized emergency component in job planning. This was followed in 2018 when the Royal College of Surgeons of England produced the report *The Higher Risk General Surgical Patient*: *Raising the Standard* [2], an update of the 2011 report, *The Higher Risk General Surgical Patient* [3]. It lists 12 new key recommendations which include consultant leadership, frailty, risk assessment, National Early Warning Score (NEWS), sepsis, radiology and quality assurance and improvement. It is the opinion of the expert group who produced the document that all 12 should be mandatory in all acute hospitals with adult general surgical services on site. These guidelines aim to complement these recommendations.

Emergency surgery has for too long been seen as the Cinderella specialty within general surgery. However, the landscape is changing. Emergency surgery is becoming an ever-increasing part of each and every service. Many units are now providing specialist rotas with specific lower gastrointestinal (GI), hepatobiliary and upper GI cover. Clearly this is only truly possible in those units big enough to provide the number of individual surgeons to staff such rotas.

Recent publications [4] have shown that the outcomes for those patients with acute colorectal problems are best when dealt with by a colorectal specialist. The same is true for upper GI problems. The National Laparotomy Audit (NELA) report 2016–17 reveals that almost 50% of all emergency laparotomies are performed because of colorectal pathology [5].

However, the reality in many smaller District General Hospitals is that all members of the surgical team are required to provide out of hours emergency cover. It is impossible for all individuals to be completely up to speed with developments in every area of general surgery and so up to date evidence-based guidelines are an essential part of an individual's armamentarium. As such, these emergency colorectal guidelines will support those individuals who are required to provide emergency cover for a wide variety of problems when on call. They will also act as a clear reference guide for others. It should be noted that as there are adequate pre-existing national guidelines for the management of abdominal trauma this topic has been purposely omitted.

The primary objective is to provide detailed evidence-based guidelines that are practical and easily applicable in the clinical setting, for the target audience of surgeons undertaking adult emergency colorectal surgery in Great Britain and Ireland.

METHODOLOGY

Consultant surgeons who are elected members of the ACPGBI Emergency General Surgery (EGS) Subcommittee (ASM, BB, MDC, SED, RJG, DAJS together with PJT) were invited to contribute various sections to the guidelines. They were directed to produce a pathology-based document using literature searches that were systematic, comprehensible, transparent and reproducible. Senior trainees (KB, NMF, LHM, GR, DW) who were affiliate members of the ACPGBI contributed fully to several of the sections. A consultant radiologist (JAS) provided advice and guidance regarding the radiological aspects of the guidelines.

A critical appraisal of the guidelines using the AGREE II instrument was undertaken. All domains scored >70% [6].

Evidence-based and unambiguous recommendations were developed by the section authors. Each recommendation was submitted to the whole EGS Subcommittee. The Subcommittee cross-reviewed each of the individual recommendations in order to ensure consistency of style, presentation and quality. They were refined. Voting was carried out on a five-point Likert scale of 1 (strongly disagree) to 5 (strongly agree, SA). Any statement scoring 1–3 on the Likert scale could have suggestions made with the intention to rephrase recommendations if specific objections were raised during the first round. Only those recommendations achieving 80% consensus at level 5 (SA) and level 4 (agree, A) after two rounds of voting have been included in the final guidelines.

In accordance with the EGS ACPGBI format, they have been published in a Question, Recommendation, Background format for maximal ease of use in the clinical sphere.

Randomized controlled trials (RCTs), systematic reviews and meta-analyses were included where available. Multi-centre and single centre observational reviews were included if relevant. Case reports were excluded unless they provided the only published evidence in a particular area. This is made clear in the text.

This work does not therefore concentrate on future areas of research or ground-breaking novel technologies but rather offers practical recommendations for the clinical management of these conditions.

The recommendations were then submitted to the ACPGBI patient liaison group. A patient summary was produced and is included.

The guidelines adhere to the published ACPGBI guidelines on consensus statements [7]. The level of evidence and grading for each recommendation [8] are listed in Tables 1 and 2. These guidelines represent work ongoing from May 2019 to September 2020. They contain 122 recommendations. We hope that they will provide an updated and evidence-based summary of the current surgical knowledge in the management of emergency colorectal surgery and as such will serve as a useful practical summary for clinicians undertaking emergency colorectal procedures.

TABLE 1 Level of evidence

I	Evidence obtained from a single randomized controlled trial or from a systematic review or meta-analysis of randomized controlled trials
II	Evidence obtained from at least one well-designed controlled study without randomization or at least one other well-designed quasi-experimental study
III	Evidence obtained from well-designed non-experimental descriptive studies, correlation studies and case studies
IV	Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities, or case reports

TABLE 2 Grade of recommendation

A	Evidence from Level I studies or consistent findings from evidence Levels IIA, IIB or III
B	Evidence from Level II or III studies and generally consistent findings
C	Evidence from Level II or III studies but inconsistent findings
D	Little or no systematic evidence
GP	Recommended good practice based on clinical experience of the expert group and other professionals

TABLE 3 Modified Hinchey Classification of complicated acute diverticulitis [49,54,55]

Stage	Description
Stage Ia	Confined pericolic inflammation—phlegmon
Stage Ib	Confined pericolic abscess (within sigmoid mesocolon)
Stage IIa	Pelvic, distant intra-abdominal or intraperitoneal abscess amenable to percutaneous drainage
Stage IIb	Complex abscess associated with fistula
Stage III	Generalized purulent peritonitis
Stage IV	Faecal peritonitis

DIVERTICULAR DISEASE

Introduction

An increase in the incidence and prevalence of diverticular disease has resulted in a rise in the overall number of emergency admissions for complications [9–16]. In England, Hospital Episode Statistics (HES) data analysis estimated an increased incidence of hospitalization (total inpatient and day-case admissions) for diverticular disease from 0.56 to 1.2 per 1000 population/year from 1996 to 2006 [9]. In the USA an increase in incidence from 89.8 to 113.9 per 100 000 population was seen between 2006 and 2013 [10,11]. The prevalence of diverticular disease increases with age and 85% of patients are over 50 [13,15]. There is an increasing proportion of younger

patients presenting with acute diverticulitis (AD) requiring surgery [9,15,17], although a theory that younger patients have more virulent or frequent episodes of disease has not been proven [18–26]. In patients over 50 presenting with diverticulitis, most are women; the opposite is true in those under 50 [12,15,18,19,23].

Diverticular disease is most prevalent in the Western world and is still relatively rare in Asia or Africa. A higher incidence in industrialized areas and in immigrants to Western countries implies lifestyle factors in the development of diverticulosis [27–29]. Whilst diverticula are more common overall in the left side of the colon, right-sided diverticulosis is more likely to be seen in Asians [30,31]. Low fibre diets—and their association with a relatively constipated high pressure colon—are implicated in the development of left-sided diverticulosis [32,33], but the role of diet remains unclear in AD; there is some evidence that vegetarians with high fibre diets have decreased admissions with AD [16,34]. There is no evidence that consumption of corn, nuts or popcorn makes diverticulitis more likely [35].

The pathological mechanisms leading to diverticula formation remain unclear and a complex interaction between diet, gut microbiome, genetic factors, colonic motility and structure over time is likely [16,36,37]. Alterations in colonic muscle properties, collagen metabolism and in the interactions of the extracellular matrix components may play a role in remodelling of the gut wall in diverticular disease [33]. Collagen deposition in the colon wall of patients operated for sigmoid diverticulitis is higher compared to patients without the disease [38]. A number of rare hereditable disorders of collagen and elastin are associated with complicated diverticular disease at an early age [39,40].

AD is a common cause of acute abdominal pain [41]. Complicated AD refers to AD with abscess formation, perforation or fistula formation and there is a wide spectrum of symptoms that can arise [42]. Seasonal variation in admissions has been shown [43–46] and lower socioeconomic status is also more likely to be associated with more frequent presentations and more severe disease [47].

Question 1.1

How is complicated acute diverticulitis classified?
Recommendation: Severity of acute diverticulitis should be classified according to a reproducible grading system such as the Modified Hinchey Classification.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

The most useful classification is the Modified Hinchey Classification. This categorizes patients with AD into four major categories (I, II, III, IV) with two additional subcategories (a and b), depending on the severity of the disease (Table 3). Initially intended for use intra-operatively, it is a convenient and reproducible descriptor and allows comparison of treatment modalities across patient populations.

There are multiple other classification systems available for AD which include the American Association for the Surgery of Trauma, modified Neff, Ambrosetti, Kohler, Hansen/Stock, Siewart, Boostrom and the Cleveland Clinic diverticular disease propensity score [48–54], but they are in less common usage.

Question 1.2

Which patients with acute diverticulitis can be managed on an ambulatory outpatient basis and which patients need hospital admission?
Recommendation: Most patients with Hinchey Ia and Ib acute diverticulitis, and selected patients with Hinchey IIa acute diverticulitis, should be managed on an ambulatory basis if possible, provided that facilities for rapid review are in place; Hinchey IIb, III and IV patients will require admission.
Level of evidence: II
Grade of recommendation: C
Consensus: 88.9% (SA 66.7%, A 22.2%)

Initial evaluation of a patient with suspected AD must include a problem-specific history, physical examination and blood tests, including C-reactive protein (CRP), to determine severity and prognosis. The diagnostic accuracy of clinical evaluation for AD is low but a symptom triad of left lower quadrant pain, fever and absence of vomiting is suggestive of AD [16,42,56–60]. Urinalysis and a pregnancy test may be helpful in excluding other diagnoses that can mimic the presentation of AD, such as urinary tract infections, ureteric calculi and ectopic pregnancy [61].

Laboratory tests should include full blood count, renal function, amylase and CRP [16]. CRP can be used as an indicator of the presence of complications in AD: patients with CRP >150 mg/l have an increased risk of complicated AD [61–64]; a CRP >200 mg/l is a strong indicator of perforation [58]. CRP has both diagnostic and prognostic value for patients with AD, and a CRP value higher than 150 mg/l is associated with an increased risk of postoperative mortality if surgery is undertaken [62]. Leucocytosis is also related to complicated AD and risk of surgical intervention [65,66], but

patients with fever and leucocytosis that resolve within the first 48 h of initiating treatment have improved outcomes [67].

Uncomplicated AD or Hinchey Stage I disease can almost universally be treated on an ambulatory outpatient basis, with a 6%–10% risk of readmission, very low rates of complications and an opportunity for substantial financial savings [68], but patient selection is key. For patients selected for ambulatory management, any imaged abscess should be <3 cm, there should be no signs of systemic sepsis, and patients should be able to tolerate oral intake and have an adequate social support [49,69–71]. Risk factors for failure of outpatient management include CT findings of free fluid or extraluminal air, or more than two previous episodes of AD [69,70]. Patients should be admitted if other risk factors are present such as age >65 years, significant comorbidities or immunosuppression [68,72].

Question 1.3

What imaging should be used in acute diverticulitis?
Recommendation: Contrast-enhanced CT imaging should be undertaken in all suspected cases of acute diverticulitis in order to confirm the diagnosis, to assess severity and to plan therapy.
Level of evidence: I
Grade of recommendation: B
Consensus: 100% (SA 100%)

Plain chest and abdominal radiographs may provide a diagnosis of perforation or bowel obstruction [9]. Superior diagnostic accuracy for AD is achieved with CT—or sometimes ultrasound (US) in expert hands [73]. CT and US have shown similar sensitivity and specificity for uncomplicated AD. However, although US avoids the risk associated with ionizing radiation [74–77], CT is more universally recommended.

Severe abdominal pain, obesity and obscuring bowel gas can preclude a satisfactory US examination and therefore the use of US is limited in complicated AD [8]. Missing a complicated diverticulitis can have important clinical implications and, if diverticulitis is suspected, a contrast-enhanced CT scan to confirm diagnosis and exclude complications is recommended [78].

The diagnostic benefits of CT include easier identification of alternative diagnoses [79] assessment of the severity of AD and extent of AD-associated extra-colonic abnormalities. The latter include pericolic inflammation (phlegmon or fat stranding), abscess or extraluminal gas or contrast [55,57,79] or presence of obstruction, which is more likely to be associated with malignancy than with AD [80]. Historically water-soluble contrast enema examination may be helpful in assessment of obstructed cases; however, it is inferior to CT in detecting complicated AD, particularly associated abscess, and has fallen out of use [51,81]. CT is essential for therapeutic planning if abscess drainage is being considered [51,75] and can be used to grade severity. MRI has high sensitivity and specificity for diagnosing AD and is comparable to CT; however, availability and cost limits its use [82,83].

Question 1.4

Can acute diverticulitis be managed non-operatively?
Recommendation: Antibiotics may be omitted in uncomplicated acute diverticulitis. Patients with complicated acute diverticulitis should be administered broad-spectrum antibiotics and most can be treated non-operatively, but regular clinical re-evaluation must be undertaken to determine success or failure of treatment.
Level of evidence: I
Grade of recommendation: A
Consensus: 100% (SA 88.9%, A 11.1%)

There is no evidence mandating the use of routine antibiotics in uncomplicated AD. Conservative treatment strategy without antibiotics in patients with uncomplicated AD has proven to be safe, with long-term outcomes, in terms of recurrence, complications and need for surgery, being similar to those treated with antibiotics [84–88]. However, CRP level >170 mg/l is a risk factor for non-antibiotic treatment failure [89] and selective, rather than routine, omission of antibiotics is still recommended [90].

There is no evidence to support a particular antibiotic regime, route or duration for complicated AD. Antibiotics are indicated in all cases of complicated AD. If a drainage procedure is indicated, there is no evidence to support a prolonged course of antibiotics after source control is achieved.

Approximately 20% of patients with AD will have complicated disease and the majority can be treated conservatively with antibiotics, including many cases with abscesses and pericolic extraluminal air [91–95]. Mesocolic abscesses (Modified Hinchey 1b) are more likely than pelvic or intra-abdominal abscesses to respond to antibiotics alone [96,97] and Hinchey II patients with abscesses smaller than 4 cm in size can also usually be treated with antibiotics alone. Simultaneous abscess and perforation occur in around 18% of patients and the presence of an abscess increases the risk of failure of non-operative management. Isolated pericolic extraluminal gas—defined as free gas no more than 5 cm from the site of inflammation—is found in up to 15% of patients with complicated AD, and 6% of patients with isolated pericolic extraluminal air will need emergency surgery (ES) with a 2% 30-day mortality rate. Even in patients with free gas, provided there is an absence of severe peritonitis or sepsis, up to one-third can be successfully managed non-operatively [66,68,93]. The decision to persist with non-operative therapy in complicated AD must take into account the patient's physiological state, response to treatment through regular review and associated comorbidities [98].

Question 1.5

Which patients with complicated acute diverticulitis can be treated by percutaneous drainage?

Recommendation: Pelvic abscesses should be assessed by an experienced interventional radiologist and drained percutaneously if a safe route into the abscess can be negotiated.

Level of evidence: I

Grade of recommendation: B

Consensus: 100% (SA 66.7%, A 33.3%)

When technically feasible, patients with abscesses larger than 4 cm should be managed with imaging guided percutaneous drainage and systemic antibiotic therapy. When percutaneous drainage is technically difficult or hazardous in Hinchey II AD, antibiotic therapy alone may be necessary. Reported failure rates for percutaneous diverticular abscess drainage range from 15% to 30%. Drainage is considered a failure if signs of persistent sepsis develop, abscess or fistula recurs within 4 weeks of drainage, or when emergency surgical resection has to be performed. ES for Hinchey II AD is associated with an 80% colostomy rate and high mortality rate and so percutaneous drainage should be pursued if at all possible [96,97,99]. The commonest routes for percutaneous drainage are transabdominal and transgluteal [100–102], and imaging before percutaneous drain removal is associated with a reduction in the rates of abscess recurrence and requirement for additional drainage procedures or surgery [103].

The current DAMASCUS study aims to determine the international variability in the presentation and index management of AD.

Link: DAMASCUS study

Question 1.6

What follow-up should patients undergo after successful non-operative management of acute diverticulitis?

Recommendation: There is no requirement for routine colonoscopic or radiological follow-up of patients who have recovered from conservatively managed acute uncomplicated acute diverticulitis, unless there are suspicious features on CT scans or other risk factors for malignancy coexist.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 77.8%, A 22.2%)

Recommendation: Following recovery from an attack of complicated acute diverticulitis, the colon should be imaged after a delay of 6 weeks by either optical or virtual colonoscopy, unless imaging has already taken place within the preceding 2 years.

Level of evidence: I

Grade of recommendation: B

Consensus: 100% (SA 77.8%, A 22.2%)

Although there are specific US and CT criteria which help to differentiate AD from colon cancer, for decades the management of AD has included early endoscopic evaluation to exclude malignancy, as it has been shown that there is an age-related increase in the prevalence of colonic neoplasia in patients with diverticular disease [80,104–106]. The incidence of colonic neoplasia is low in uncomplicated AD, between 1.6% and 1.9%; therefore routine interval colonoscopy may be unnecessary in this group, unless there is clinical suspicion of malignancy. The incidence of colonic neoplasia is higher in complicated AD, between 7.8% and 10.9%, and so interval colonoscopy remains mandatory following an episode of complicated AD [107,108]. Other indications for endoscopy include age over 50 years, rectal bleeding or concerning features on imaging, if not done previously [93,105,108]. The absence of diverticulae in combination with shouldering at either end of an area of stricturing has 0.91 and 0.95 sensitivity and specificity for colonic cancer [109]

There is no indication for routine outpatient follow-up of patients who have recovered from conservatively managed acute uncomplicated or complicated AD. Following successful non-operative management of AD, the proportion of patients having at least one subsequent readmission is between 8% and 21% and the risk of readmission decreases with time. Of those patients who are readmitted, approximately 22% will subsequently undergo surgery [110,111].

Question 1.7

What advice should be given to patients after hospital admission for acute diverticulitis?

Recommendation: Obese patients should be strongly advised to lose weight. All patients should be advised to increase physical activity and improve diet quality, whilst avoiding smoking and non-steroidal anti-inflammatory drugs (NSAIDs).

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 66.7%, A 33.3%)

Higher body mass index (BMI) and larger waist circumference and waist-to-hip ratio significantly increase the risks of diverticulitis and diverticular bleeding [112,113]. Morbidly obese patients, BMI ≥ 40 kg/m^2, undergoing surgery for diverticulitis are nearly 10 years younger than normal weight patients and are more likely to require ES, ostomy creation and open surgery and to undergo procedures without an anastomosis. They also tend to have a more pronounced systemic inflammatory response [114], the pathophysiology being poorly understood but possibly due to high levels of circulating inflammatory mediators associated with increased lipid metabolism [115,116]. Physical activity of greater than 30 min/day and particularly running significantly decrease the risk of complicated diverticulitis [113,117]. Although the mechanisms are

not fully understood, long-term physical activity decreases intracolonic pressure and colonic transit time, and results in alterations to intestinal autonomic activity, gut hormone secretion, microbiome and immune function [117–119]. Smoking is associated with an increased risk of complications in patients with diverticular disease [119–123]. Use of aspirin or NSAIDs increases the risk of diverticulitis and diverticular bleeding [16,124,125]. NSAIDs—but not aspirin—are strongly associated with an increased risk of diverticular perforation [126]. Impaired prostaglandin synthesis compromises mucosal integrity, increases permeability and allows bacterial translocation, which promotes inflammation [125]. Diverticulitis is defined by the presence of micro- or macro-perforation leading to abscess formation, and is believed to be the result of an impaired mucosal barrier and increased intra-colonic pressure [119]. Use of opiates or corticosteroids increases the risk of diverticular perforation [127] with opiates slowing colonic transit and increasing intra-colonic pressure which contributes to the increased risk of perforation [128]. Statins have been shown to reduce the risk of complicated diverticulitis and perforation [127,129], but there is conflicting evidence as to whether calcium channel blockers also reduce the risk of perforation [119,127,128].

Treatment with mesalazine, rifaximin or probiotics has not been found to prevent recurrent episodes of diverticulitis or even control persistent symptoms after an episode of AD [130–136]. An increase in dietary fibre or supplemental fibre is widely accepted to be of benefit for general health and should be recommended, but there is little evidence that it reduces current symptoms or recurrence of symptoms. Patients should be provided with written advice on discharge.

Question 1.8

Which patients with acute diverticulitis should be considered for laparoscopic lavage?
Recommendation: Laparoscopic lavage is currently not recommended for treatment of complicated acute diverticulitis but may be an acceptable alternative to avoid major resection in high risk patients provided its limitations are communicated to patients.
Level of evidence: I
Grade of recommendation: A
Consensus: 100% (SA 55.6%, A 44.4%)

Perforation associated with AD represents 75% of diverticular emergencies requiring surgery [137]. Complementary to estimates of inflammatory parameters and CT findings, good decision-making and clinical judgement determine the need for surgery, depending upon the patient's clinical status, comorbidities, immunosuppression, signs of peritonitis and sepsis [93,138].

The optimal management of Hinchey III AD has been the focus of much debate. Studies of laparoscopic lavage (LL) in Hinchey III AD without visible perforation have shown that LL is a safe alternative to resection but in these studies patients with high American Society of Anesthesiologists (ASA) score were excluded. Patients undergoing LL tend to be younger and have a higher BMI. Patient factors that would contraindicate LL include shock, need for inotropic support and immunosuppression. Findings at operation that preclude LL are persistent perforation—actively sought by underwater air distention test—or faecal peritonitis.

Outcomes from studies show a three times greater chance of ongoing intraperitoneal sepsis with LL than with open resectional surgery, with significantly increased rates of postoperative intra-abdominal abscess and higher reintervention rate, including emergency reoperations. Morbidity and mortality are not significantly different between LL and open surgery. LL has a significantly shorter operating time, fewer stomas, fewer postoperative cardiac and wound complications and a shorter length of hospital stay [136–148]. Published studies have made no attempt to standardize the surgical technique for LL but, after laparoscopic confirmation of Hinchey III AD, variable amounts of fluid were used to perform the lavage (mean 15 L), active searching for diverticular perforation was variable and there was no surgical credentialling or specialization [149,150]. Limitations of LL include the risk of missing a persistent perforation (30%), faecal peritonitis enclosed within a sigmoid loop (10%) and overlooking a sigmoid cancer (10%) [151].

Question 1.9

Which patients should undergo emergency sigmoid resection for acute diverticulitis?
Recommendation: Patients who have failed conservative management or those with frank perforation or large bowel obstruction should undergo emergency sigmoid resection for acute diverticulitis.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 55.6%, A 44.4%)

Hartmann's procedure (HP) or primary anastomosis with or without diverting ileostomy are the two surgical techniques used in patients undergoing ES for perforated AD, HP being performed most often [152,153]. Surgeon and patient factors influence the type of operation performed. Surgeon-specific factors include colorectal sub-specialization, with non-colorectal surgeons more likely to perform HP. Patients undergoing HP tend to be older, have higher Charlson Comorbidity Index and ASA scores and are more likely to be immunosuppressed [154–156]. Primary anastomosis can be performed in haemodynamically stable and immunocompetent patients with Hinchey III or IV [157–160]. Recent studies and meta-analysis have shown significantly lower overall mortality in patients with primary anastomosis compared with HP. Surgical site infection (SSI) rates, reoperation and stoma non-reversal rates are significantly lower in primary anastomosis, but at the expense of a longer mean operating time for primary anastomosis compared with HP [161–165].

Primary anastomosis without diverting ileostomy may be preferred under suitable conditions in order to avoid the potential difficulties associated with a column of colonic stool when contemplating ileostomy reversal, and in 27% of those patients assigned to primary anastomosis in the LADIES trial no stoma was constructed [157]. There is no consensus on the value of antegrade colonic lavage under these circumstances but, provided care is undertaken to avoid spillage and colonic mobilization is undertaken when necessary, there may be some advantages.

Evidence to support or refute the safety and effectiveness of a laparoscopic vs. open approach in complicated AD is insufficient and laparoscopic surgery should only be undertaken by suitably trained surgeons. The operating time is longer than open surgical resection, although laparoscopic surgery may improve postoperative pain control and reduce the duration of paralytic ileus.

Laparoscopic and open surgery have comparable postoperative mortality, morbidity and reoperations due to anastomotic leakage [144,151,166,167].

The use of a damage control strategy involving resection without anastomosis, temporary abdominal closure (TAC), planned re-look and delayed stoma formation—or even delayed anastomosis—should be considered in the septic unwell patient at initial laparotomy [168–171]. Fully informed consent is essential, particularly in those patients in whom a primary anastomosis is considered a viable option [156].

Question 1.10

What are the essential operative steps for sigmoid resection in complicated diverticular disease?

Recommendation: Resection of acutely inflamed and perforated bowel should be undertaken, avoiding damage to adjacent structures and minimizing tension on an anastomosis or colostomy by selective mobilization of the splenic flexure. Primary anastomosis with or without diverting ileostomy should be considered by suitably trained surgeons under favourable conditions.

Level of evidence: IV

Grade of recommendation: GP

Consensus 100% (SA 66.6%, A 44.4%)

There are no studies evaluating the extent of sigmoid resection in the emergency setting, but limiting the resection to the segment that is acutely affected without compromising blood supply of the remnant bowel is sensible for HP. If a primary anastomosis is undertaken, the distal resection level should be at the top of the rectum and the proximal resection level at a point where there are no or minimal diverticula in order to try to minimize anastomotic events. Mobilization of the splenic flexure may be necessary selectively in order to ensure reduced tension on a colorectal anastomosis or an end colostomy, but it does risk spread of contamination in Hinchey III and IV patients. Mesenteric division close to the bowel wall is likely to decrease the risk of ureteric injury, particularly in the presence of an inflammatory mass, at the expense of potentially troublesome bleeding. If a sigmoid cancer is suspected, oncological resection with higher ligation of the inferior mesenteric artery/superior rectal artery and dissection in a mesocolic/mesorectal plane should be undertaken if possible.

There are no studies giving guidance on the management of the rectal stump in the emergency setting, but division of healthy lower sigmoid or rectum below the affected segment is likely to be associated with a lower risk of stump closure dehiscence. Rectal stump washout may be performed in order to try and minimize the effect of rectal stump dehiscence. The length of the remaining rectum and its suitability for future reversal are useful to record in the operation note.

Whilst rectal catheters are in widespread use, there are no studies demonstrating specific benefit. Similarly, there is no evidence to support the use of abdominal drains following surgery for perforated diverticulitis.

COLORECTAL CANCER

Introduction

Colorectal cancer presents as an emergency in 20% of cases in the UK. Emergency presentation is associated with a poorer outcome, high levels of morbidity, mortality and reduced overall survival. This may be explained partly by the association of emergency presentation with increasing age, lower socioeconomic status, increased comorbidity, higher stage of disease and lower rates of treatment with curative intent: 52% for emergency presentation, compared with 69% and 86% referred from general practitioner (GP) and screening services respectively [172]. Perioperative mortality for ES continues to reduce in European countries [172,173]. However, in the UK, 90-day mortality following ES for colorectal cancer is nearly six times greater than that of elective surgery (11.5% vs. 2.0%). Consequently, optimization of treatment strategies for these patients is a priority to improve clinical outcomes [161]. The National Health Service (NHS) long-term plan states

that one of its priorities for the next 10 years is diagnosis of Stage I and II disease for 75% of cancer patients. If this is achieved, it would reduce the rate of emergency presentation of colorectal cancer [174].

Emergency presentation can occur as the initial event leading to diagnosis, but may also occur during the course of the disease, as a consequence of its treatment or as a terminal event at the end of life. These recommendations will focus on the most common de novo emergency presentations of colorectal cancer which are with obstruction (up to 80%), perforation (up to 20%) and, less commonly, acute lower GI bleeding (ALGIB).

Large bowel obstruction

Question 2.1

What is the optimum imaging modality for patients presenting with signs and symptoms of malignant large bowel obstruction?

Recommendation: To diagnose malignant large bowel obstruction a contrast-enhanced CT scan is the imaging modality of choice. A plain abdominal radiograph is unnecessary.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 77.8%, A 22.2%)

The sensitivity and specificity of abdomino-pelvic contrast-enhanced CT scan in the diagnosis of large bowel obstruction is high (sensitivity 96%, specificity 93%) and it outperforms other imaging modalities including US scan and plain abdominal radiography [175]. Performing a plain abdominal radiograph may delay time to CT and a definitive diagnosis. A CT provides effective local and distant staging information to inform treatment decisions [175–178]. When CT is equivocal about the cause of obstruction, endoscopic assessment may be helpful.

In a stable patient, endoscopic evaluation can confirm a radiological diagnosis, define the aetiology when CT is inconclusive, provide tissue biopsies for histological assessment and be used for combined endoscopic/fluoroscopic placement of a stent for obstruction. However, use of endoscopy is not mandatory where the diagnosis is not in doubt and surgical treatment is planned.

The role of self-expanding metal stents (SEMSs)

Question 2.2

What are the indications and contraindications for self-expanding metal stents?

Recommendation: Self-expanding metal stents can be used for the treatment of malignant large bowel obstruction as either a definitive procedure for palliation or as a bridge to surgery.

Level of evidence: I

Grade of recommendation: A

Consensus: 100% (SA 88.9%, A 11.1%)

Recommendation: Self-expanding metal stents should definitely not be used in the presence of perforation, peritonitis or systemic toxicity and low rectal lesions. Self-expanding metal stents are relatively contraindicated when the patient is taking anti-angiogenic chemotherapy and for benign causes of large bowel obstruction.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 77.8%, A 22.2%)

National guidelines concur that the SEMS is the treatment of choice for malignant large bowel obstruction (MLBO) in the palliative setting due to its reduction in stoma rates, hospital length of stay, inpatient mortality and intensive care unit admission rates, and time to chemotherapy [177,179,180].

The use of SEMSs as a bridge to surgery (BTS) has short-term benefits. It can downgrade the emergency situation by relieving obstruction, enabling medical optimization of the patient, and giving time for staging and planning of definitive treatment. This enables an early planned resection with higher rates of primary anastomosis, lower rates of stoma formation, increased use of laparoscopic techniques and reduced morbidity and mortality [181–183].

The use of SEMSs in the presence of perforation or peritonitis is contraindicated [177]. SEMSs in patients who would benefit from anti-angiogenic therapy (e.g., bevacizumab) are relatively contraindicated, due to the higher rates of perforation seen in this group, although the evidence for this is debated [184–186]. There does not appear to be an increased risk of SEMS-related perforation with other newer chemotherapeutic agents such as cetuximab [187].

SEMSs can be used in patients with MLBO due to extraluminal malignant disease and peritoneal carcinomatosis but with lower success rates [188–190], increased technical difficulty [189], reduced patency rates [191] and increased complication rates [192]. SEMSs are being used more frequently in benign causes of obstruction, in particular in benign strictures; however, this is associated with increased complication rates and lower clinical success rates [193]. In addition, the use of stents to cover anastomotic leaks and fistulas is increasing and a meta-analysis of small retrospective cases series by Arezzo et al. showed a short-term success rate of 73% but a longer-term success rate of only 57% with complications occurring in 41.5% [194].

Question 2.3

Are self-expanding metal stents as a bridge to surgery for malignant large bowel obstruction oncologically safe for patients?

Recommendation: Self-expanding metal stents appear to be as oncologically safe as emergency surgery. The 3- and 5-year loco-regional recurrence rates, disease-free survival rates and overall survival rates are comparable for these two groups of patients on the basis of current data. However, there is a risk of perforation and perforated cancers are at a higher risk of local recurrence. A fully informed consent process is mandatory.

Level of evidence: I

Grade of recommendation: A

Consensus: 100% (SA 77.8%, A 22.2%)

Concerns about tumour cell dissemination and perforation by stent insertion as possible contributors to recurrence and poorer survival have led to doubts regarding this technique as a panacea for all cases of MLBO. Early studies showed an increase in local recurrence in patients receiving a SEMS as a BTS [195] and early termination of several RCTs because of increased morbidity in the stented arms [196–198] and subsequent poorer oncological outcomes in those experiencing SEMS-related perforations reinforced these concerns [199]. These concerns have meant that SEMSs have largely been used for patients with metastatic disease or serious comorbidities precluding surgical resection. National guidelines have not recommended their routine use, reserving it as an option for those with metastatic disease or at high risk of mortality from ES [179]. More recent American and UK guidelines recommend SEMSs as a BTS on an individualized patient basis, but there is significant variation in international guidance on this issue [200] which will continue to change with evolution and maturation of the data.

Accumulating evidence and increased experience with the SEMS technique has shown more reassuring oncological outcome data. A recent meta-analysis of RCTs examining SEMSs compared with ES found a higher risk of overall cancer recurrence in the SEMS as a BTS group (37% vs. 25.9%), but no difference in 3-year disease-free and overall survival [201]. Equivalent 5-year oncological outcomes have been shown in a retrospective cohort study [202] and two systematic reviews [182,203]. The Dutch Colorectal Audit showed equivalent 3-year oncological results between patients with left-sided colonic obstruction undergoing ES or SEMS as a BTS. However, the 17 patients who experienced SEMS-related perforations had non-statistically significant higher recurrence rates (18.0% and 11.0%, $P = 0.432$) and poorer 3-year disease-free (49% and 59.6%, $P = 0.717$) and overall survival (61% and 75.1%, $P = 0.529$) [183].

The early poorer oncological results seen may have been due to inexperience with the technique and in particular the use of balloon dilatation, which is not recommended [204]. Increasing expertise and familiarity with SEMSs has led to increased success rates with lower perforation rates which is likely to be crucial to the improvement in oncological outcomes seen.

Question 2.4

What is the expected success rate for a self-expanding metal stent?

Recommendation: Units should be aiming for a clinical and radiological success rate of the order of 90%. All units should audit their figures and include complications.

Level of evidence: I

Grade of recommendation: A

Consensus: 100% (SA 88.9%, A 11.1%)

The use of SEMSs has increased due to the lower morbidity associated with endoscopic intervention compared with ES. The short-term success rates in large prospective trials are good, with technical and clinical success rates in excess of 90% [184,205–209]. Although some studies report somewhat lower clinical success rates, these still remain greater than 80% [210–212]. In addition, success rates for SEMSs tend to be higher in those stented as a BTS rather than for palliation [191,207]. Real-world data are probably reflected better in national audit data rather than clinical trials and they tend to be lower than those seen in the trials. The Dutch Colorectal Audit includes 222 stented patients and reports technical success rates of 194 of 222 (87.4%) and clinical success rates of 177 of 222 (79.7%) [183].

Overall complication rates for SEMS placement are up to 35% including early short-term and later longer-term complications. The main complications include perforation (0%–12%), failure to stent, stent migration and re-obstruction. Reintervention rates after

SEMSs can be up to 20%. Less frequent complications include pain, bleeding, tenesmus (particularly for rectal SEMSs), fistula, late perforation, incontinence and fever [212].

Perforation by SEMSs can take several forms. It may be clinically overt, guide-wire-related, silent, or due to micro-perforation. An overt perforation results in symptoms and leads to a subsequent decision to proceed to ES or palliative care. Guide-wire-related perforations are radiologically detectable but may be clinically asymptomatic and are usually managed conservatively. At surgery, a clinically occult SEMS perforation may be seen, or later picked up by the pathologist on examination of the resected specimen. Perforation rates are higher if a stricture is predilated and this practice is not recommended. In the Dutch Colorectal Audit, the overall SEMS perforation rate was 7.7% [183]. Given the possible detrimental effect on oncological outcomes, it is essential that the SEMS-related perforation rate is low and this is related to operator experience. The perforation rate should be audited at an institutional level. In the UK, the Joint Advisory Group for Endoscopy have set a key performance indicator for perforation following SEMS placement of <10% and an aspirational target of <5% [213]. High perforation rates in the early trials led to their premature termination [196]. The perforation rate in the more recently published prospective trial is much lower, between 1.6% and 5%, probably reflecting increased expertise [207,209,211,214–216].

For palliative patients, re-obstruction becomes a significant risk but can often be managed by further stent placement [217].

Question 2.5

Is a self-expanding metal stent the treatment of choice for malignant large bowel obstruction in patients with irresectable primary and/or metastatic disease?

Recommendation: A self-expanding metal stent should be the treatment of choice for patients with irresectable primary and/or metastatic disease and malignant large bowel obstruction as it is associated with better quality of life, shorter hospital stay and lower stoma rates compared with palliative surgery.

Level of evidence: I

Grade of recommendation: A

Consensus: 100% (SA 66.7%, A 33.3%)

A 2011 Cochrane review found higher clinical success rates in patients undergoing ES compared with SEMSs for MLBO [218]. The clinical success rates at relieving obstruction do still seem to be better with palliative surgery in comparison with SEMSs (96% vs. 86.1%, $P = 0.02$) [217]. However, since 2011, further studies have shown a significant benefit with SEMSs in terms of quality of life, reduction in stoma rates, length of hospital stay, lower intensive care unit admission rates and shorter time to commencement of chemotherapy albeit with conflicting effects on morbidity and mortality compared with palliative surgery [217,219,220]. SEMSs have become the treatment of choice for palliation, when local expertise exists, for left-sided MLBO, and this is incorporated into several clinical guidelines [177,179,180,221,222]. Proximal colonic stenting is technically more challenging and the recommendations have differed between guidelines and will depend on the local expertise in performing SEMSs. The American Society of Colon and Rectal Surgeons (ASCRS) guidelines now recommend considering SEMSs as a palliative treatment for right-sided MLBO [180]. SEMSs have definite favourable short-term outcomes compared with ES in the palliative setting. As a palliative measure, SEMSs should be considered the first line of treatment.

Question 2.6

When should self-expanding metal stents be used as a bridge to surgery in symptomatic malignant large bowel obstruction for potentially curable disease?

Recommendation: There is good evidence to support the use of self-expanding metal stents as a bridge to surgery in malignant large bowel obstruction (distal to the splenic flexure) prior to definitive surgical intervention, particularly in high risk patients. There should be a discussion with patients about the role of self-expanding metal stents as an alternative to emergency surgery and the risks and benefits highlighted for both approaches.

Level of evidence: I

Grade of recommendation: A

Consensus: 100% (SA 100%)

Recommendation: Self-expanding metal stents as a bridge to surgery can be used in right-sided malignant large bowel obstruction, although this may have more limited application in practice. The use of self-expanding metal stents in curable rectal cancers within 5 cm of the dentate line is not recommended.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 100%)

The choice between SEMSs as a BTS or ES is finely balanced and must involve open discussion and shared decision-making between the surgeon and patient. This process should balance individual surgical risk with the relatively immature data on long-term oncological outcome (discussed above). Even in an average surgical risk patient, of ASA I or II, ES still has higher rates of morbidity and mortality and anastomotic leak rates than elective surgery and postoperative complications can negatively affect oncological outcomes. The choice of SEMSs as a BTS or ES is an individualized decision and should be accompanied by a detailed documentation of individual surgical risk and the consent discussion. International guidance is highly variable in its recommendations of whether SEMSs should be used as a BTS [200] with current UK National Institute for Health and Care Excellence

(NICE) guidance recommending that SEMSs as a BTS should be discussed with patients as an equivalent alternative to ES [177].

Meta-analyses have shown that SEMSs as a BTS are associated with lower morbidity rates than ES [201,223,224], lower stoma rates and increased rates of primary anastomosis [182,223] and similar mortality rates [201,223]. Most studies have concentrated on left-sided MLBO, but similar results have been shown in cohort studies including proximal colonic malignancy [206,208,209]. Right-sided tumours made up between 7.8% and 23.2% in these cohorts [207–209] and these authors support the use of SEMSs as a BTS in both left-sided and more proximal tumours. Current UK [177] and European guidance [179] does not support the use of SEMSs as a BTS for right-sided colonic lesions although the American guidance does [180]. A systematic review focusing on right-sided MLBO and SEMSs as a BTS has shown much lower morbidity and mortality in the BTS group but with the caveat that the 14 studies included were all cohorts and mainly retrospective [225].

SEMSs have been used in published case series for obstructing rectal malignancy; however, in the majority of cases this has been as a palliative measure and not as a BTS. The use of SEMSs in rectal cancer appears to be less successful than for left-sided cancers [215]. In addition, the rectum tends not to be well defined in studies examining the use of SEMSs, with one study defining the stented rectum as being greater than 5 cm from the verge but with no definition of the proximal extent [192]. In general, SEMSs should not be placed within 5 cm of the dentate line because of the risk of stent-related symptoms of tenesmus, pain and incontinence. The more recent larger prospective Eastern studies have included SEMSs as a BTS in rectal cancer; however, the overall numbers are quite small (Saito et al. [*n* = 11], Tomita et al. [*n* = 13]) [208,209] and there is insufficient data from these papers regarding the location within the rectum at which the SEMS was used. At present there is not sufficient evidence to support the use of SEMSs as a BTS in obstructing rectal cancers. In a palliative setting, SEMSs may be suitable in selected obstructing upper rectal cancers, albeit with lower success rates and higher complication rates than left-sided SEMSs.

Question 2.7

When is the optimal time for resectional surgery after using a self-expanding metal stent as a bridge to surgery?
Recommendation: In the absence of strong evidence, it seems sensible that resectional surgery should be scheduled immediately following medical optimization of the patient's clinical conditions, full radiological staging of disease and multidisciplinary team discussion.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 66.7%, A 33.3%)

The European Society of Gastrointestinal Endoscopy (ESGE) guidelines recommend operating within 5–10 days of SEMS placement [179], but the evidence to support this interval is weak. Broholm et al. [226] found an increased risk of recurrence associated with a longer wait to surgery in 112 SEMS patients (range of time to surgery 0–165 days, median 18 days), of whom 18% required ES due to SEMS-related complications of migration and perforation. The larger prospective studies have relatively short durations of 1–3 weeks from stenting to surgery [201,208,209].

Question 2.8

Should covered or uncovered self-expanding metal stents be used?
Recommendation: Uncovered stents should be used in the bridge to surgery setting as they are less likely to migrate. In the palliative setting, participation in a clinical trial to determine the optimal stent design should be considered.
Level of evidence: III
Grade of recommendation: B
Consensus: 100 (SA 100%)

Both covered and uncovered stents have been used for SEMSs; however, the majority of studies have used uncovered stents. There is no difference in the technical and clinical success or patency rate between the two [227]. The main type of stent used is the Wallflex, an uncovered flared stent with both through the scope and over the wire delivery systems. The other commonly used stent is the Niti-S, which is an uncovered, non-flared stent. Covered stents are associated with higher stent migration rates in retrospective case series [228,229]. Covered stents can be either fully covered or partially covered; however, even partially covered stents are associated with migration in retrospective case series [230]. The higher stent migration rate seen with covered stents is thought to be due to less tumour ingrowth which can provide anchoring. The larger prospective trials to date have used uncovered stents [206,207,209].

The ESGE guidelines do not recommend one type of stent over another [179]. However, the earlier American Society of Gastrointestinal Endoscopy guidelines recommend the use of uncovered stents [231] this may simply be a reflection of the fact that the majority of the stents available in the US market at the time were uncovered [232].

For palliative stenting, where the stent is likely to be in situ for a longer duration and ingrowth of tumour a significant risk, consideration should be given to the use of a covered stent. However, the evidence supporting the use of one stent design over another

is weak. The ongoing CReST2 study aims to answer the question of whether covered or uncovered stents are preferable in the palliative setting.

Link: CREST2 study

Surgical decision-making

Question 2.9

What are the surgical options for malignant large bowel obstruction?

Recommendation: The choice of surgical procedure should be guided by the physiological condition of the patient, the site of obstruction and the state of the proximal colon. For proximal colonic obstruction (up to the distal transverse colon), resection and primary anastomosis is preferred, but in a patient with markedly deranged physiology, resection, mucus fistula and end ileostomy is sensible. For left-sided obstruction (from the distal transverse colon), in a patient with stable physiology a resection and primary anastomosis is preferable. Worsening clinical condition and comorbidity dictates resection with an end colostomy.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

Recommendation: Where patient physiology is markedly deranged and significant comorbidities exist, a proximal defunctioning loop stoma alone is reasonable to allow medical optimization prior to elective resection. Obstructing rectal cancer is best managed with a proximal loop colostomy to allow full radiological staging and neoadjuvant treatment if required.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 66.7%, A 33.3%)

For stable patients with a proximal colonic obstruction and low surgical risk, it is a reasonable and safe option to perform a resection and primary anastomosis [233–236]. There are a number of anastomotic variations including handsewn or stapled techniques and different methods of constructing stapled anastomoses. The European Society of Coloproctology (ESCP) right hemicolectomy audit of 3208 patients reported a slightly increased anastomotic leak rate from stapled anastomoses after adjustment for cofactors (OR 1.43, 95% CI 1.04–1.95, P = 0.03) [237] but no difference in the leak rate between different types of stapled anastomotic configurations [238]. However, the anastomotic leak rate for right colonic resection in ES is not insignificant [239,240] with a rate of 14.3% reported in the recent ESCP right hemicolectomy snapshot audit [237]. In this audit, 19.5% of patients undergoing emergency right hemicolectomy did not have a primary anastomosis. Frago et al. reported an overall anastomotic leak rate of 16.4% in 377 emergency colectomies for obstruction, with proximal anastomoses more likely to leak than distal [241]. A large national Japanese database reported a much lower anastomotic leak rate (1.7%) but a higher rate of adverse outcomes with ES [242]. Amelung et al. in a retrospective study examined three treatment modalities for obstructing proximal tumours [224]. The majority of patients were treated with emergency resection (compared with stoma or SEMS). For the 85.6% of emergency resections with primary anastomosis, the leak rate was 7.4%. Tan and Sim have identified advanced age, ASA Grades III–IV and preoperative renal impairment as factors associated with worse perioperative outcome in obstructed colorectal malignancy, albeit in a solely Asian population [233]. Consequently, in patients with poor surgical risk or at higher risk of anastomotic leak, it is reasonable not to perform a primary anastomosis and to consider resection and ileostomy [224]. There has been one meta-analysis of laparoscopic vs. open approach for obstructing right-sided cancers [243]; however, only five studies were included with small numbers overall and anastomotic leak rate was not reported in some of the studies which limits the interpretation of the data.

For obstructing left-sided cancer, there are multiple surgical options, the appropriate approach again depending largely on the physiological and comorbid status of the patient. A Cochrane review in 2004 addressing primary or staged resections found the evidence at the time was too weak to determine the best surgical management strategy [244]. Potential surgical options for obstructing left-sided cancers include resection and primary anastomosis with or without a covering stoma, HP or defunctioning stoma alone. Breitenstein et al. [245] in a large meta-analysis showed no benefit from two- or three-stage resection vs. one-stage resection. Staged procedures do inevitably result in longer overall hospital stays and the reversal rate for HP in colon cancer is low at 20% [246]. Resection and primary anastomosis is a safe technique which has been used for many years and should be the preferred option if the patient's clinical condition allows [247,248] and can also be used safely in selected elderly patients [249]. Where possible, a segmental resection is preferred over a subtotal colectomy because of better functional results [250] although some authors show no difference in outcomes between segmental resection, HP or subtotal colectomy [251]. Subtotal colectomy can be reserved for cases of proximal colonic damage from distal obstruction or synchronous tumours and, when employed, a minimal amount of distal ileum should be resected. Anastomotic leak rates vary in retrospective case series between 2.2% and 12% [222,246,252–254]. Subtotal colectomy may have a lower anastomotic leak rate than segmental colectomy [255]. Individual risk stratification in terms of predicting risk of anastomotic leak and outcome is crucial for safe surgical decision-making.

Staged resections should be considered for obstructing rectal cancers, when a diverting stoma or SEMS placement (where appropriate) allows time for accurate local staging and consideration of neoadjuvant therapies [256]. Where SEMSs are not appropriate and a defunctioning stoma is performed as a BTS in rectal cancers, a right-sided transverse loop colostomy should be considered, as it is unlikely to interfere with the subsequent surgical approach [222,257], unless a definitive abdominoperineal excision of the rectum can be predicted, when a left-sided colostomy should be formed. A loop stoma is preferred to allow venting of the distal limb [256]. A defunctioning stoma as a BTS is an option for some patients instead of using a SEMS [258–260]. Patient preference and uncertainty of the long-term oncological results of SEMSs due to immaturity of the data make this a valid surgical option after discussion of the risks and benefits of the different management strategies with the patient. In general, however, this option is likely to be reserved for those who would benefit from optimization prior to semi-elective surgery or for those where SEMSs have failed or are not available due to local resources.

Retrospective studies have reported on-table lavage to be safe in obstructed colorectal cancers; however, it also prolongs the surgery and does not appear to confer any specific advantage over decompression alone [261,262]. On-table lavage is at the discretion of the operating surgeon as it does not increase the morbidity or mortality rate. However, there have been no RCTs to date showing a benefit in the emergency situation over manual decompression alone [263].

Question 2.10

What is the optimal surgical approach for irresectable Stage IV colorectal malignancy or peritoneal carcinomatosis causing malignant large bowel obstruction?

Recommendation: A self-expanding metal stent is the preferred intervention for irresectable Stage IV disease or peritoneal carcinomatosis causing large bowel obstruction. Surgery should be reserved for patients with good performance status and with isolated areas of disease that can be surgically relieved. Success rates for stents are lower if the obstruction is due to extrinsic compression. Patients should be counselled about high rates of re-obstruction, morbidity and mortality. The goals of treatment together with patient and family expectations need to be discussed realistically.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 88.9%, A 11.1%)

Palliative surgery in patients with peritoneal carcinomatosis is associated with high morbidity and mortality rates [264]. However, patients with advanced malignancy are at high risk of obstructive symptoms (10%–28% of colorectal cancers) so this is not an uncommon situation [265]. Carcinomatosis from GI malignancy compared with ovarian primaries is associated with worse outcomes [266]. Negative prognostic indicators for surgery in these cases include older age, poor nutritional state, poor performance status, extent of malignancy, small bowel as opposed to large bowel obstruction and prior abdominal or pelvic radiotherapy [267]. Even in patients who undergo surgery, the re-obstruction rate can be as high as 50% [268].

Surgery is generally reserved for patients with an obvious obstruction point, which cannot be managed endoscopically (e.g., with SEMS), and when no major barriers to surgical intervention exist such as significant comorbidity, extensive carcinomatosis, multilevel stenoses or invasion of the root of the mesentery [267,269]. When surgery is performed, the operative approach must be tailored to the clinical and radiological findings, with the primary goal of relieving the obstruction, alleviating symptoms and sometimes allowing progression to palliative treatment which may prolong survival [270]. Surgery will usually take the form of a palliative loop stoma. A shared model of decision-making is important in these clinical scenarios, particularly in identifying the goals of care. In general, survival is poor. Median survival in established cases of untreatable MLBO is only approximately 4–5 weeks, although up to a third of patients show spontaneous resolution of acute symptoms with medical management [269]. In patients undergoing surgery, a meta-analysis showed that resection was associated with the longest survival (7.2 months) with stoma and bypass surgery having shorter survival times (3.4 and 2.7 months respectively) albeit in highly selected populations with small numbers of patients [270]. In addition, major complication rates among those who had surgery were high at 37%. The type of resection performed in the studies was not reported, which limits interpretation of the results.

Question 2.11

What is the role of laparoscopic resection in emergency surgery for colorectal cancer?

Recommendation: Due to a shorter hospital stay and lower postoperative morbidity and mortality, laparoscopic resection is recommended where patient and tumour characteristics are favourable.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 77.8%, A 22.2%)

International guidelines suggest that the laparoscopic approach for MLBO due to colorectal cancer should be reserved for selected favourable cases and in specialized centres [222]. Retrospective cohorts and case–control studies have shown that laparoscopic surgery for emergency colorectal surgery (of varying aetiologies) is safe and has similar benefits to laparoscopic surgery in the elective setting with shorter length of stay and lower postoperative

morbidity. However, it is likely that case selection biases these results, with younger, fitter, less comorbid and less physiologically deranged patients being selected for a laparoscopic approach.

The recent LaCeS trial has demonstrated that randomization of a cohort of ES patients between laparoscopic and an open surgical approach is feasible, acceptable and safe, albeit with a conversion rate of 39% [271]. Vallance et al. [272] have examined patient and institutional factors associated with the laparoscopic approach for urgent surgery for colorectal cancer in the English National Bowel Cancer Audit. The proportion of urgent laparoscopic resections doubled across the study period (2010–2016) from 15.1% to 30.3% with no change in the conversion rate, which remained stable at 18.7%. After multivariable logistic regression analysis, patient characteristics associated with the use of a laparoscopic approach were a lower ASA grade and earlier T stage. The use of laparoscopic surgery was associated with a reduced length of stay and lower 90-day mortality.

Perforation

The majority of studies report retrospective, single centre experiences of emergency presentations of colorectal cancer; in these cohorts the perforated cancers represent 18.6%–28.4% of cases [272–276]. In population-based cohorts, 1.6%–4.1% of the total number of colorectal cancers presented with perforation [277,278]. Perforation occurs at the site of the cancer in 65%–92% and proximal to the cancer in 3%–35% [279].

Reported early perioperative mortality rates from perforated colorectal cancer vary widely and have been as high as 62% [279]. However, more recent reports show perioperative mortality in the range 0%–20% [273,274,276–280]. Mortality rates may depend on the site of perforation. It has been thought that perforation proximal to the tumour site in an obstructed colon tends to lead to diffuse peritoneal contamination and septic shock resulting in an increased risk of perioperative mortality. A perforation at the tumour site results in local contamination and a lower risk of severe peritonitis, although the literature is contradictory. Mortality is associated with age, comorbidity and Stage IV disease [173,281].

Question 2.12

How should patients who present with a perforated cancer be counselled?

Recommendation: Patients with a perforated cancer should be advised of the higher rate of local recurrence and peritoneal carcinomatosis but that there is no difference in the rate of development of distant metastases. The long-term oncological outcomes for curatively treated patients presenting as emergencies with either obstruction or perforation are equivalent.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 77.8%, A 22.2%)

The influence of perforation on oncological outcomes remains unclear [279]. It is difficult to draw conclusions from relatively small, single centre, retrospective studies with variable lengths and completeness of follow-up and with varying rates of perioperative mortality. The heterogeneity of groups within studies (all perforations vs. local or proximal perforations; the inclusion of all ES patients including those with obstruction and perforation; urgent, expedited surgery vs. emergency, immediate surgery) also makes conclusions unreliable.

Poorer cancer outcomes for patients undergoing curative ES in comparison with elective groups are reported [282,283] but it is suggested that these dismal outcomes are largely due to differences in patient and tumour characteristics and statistical adjustment for differences and propensity score matching eliminates these differences [284]. In the context of perforated tumours alone, the poorer outcomes in patients presenting with perforation may be due to early deaths from perioperative mortality and advanced disease stage [277,285]. Once adjustment is made for perioperative mortality, similar 5-year overall survival rates seem to be seen for perforated cancers undergoing complete resection compared with non-perforated controls [280].

Evidence regarding the incidence of peritoneal carcinomatosis after curative surgery for colorectal cancer is poor, but a perforated primary tumour may be an important factor [286]. Population-based studies or registries with more complete data are more likely to be reliable than single centre studies. Cheynel et al. showed that, in a population-based study, locally perforated cancers had a higher rate of local recurrence (15.7% vs. 7.8%, $P = 0.021$) and peritoneal carcinomatosis (13.8% vs. 6.3%, $P = 0.036$), but no difference in the rate of distant metastases (17.7% vs. 18.6%, $P = 0.99$). Perforation was an independent risk factor for local recurrence or peritoneal carcinomatosis (OR 2.17; 95% CI 1.27–3.69, $P = 0.004$) but, despite this, after exclusion of postoperative mortality perforation was not a significant prognostic factor for survival on multivariate analysis (OR 1.16, 95% CI 0.72–1.9, $P = 0.54$) [277]. The Erlangen Colorectal Cancer Registry showed lower disease-free 5-year survival (42.9% vs. 72.8%) and overall survival (47.3% vs. 66.9%) in 52 patients with perforated colon cancer in comparison to 1206 patients with non-perforated colon cancer and showed that perforation was an independent negative prognostic factor [256].

There does not appear to be a significant oncological difference in the longer term between curatively treated patients presenting as an emergency with obstruction or perforation. When emergency cases are examined together as a group, Chen et al. found on multivariate analysis that although patients with locally perforated colonic cancer had a lower disease-free survival ($P = 0.005$) than those with obstructed cancers there was no difference in overall survival [275] whereas Biondo et al. showed no differences at all between curatively treated emergency patients with perforated (locally or proximally) or obstructed colonic tumours with respect to tumour recurrence, type of recurrence, overall survival, 5-year disease-free survival and cancer-related survival [274]. More recently, the same authors analysed a cohort of patients collected over 18 years, showing that local recurrence was predicted by the presence of diffuse

peritonitis, but no significant difference was identified in local recurrence rates between patients presenting with obstruction or perforation [276].

Question 2.13

What are the surgical options for perforated colorectal cancer?

Recommendation: Operations should be individualized taking into account existing physiological derangement, comorbidity and tumour characteristics. Oncological resection should be performed wherever possible: for perforation at the tumour site, formal resection with or without anastomosis, with or without stoma. For proximal perforations, simultaneous tumour resection and management of the proximal perforation is necessary.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 66.7%, A 33.3%)

The goals of emergency treatment of perforated colorectal cancer are to avert the immediate negative impacts of the complication (e.g., death, sepsis), achieve the best possible tumour control, and ensure timely recovery to permit initiation of appropriate adjuvant or systemic treatment [180]. Given the dilemma surrounding long-term oncological outcomes in patients treated for perforated cancer, it is important that, where possible, patients should be treated with a standard oncological resection to optimize tumour control. A balance has to be struck between patient safety with prompt control of sepsis and optimizing oncological outcome.

Patients who present with perforated colonic cancer are less likely to have a primary anastomosis [276,278–280]. This is mirrored by the ASA grade of the patient; patients with higher ASA grades having a lower rate of primary anastomosis [278]. This is entirely appropriate as the choice of surgical operation depends on the clinical condition of the patient; the risk of primary anastomosis and possible anastomotic leak has to be weighed against the option of a stoma which may not be reversed. Anastomotic leak rates in patients undergoing ES and having a primary anastomosis may be higher than those in elective surgery. Biondo et al. [276] showed an anastomotic leak rate of 15.8% in patients undergoing a primary anastomosis following emergency colorectal cancer presentation. However, similar to oncological outcomes, this may again be due to confounding factors related to patient characteristics as others have found similar leak rates in primarily anastomosed patients [278]. Primary anastomosis (with or without proximal diversion) can be considered in patients with minimal contamination, clinical stability and healthy tissues. In general, resection should follow established oncological principles but there should be a low threshold for performing a staged procedure, accepting that stomas formed in the emergency situation are often not reversed [280], although considering the use of double-barrelled stomas where possible and avoiding split site stomas increases the chances of stoma reversal.

In the case of right-sided perforation, a right hemicolectomy should be performed. Whether an anastomosis is formed or not depends on the condition of the patient bearing in mind that anastomotic leak rates can be high. The recent 2015 ESCP snapshot audit of 3208 patients undergoing right hemicolectomy showed that the overall anastomotic leak rate is 8.1% but can be up to 14.3% in patients presenting as an emergency, although emergency presentation was not a risk factor for anastomotic leak on multivariate analysis [237].

For perforated distal colonic tumours, an oncological resection and anastomosis, with or without ileostomy, should be the option of choice if the condition of the patient allows, as a Hartmann's resection has a low rate of stoma reversal. A Hartmann's resection is preferred where the clinical condition of the patient is poor. For diastatic perforation (proximal to the site of an obstructing tumour) formal tumour resection and management of the proximal perforation is needed, frequently in the form of a subtotal colectomy with a subsequent negative impact on function [250]. Ideally, minimal resection of the terminal ileum and leaving at least 10 cm of colon remnant above the peritoneal reflection improves function.

Perforation of the extraperitoneal rectum is uncommon. The priority is control of sepsis by drainage of any collection, ideally intraluminally, broad-spectrum antibiotics and a proximal defunctioning stoma to allow full staging and multidisciplinary planning of neoadjuvant therapy.

Bleeding

Rectal bleeding is a symptom of colorectal cancer in about half of patients [287] but it is less common for patients to present with an ALGIB. A lower GI malignancy was the ultimate diagnosis in 6.1% of patients presenting as an emergency admission secondary to an ALGIB in the recent UK acute lower GI bleed audit, although this may be an underestimate because 22.8% of 2528 patients with ALGIB had no formal diagnosis at discharge [288]. This is comparable to the rate demonstrated in a prospective population-based study in Iceland of 7.4% of ALGIB being due to colorectal malignancy [289]. As the rate of underlying colorectal malignancy is at least twice that deemed appropriate for urgent referral and investigation by NICE [289], all patients (if fit enough to benefit from it) should be investigated to determine, and plan any treatment for, the underlying aetiology of an ALGIB. In the recent UK ALGIB audit, 328 patients (13%) were discharged with no investigations and, of the 4.4% of patients readmitted with a further ALGIB within 28 days, more than half (53.2%) had had no inpatient investigation during their initial presentation [288]. The urgency of investigation depends on the severity of the initial bleed, either as an inpatient for unstable or stable

major bleeds or as an urgent outpatient within 2 weeks for stable minor bleeds [290].

Question 2.14

Can acute lower gastrointestinal bleeding be managed on an outpatient basis?

Recommendation: A proportion of patients with acute lower gastrointestinal bleeding can be managed safely on an outpatient basis if appropriately risk-stratified.

Level of evidence: III

Grade of recommendation: B

Consensus: 88.9% (SA 66.7%, A 22.2%)

The British Society of Gastroenterology (BSG) guidelines for the diagnosis and management of ALGIB detail a risk-stratified approach to the management of ALGIB. Patients are classified into stable or unstable categories. Stable patients are then subdivided into minor or major groups using a validated risk assessment tool (Oakland score). Minor self-terminating bleeds without other indications for hospital admission can be discharged and managed on an urgent outpatient basis with investigations within 2 weeks [291].

Link: Oakland score calculator

Question 2.15

What are the optimal diagnostic techniques for lower gastrointestinal bleeding and when should these different techniques be employed?

Recommendation: Colonoscopy is the preferred initial investigation for minor or major acute lower gastrointestinal bleeding in stable patients. CT angiography is preferred in unstable patients.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 66.7%, A 33.3%)

Colonoscopy is the most effective initial intervention for stable patients allowing a diagnosis to be made, the site of a malignancy to be tattooed and giving an opportunity for therapy in cases of active bleeding. Patients who have had a major bleed should be admitted to hospital and undergo colonoscopy on the next available list [291]. Bowel preparation, either orally or by nasogastric administration, should be used to increase the diagnostic yield and caecal intubation rate [292].

As the majority of ALGIB settle spontaneously, using radiological investigations to form a diagnosis is not necessary in all cases; only 25.9% of patients required a CT or CT angiogram in the UK audit, which was diagnostic for the source of bleeding in 55.8% and 49.7% respectively [288]. CT angiogram is preferred in an unstable patient due to its speed of access and assessment of the whole GI tract; in general this will be a triple phase examination (unenhanced, arterial and portal venous/delayed phase) from diaphragm to below the inferior pubic ramus in order to ensure that the anorectum is covered [293]. Radionuclide imaging is unlikely to be helpful in the context of ALGIB due to a colorectal malignancy as colonoscopy and CT/CT angiogram will nearly always be able to localize a tumour.

Question 2.16

What therapeutic approaches should be considered for bleeding colorectal malignancy?

Recommendation: Patients should be resuscitated and transfused according to standard protocols. Therapeutic options should be individualized according to clinical condition and include colonoscopic therapeutic intervention, angiographic embolization, surgical resection and, very rarely, endovascular stent techniques.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

Therapeutic interventions, other than resuscitation and transfusion of red cells, are rarely required for ALGIB, 80% of which cease spontaneously [294]. Studies and guidelines that address the management of ALGIB consider all cases and aetiologies, but only a small proportion will have ALGIB due to colorectal malignancy.

Colonoscopy is the mainstay of diagnosis but can also provide therapeutic options for bleeding malignancy such as vasoconstrictor injection, application of clips, heater-probe or radiofrequency ablation [295]. Whichever technique is used, rebleeding from colorectal malignancy is common. Although uncommonly required, angiographic embolization is an effective method to treat ALGIB; it was performed in 19 (0.8%) of the 37 (1.5%) patients undergoing angiography in the UK ALGIB audit [288]. However, rebleeds are not uncommon although re-embolization can be considered [295,296]. Embolization-related ischaemia may occur (4%–11%) and can require surgical intervention. Patients experiencing ALGIB due to colorectal malignancy are likely to continue to bleed or rebleed after intervention. Colonoscopic or angiographic therapeutic interventions, if required, should be considered an emergency temporizing measure to allow full radiological staging of disease, optimization of the patient's clinical condition and multidisciplinary

team discussion to plan urgent multidisciplinary treatment of the underlying malignancy.

ES for acute lower GI bleeding is very rarely needed. Only six patients of 2528 in the UK lower GI bleeding audit required laparotomy (0.2%), only two of which were due to malignancy [288] and none of 1134 patients in a prospective population-based study [289]. ES for a bleeding colorectal malignancy is likely to be required if there is haemodynamic instability despite a 6-unit blood transfusion, slow bleeding requiring more than 3 units/day blood transfusion, inability to stop bleeding despite endoscopic and endovascular techniques or recurrent episodes of significant haemorrhage. In these rare situations, oncological principles should be followed wherever possible. The choice of surgical procedure should be individualized depending on the patient's clinical condition but a low threshold should be given to the use of stomas in these rare, life-threatening cases.

In uncommon situations where irresectable malignancy may cause dramatic ALGIB due to major vascular involvement by the tumour, the use of endovascular stents, where anatomically feasible, may improve quality of life and provide successful palliation [297].

INFLAMMATORY BOWEL DISEASE

The emergency management of inflammatory bowel disease (IBD) has been considered extensively recently by the ACPGBI and is comprehensively covered in the ACPGBI IBD Guidelines.

Link: ACPGBI IBD Guidelines

ACUTE BOWEL ISCHAEMIA AND INFARCTION

Introduction

Acute mesenteric ischaemia (AMI) is defined as the sudden interruption of the blood supply, or venous drainage, to a section of bowel, leading to ischaemia, cellular damage and/or intestinal necrosis [298–300]. It has an estimated prevalence of 1:1000 European and US hospital admissions [301–303] and is associated with a high mortality rate, particularly if detected late and decompensated acidaemia has ensued. Bowel ischaemia is observed in approximately 11.8% of cases within the NELA and has an associated 23.9% 30-day and 27.7% 90-day mortality rate [298]. AMI clinical management is therefore time sensitive and associated with a high mortality risk. It requires a high index of suspicion by the clinical team and thus is a key challenge to the on-call general surgeon.

Previous work has demonstrated variable mortality rates of patients with AMI between centres [303,305]. One reason for this may be the variability in management as observed between centres contributing to NELA [299]. There is also likely to be an element of intra-clinician variability of practice. This could partly be a result of the paucity of guidelines available on this subject.

AMI can be divided into four broad categories [306]

1. arterial embolization, occurring in 40%–50% of cases;
2. arterial thrombosis, in 25%–30% of patients;
3. non-occlusive mesenteric ischaemia (NOMI) in approximately 20% of patients;
4. mesenteric venous thrombosis in 10%.

Where appropriate, the management of these conditions is combined in these recommendations with any variation pertaining to the management of individual subcategories stated.

Question 4.1

How is the diagnosis of acute mesenteric ischaemia made?
Recommendation: As there are no reliable clinical symptoms or signs that are pathognomonic a high index of suspicion is vital in detecting intestinal ischaemia. Untreated atrial fibrillation, underlying vascular disease and risk factors for atherosclerosis should raise suspicion.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 100%)

The diagnosis of AMI can be difficult. Sudden onset of abdominal pain and symptoms out of keeping with the clinical signs elicited should raise concern, the site and extent of the pain being variable. Peritonism is a late clinical sign, as is per rectal bleeding, fever or haemodynamic instability. AMI can cause extreme pain and patients may have substantial analgesic requirements. Pain out of context with clinical signs is often described as being the typical presentation of AMI [301]. However, this clinical finding has a poor negative sensitivity [307]. Guaiac-positive stools, atrial fibrillation, heart failure, diffuse tenderness and peritoneal signs may be present [307]. Vomiting, nausea, diarrhoea are early clinical signs with peritonism, haemodynamic instability and shock occurring later [307]. Large bowel ischaemia presenting with per rectal bleeding is common and typically has a more benign course than small bowel ischaemia [308].

Given the diverse nature of aetiologies causing AMI, and the dynamic process of bowel ischaemia, no specific spectrum of clinical signs can be relied upon to establish the diagnosis. A high index of suspicion with a low threshold to perform further investigations in a timely manner is recommended in order to ensure diagnosis. Mortality is associated with delayed diagnosis and thus early investigation is important [309].

One epidemiological study showed that AMI is more common than appendicitis in the elderly cohort [310]. As such, the diagnosis should be suspected in elderly patients, particularly those with other cardiovascular comorbidities, presenting with abdominal pain [310,311]. Alcohol intake, sex and comorbidity history of hypertension, hyperlipidaemia, diabetes, atrial fibrillation, stroke, heart failure, chronic renal disease, ischaemic heart disease, chronic obstructive pulmonary disease and cirrhosis have all been reported to be risk factors [302,312–314]. Post cardiac and aortic aneurysm surgery (particularly in the context of emergency repair for

rupture) and any other vascular intervention increases the risk of bowel ischaemia [315–320]. AMI should also be considered in patients admitted to critical care with septic shock in whom an infective cause has not been demonstrated 24 h after admission [321].

Some patients present with AMI without any obvious aetiological risk factor being present. Embryological malrotations, for example, can lead to volvulus and subsequent ischaemia without any concomitant risks [322–324].

Question 4.2

What are the important factors in determining outcome in ischaemic bowel?

Recommendation: Prognosis should be based on physiological parameters which include comorbidity together with the length of bowel affected and extent of bowel infarction. There are no validated scoring systems that can predict outcome.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

Although several risk-stratification tools have been proposed [304,316,319,320], none has been validated in large volume clinical practice [301]. Outcome is based on pathology, physiological disturbance and underlying comorbidity [309]. However, the use of risk calculators available for emergency laparotomies has been shown to reduce variability in the perception of risk by surgeons [325]. Such tools may be useful when counselling patients and their families about the risk of adverse outcome in this setting.

Predictive factors for necrosis (and thus poorer outcome) include a combination of organ failure, a lactate >2 mmol/l and bowel loop dilatation on CT [326]. Although pneumatosis intestinalis on CT or plain X-ray tests is a sign of bowel ischaemia, caution should be used in interpretation and clinical correlation remains vital. Isolated pneumatosis intestinalis does not always require operative intervention [327–329]. The site of intestinal ischaemia is also a risk-stratifier. The right side of the colon has a worse survival profile than left-sided colonic ischaemia [330–332].

Question 4.3

What investigations are required for the management of acute mesenteric ischaemia?

Recommendation: A multiphase CT should occur urgently in any patient suspected of acute mesenteric ischaemia where active treatment is appropriate.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 100%)

AMI is an evolving process from multiple aetiologies. With inadequate perfusion, to ischaemia and then infarction blood tests such as pH or lactate will become increasingly abnormal. The outcomes are best for those with early pathology [306,314] and thus management decisions, including further investigations, should not be delayed due to the lack of positive evidence in blood tests where AMI is suspected [301,333].

Most recent evidence assessing the accuracy of blood tests in detecting mesenteric ischaemia and infarction is poor [333–359]. On meta-analysis review [334,335] of the predictive biochemical and haematological markers in AMI, D-dimer was found to have the highest sensitivity (93.4%–96%). It was non-specific, however (36.4%–40%). As a result, it cannot be used to discriminate AMI cases. Lactate and acidaemia will rise during the pathophysiological processes involved in AMI. However, neither are sensitive or specific markers for AMI. Investigations to diagnose AMI should not be delayed until the presence of a high serum lactate level or increased levels of acidaemia are noted, if the clinical suspicion is high. Although tests such as urinary intestinal fatty-acid binding protein levels show promise, they cannot be recommended at present to discriminate AMI cases [333,334,346,350]. As such there are no key blood biomarkers recommended for the diagnosis of AMI.

Whilst there have been multiple recent publications assessing the radiological diagnostic modalities in AMI, they are mainly review articles and baseline evidence is poor; however, only CT angiography had adequate accuracy to establish the diagnosis of AMI in lieu of a laparotomy [360]. Plain abdominal X-rays have no clinical value in this setting. A multiphase phase CT is the modality of choice; classically this is a dual phase examination, with arterial and portal venous phases. The addition of an unenhanced scan is beneficial as unenhanced bowel hyperdensity is highly specific of ischaemia [361] and improves sensitivity, diagnostic confidence and interobserver agreement [362]. Findings on CT depend on the underlying cause of AMI, whether it is arterial, venous or NOMI; however, reduced bowel wall enhancement has high sensitivity [363], with appreciable inter-reader agreement of CT features of AMI [364]. Finally, CT is able to differentiate spontaneous intramural intestinal haemorrhage from AMI [365].

Intravenous contrast increases diagnostic accuracy. The impact of contrast on acute nephropathy is controversial and may be lower than initially perceived [366,367]. If AMI is suspected, a CT scan with intravenous contrast should not be delayed in order to commence fluid resuscitation and improve renal function. Oral contrast is not required and can limit the ability to assess wall density and enhancement.

Question 4.4

What role do laparoscopy and endoscopy have in the diagnosis of mesenteric ischaemia?
Recommendation: There is no strong evidence to support diagnostic laparoscopy in acute mesenteric ischaemia, but its use may prevent an unnecessary laparotomy. A limited flexible sigmoidoscopy is the most accurate means of assessment of left-sided colonic ischaemia if diagnosis is uncertain.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

There is little role for diagnostic laparoscopy in the initial management of AMI [301]. Colonic ischaemia typically has a more indolent course with a better prognosis compared with small bowel ischaemia [308,368,369]. Colonic ischaemia can be detected by careful use of flexible sigmoidoscopy. CT in large bowel ischaemia is less accurate than in small bowel ischaemia. If the patient remains stable an unprepped flexible sigmoidoscopy is recommended. It should take place within 48 h of presentation [369]. If the patient deteriorates with signs of peritonism then surgical intervention should be considered. A second opinion from an experienced colleague is recommended because this group of patients are often elderly, frail and comorbid.

Question 4.5

What is the initial management of acute mesenteric ischaemia?
Recommendation: Immediate resuscitation with intravenous fluids, supplemental oxygen and antibiotics should be administered as preliminary treatment whilst arrangements are made for definitive care.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 55.6%, A 44.4%)

The key pathology in AMI is inadequate blood supply to the bowel or lack of venous drainage. The European Society of Trauma and Emergency Surgery recommendations of the three 'Rs' are relevant here:

1. resuscitation,
2. rapid diagnosis and
3. urgent revascularization.

Intravenous fluids should be administered to optimize blood pressure and end organ perfusion. A balanced crystalloid administration is the preferred fluid choice [301,370,371]. Supplemental oxygen should also be provided [301]. Small numbers will benefit from revascularization and where identified these patients should be discussed with the vascular team.

Vasopressor support can decrease splanchnic vessel perfusion and should be avoided where possible [301,372]. The use of vasopressin rather than noradrenaline has been proposed in patients with NOMI [372]. Critical care support is strongly recommended. Broad-spectrum antibiotics should be given to patients with suspected AMI to reduce the risk of sepsis secondary to bacterial translocation [298,301]. All resuscitation actions should be given in a timely manner as revascularization or resection is the definitive treatment and should occur as soon as feasible. Extended preoperative optimization in AMI is of limited value as the progressive ischaemic insult normally exceeds the ability of resuscitative efforts to improve condition until the ischaemic tissues are either removed or reperfused.

Question 4.6

What are the definitive treatment options available for acute mesenteric ischaemia?
Recommendation: Infarcted bowel should be resected at emergency laparotomy. In those patients who do not have evidence of infarction, a discussion with a vascular specialist should occur regarding the option of revascularization. The revascularization technique depends on the underlying pathology and vascular anatomy and should be assessed on an individual patient basis in a multidisciplinary approach.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 88.9%, A 11.1%)

The definitive management for patients with AMI depends on the underlying cause of the reduction of perfusion to the bowel, and whether the bowel is ischaemic or infarcted. Any patient with a clinical suspicion of bowel infarction with peritonitis will require immediate laparotomy and resection of bowel, if active treatment is to be pursued [301]. Any bowel that is resected should be sent for histological analysis. In patients with no likelihood of infarcted bowel but features in keeping with AMI, the treatment options for revascularization are open or endovascular in nature. Open vascular revascularization has traditionally been the optimal treatment option [301,373–377]. More recently, endovascular treatments have gained traction [373,376–384]. However, there is a lack of RCTs

comparing these approaches [374] with most evidence being of poor quality [375]. Meta-analyses of the poor quality data show better early outcomes associated with endovascular approaches [373,376,378]. However, the long-term mortality is equivalent [373]. Venous thrombosis can be treated with systemic anticoagulation [374,385,386] albeit with a risk of a sequela of portal hypertension.

Re-canalization depends on the nature of the pathology. If arterial revascularization is to be considered, the evidence is too heterogeneous to currently recommend an endovascular approach in preference to an open approach. At present, early discussion with interventional radiology and vascular surgery and providing a revascularization approach that is based on local availability, patient morbidity and clinician expertise is the recommended approach.

Question 4.7

What is the role of abbreviated laparotomy in acute mesenteric ischaemia treatment?
Recommendation: Patients with peritonism or bowel infarction need immediate laparotomy and resection of affected bowel segments. Further resections over consecutive days may be required. Interim management of the open abdomen with a negative pressure dressing system is recommended.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 100%)

Patients with bowel infarction or peritonism are critically unwell. As such, if active management is to be pursued, urgent resection of all obviously affected bowel should occur. No anastomoses should be considered in this setting (unless an obvious precipitant for the bowel infarction can be identified) at the time of the first laparotomy and a damage control approach should be adopted [387]. This includes emergency resection of obviously infarcted bowel, consideration for an open abdomen (OA) and management in the critical care scenario [388–399]. Intra-abdominal hypertension (IAH) is a significant risk in patients with such intra-abdominal catastrophe and therefore a laparostomy approach is safe, timely and allows early return to critical care for further management. The primary laparotomy should be considered as source control of the infarcted bowel. Unless an obvious precipitant can be identified, the resected bowel should be sent to histopathology for assessment of conditions such as vasculitis.

Consideration of anastomosis of bowel ends and revascularization should occur after the initial resection and appropriate critical care in these scenarios. The timing of the second laparotomy should be within 48 h of the initial procedure [301]. Bowel ends should be pink, peristalsing and have an obviously healthy mesentery if any anastomosis is to be considered.

Question 4.8

How can morbidity and mortality rates be improved following acute mesenteric ischaemia?
Recommendation: Improving morbidity and mortality rates will involve early detection and expedited management. Early discussion with an intestinal failure unit to judge prognosis and agree treatment strategy is essential for patients with acute severe intestinal failure or long-term intestinal failure following acute mesenteric ischaemia.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 77.8%, A 22.2%)

In-hospital mortality rate has not changed in the last decade [391,392]. As such, the in-hospital mortality rates remain high (up to 63%) [112]. Patients with arterial mesenteric infarction or with NOMI are three times more likely to die during the first hospital admission compared with those with venous mesenteric infarction.

Mortality is associated with the mechanism of ischaemia, with arterial origin being associated with a higher morbidity and mortality than venous engorgement [393]. The goal of optimal management should be rapid identification and revascularization of viable GI tissues [301,394] which requires early recognition. Thus, a low threshold for investigating patients at high risk of AMI is likely to increase the detection of the condition and therefore initiate earlier treatment. There is also likely to be inter-hospital variability in practice [395] in UK centres. Regular audit of clinical practice to reduce these variabilities, such as that undertaken in NELA [299] offers an opportunity to improve outcomes of patients with these conditions.

Many of this group of patients who survive and are stable will have significant ongoing problems. They may have short bowel lengths remaining, stomas, possibly an OA or entero-atmospheric fistula (EAF). An early discussion with an intestinal failure unit is recommended, and in some cases may prevent some of the morbidity associated with this condition.

Question 4.9

What is the postoperative management of patients who have had acute mesenteric ischaemia?
Recommendation: Postoperative management is dependent on the underlying aetiology of the bowel ischaemia. Treatment involves reduction in risk factors and optimization of atrial fibrillation. Patients unable to maintain calorie, fluid or electrolyte levels due to stoma losses should be referred to the regional intestinal failure service.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 55.6%, A 44.4%)

Mortality rates for AMI remain high. Those patients who survive these conditions should be managed taking into account the cause of the AMI, their baseline comorbidity and their frailty levels after their ESs. Vascular risk factors should be optimized in those patients with embolic disease, arterial thrombus or NOMI [396]. This should include assessment and management of atrial fibrillation if present. The choice of anticoagulation postoperatively should be balanced against the risk of bleeding. Reports of the use of the novel anticoagulants are widespread and appear to be safe [396–398]. Patients should be anticoagulated if the precipitant cause of the ischaemic bowel is pro-coagulation and clot formation. Discussion with the local haematology team is recommended if this is identified. Patients without obvious precipitating causes, particularly in venous thrombosis, should be investigated for vasculitis and thrombophilia [399], with advice and guidance provided by the haematology team.

Patients who have had extensive bowel lengths resected, have short gut and are suitable for consideration of further procedures should be referred to the regional intestinal failure unit. Nutritional failure caused by any significant length bowel resection should be considered, screened for in the at-risk patient and managed proactively. Multi-visceral transplantation after widespread bowel ischaemia has been reported and may be considered in select cases [400].

COLONIC VOLVULUS AND PSEUDO-OBSTRUCTION

Introduction

The term 'volvulus' is used to describe an abnormal twist of the stomach, small intestine or colon [401]. This can lead to impaired blood supply, ischaemia, infarction and/or perforation. Volvulus of any aspect of the GI tract is a general surgical emergency. The most common area of the GI tract to develop volvulus in adults is the colon, with the sigmoid and caecum being particularly at risk [401]. Volvulus leads to between 2% and 15% of all large bowel obstructions in the developed world but the incidence varies greatly across the globe [401–403].

The evidence base for volvulus of the colon is poor and there are few evidence-based recommendations available to guide clinical practice. A similar lack of synthesized evidence is available for pseudo-obstruction, a functional distention of the colon without an underlying structural blockage [404]. There is an estimated incidence of 100 cases in 100 000 admissions to US hospitals [405]. Pseudo-obstruction can occur after other non-GI insults such as burns, cardiac and orthopaedic procedures, intercurrent illnesses or after caesarean section [406,407]. As such, pseudo-obstruction, also known as Ogilvie's syndrome, is a common reason for interspecialty referrals to the general surgical team.

Previous literature has demonstrated variability in the clinical management of patients with these conditions [408] and there are few UK standards or recommendations. However, there is recently published guidance from the ASCRS [409].

Colonic volvulus

Question 5.1

Are there any diagnostic clinical features of colonic volvulus?
Recommendation: A combination of abdominal distention, complete/absolute constipation and known risk factors (elderly, frail, comorbidity, constipation and neurological conditions) should alert the clinician to the possibility of a colonic volvulus.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 100%)

The clinical presentation of sigmoid and caecal volvulus is that of large bowel obstruction. Abdominal distention, cramping abdominal pain, vomiting and nausea are commonplace [401,409,411,412,414–418]. Volvulus appears to be associated with a wide, long mesocolon compared with control patients, rendering a mesenteric twist easier to occur [419]. The specific mechanism by which the twist occurs, however, is unclear. Sigmoid volvulus is more common than caecal and transverse colonic volvulus is rare [401].

Sigmoid volvulus is more common in male patients whilst caecal volvulus is more frequent in female patients [410,414,420,421]. Sigmoid volvulus is associated with increasing age and comorbidity unlike caecal volvulus. However, both are more common in the elderly population [409]. Neuro-psychological conditions increase the incidence of volvulus, as does constipation and medical comorbidity [402,413,416,422].

Question 5.2

What is the imaging modality of choice for volvulus?
Recommendation: A contrast-enhanced abdominal/pelvic CT should be performed on index admission or where diagnostic uncertainty exists.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 66.7%, A 33.3%)

The differential diagnoses for colonic volvulus are pseudo-obstruction, large bowel obstruction and severe constipation. An accurate diagnosis is vital to ongoing care. A plain abdominal radiograph can often determine the diagnosis of both sigmoid [423,424] and caecal volvulus [425,426] with high specificity. Assessing for a coffee bean sign (which occurs when the closed loop obstruction fills with gas and the medial walls of the adjoining bowel oppose) establishes the diagnosis. However, plain radiography has a low diagnostic sensitivity and is unable to assess blood supply or the identification of coexistent relevant pathologies [427,428] which is of utmost importance in determining appropriate management. Therefore, contrast-enhanced CT scan is the gold standard allowing, in addition, the viability of the bowel to be assessed [429]. It would be reasonable to perform an abdominal X-ray in a stable patient with a known recurrent sigmoid volvulus. However, if there is any diagnostic uncertainty then a CT should be performed. Although diagnosis with barium enema has been historically described, there is little evidence for its use in current practice.

Question 5.3

What is the role of endoscopy for colonic volvulus?
Recommendation: Flexible or rigid sigmoidoscopy can be used in sigmoid volvulus to facilitate detorsion of the colon. Flexible sigmoidoscopy can be used to assess viability of the colonic mucosa. Colonoscopy is not recommended in caecal or transverse colon volvulus, for which surgical resection is the recommended treatment option.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

Torsion of the sigmoid colon can be readily accessed by a flexible or rigid sigmoidoscope. As such, these approaches have both been described in management. Delay increases the risk of complications with resultant increase in mortality. Urgent flexible or rigid sigmoidoscopy should therefore be undertaken to achieve two aims; to facilitate detorsion of the colon, which has a relatively high success rate [430–433] and to assess the health and viability of the mucosa. Where possible a flexible rather than a rigid sigmoidoscopy should be performed, as this approach increases the visualization of the colon. There is also some low quality evidence to indicate that flexible sigmoidoscopy has better detorsion success rates [432]. A flatus tube can be used to facilitate flatus and faecal passage and reduce immediate recurrence. Adequate care of these tubes is required, however [434]. The tube should remain in situ for 1–3 days [409,412,426,435]. Some reports describe the use of a flexible sigmoidoscope for reduction followed by discharge and elective resection [431] as a safe approach in these cases. An endoscopic approach should not be considered in patients with peritonism. If flexible sigmoidoscopy is unsuccessful, urgent operative approach should be performed to reduce the risk of further complications if clinically appropriate.

The use of colonoscopy in caecal volvulus has been described but has a low success rate [426,436,437]. There are too few data on the use of colonoscopy in transverse colon volvulus.

Question 5.4

What is the long-term management after detorsion of a sigmoid volvulus?
Recommendation: As a high proportion of sigmoid volvulus recurs after detorsion a definitive management plan should be considered at the time of the index admission.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 66.7%, A 33.3%)

Patients with sigmoid volvulus tend to be poly-morbid and frail. A conservative approach after detorsion of the colon rather than an operative approach is often desirable. However, on review of case series level analysis, the recurrence rates in patients without further intervention are as high as 85% [431,438–440]. Recurrence will again be associated with the risks of ischaemia, infarction or perforation. Further intervention should be considered [440].

Question 5.5

What are the optimal methods of definitive management in volvulus?
Recommendation: Operative management is individualized to each patient, their comorbidities and their pathology. Resection of the component of the colon subject to volvulus is the optimal approach in patients whose physiology would sustain an operative intervention. Where frailty is identified there should be documentation of a best interest meeting, where possible, when planning definitive care.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 66.7%, A 33.3%)

The management of volvulus depends on multiple factors. Caecal volvulus generally requires an operative approach whereby resection has better outcomes than caecopexy procedures [402,409,425]. Sigmoid volvulus can be managed by sigmoid resection, with or without anastomosis. Operative sigmoidopexy and caecopexy cannot be recommended as an option of choice in adult practice as recurrence rates are too high. Mesopexy has no evidence to support its use. The use of a percutaneous endoscopic colostomy tube has been described extensively in the literature [413,438,441,442]. It requires preferably the placement of two tubes to secure the sigmoid and avoid rotation of the sigmoid around a single tube. The procedure is not without risk but in a frail high risk patient may be considered less risky than conservative or surgical intervention.

There is an increasing awareness of the impact of frailty upon outcomes. The decision to perform one procedure over another depends on the fitness of the individual patient. Adverse outcomes from intervention (and non-intervention) are common and a multidisciplinary approach and documentation of a best interest meeting are recommended to support the work of the clinical team. However, the sixth NELA report revealed that only 28.8% of frail patients over 65 had input from a specialist for care of the elderly [443]. The ELF study reported that over 37% of patients over 65 years of age needed an increased level of care on discharge following ES.

Link: ELF study

The diagnosis of colonic volvulus requires a low index of suspicion as no aspect of risk factor assessment or history and examination will be discriminatory. Any patient with evidence of peritonism or sepsis should be managed in an emergency manner as the complications of volvulus such as infarction or perforation may have occurred. Sigmoid resection confers the lowest risk of recurrence [401,409,410,444–446]. The decision to perform a colostomy or an anastomosis depends on the individual patient and the findings during the operation [418,441]. Anastomosis in this setting has been described to be safe [414,420,432,433,447–449].

Pseudo-obstruction

Question 5.6

Are there any diagnostic clinical features for pseudo-obstruction?

Recommendation: The diagnosis is one of exclusion. It is imperative to exclude mechanical bowel obstruction. The diagnosis should be suspected in an elderly or frail comorbid patient who presents with a distended tympanic abdomen with reduced or absent bowel action/flatus and a capacious rectum on digital rectal examination. Frequently the patient will have a recent acute diagnosis not within the gastrointestinal tract. They may have undergone other recent surgery.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 100%)

Question 5.7

How is the diagnosis of pseudo-obstruction made?

Recommendation: CT with intravenous contrast is diagnostic.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 55.6%, A 44.4%)

Acute colonic pseudo-obstruction is a functional distention of the colon without any structural obstruction. The presenting features, like colonic volvulus, are those of large bowel obstruction with severe or complete constipation, abdominal distention, discomfort and nausea being common [404,409].

Often patients have been admitted with a pathology outside the GI tract such as patients who have had orthopaedic [407], gynaecological [450] cardiac [406,451] procedures, or have been admitted with medical (non-surgical) diagnoses [406,441,452–454]. Patients with pseudo-obstruction are frequently significantly poly-morbid and frail [404,405,409] and have electrolyte disturbance or acute renal failure. The condition is also described after caesarean section [455].

There is a high in-hospital mortality rate associated with this condition (up to 8%) [405]. Thus, these patients need to be closely monitored and managed urgently. This may include serial abdominal X-rays which allow assessment of caecal diameter, a crucial aspect to guide further management. A caecal diameter of 9–12 cm is concerning for impending perforation [456]. Given the high association with renal dysfunction and electrolyte disturbance, monitoring of serum biochemistry can provide indications that the diagnosis might be that of pseudo-obstruction but risk profile analysis alone is insufficient to diagnose this condition.

In order to establish the diagnosis of pseudo-obstruction and exclude any mechanical cause a CT with intravenous contrast may be required. In this setting oral and rectal contrast are not used routinely in the UK and offer little benefit. If rectal contrast is used then a water-soluble contrast agent such as Gastrografin should be used, because of the risk of perforation.

Question 5.8

What are the initial treatment options in pseudo-obstruction?

Recommendation: Identification and correction of any renal dysfunction or electrolyte abnormality and review of prescribed medications is appropriate. Provided the patient remains stable with no peritonism or tenderness over the caecum and the caecal diameter is <12 cm, conservative management can be continued for 48–72 h.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 55.6%, A 44.4%)

Pseudo-obstruction is associated with electrolyte disturbance and acute renal failure. Careful correction of these disturbances can be associated with resolution of the pseudo-obstruction in the absence of any further management. Calcium, magnesium, potassium and sodium levels should be monitored and corrected as required [404,409]. Acetylcholine enhances motor transit and peristalsis in the human colon [457]. Therefore, any disturbance or reduction in acetylcholine production increases the risk of pseudo-obstruction. Accordingly, a careful review of prescribed medications is required to exclude, where possible, any opiate or anticholinergic medications [404,409,458]. Nasogastric tube decompression may be considered along with increasing patient mobility or simple frequent positional changes in bed including lying on the abdomen, if possible.

Caecal diameter is crucial. As long as the patient remains stable with no peritonism and the caecal diameter is <12 cm conservative management can be continued for 48–72 h. This conservative management will lead to resolution of the pseudo-obstruction in as many as 70% of patients [459]. In patients with a caecal diameter >12 cm or signs of peritonism then intervention as outlined in Question 5.10 may be necessary.

Question 5.9

What are the treatment options if conservative management fails to resolve pseudo-obstruction?
Recommendation: Pharmacological intervention with neostigmine in a cardiac-monitored setting or endoscopic decompression in conjunction with a flatus tube should be considered if conservative management fails.
Level of evidence: III
Grade of recommendation: C
Consensus: 100% (SA 88.8%, A 22.2%)

Colonoscopic decompression, whereby the gaseous distention is removed from the colon by a colonoscope, and placement of a flatus tube has been demonstrated to successfully alleviate the symptoms associated with pseudo-obstruction [404,409,451,454,460]. The procedure should be done with minimal insufflation and preferably with caecal intubation. An alternative is the anticholinesterase drug neostigmine which has been demonstrated to be effective for this condition [451,455,461–467]. The seminal paper demonstrating the benefit of this medication was from Ponec et al. [467] where 2 mg of neostigmine, given intravenously in saline over 3–5 min, was shown to successfully manage pseudo-obstruction compared with saline injection. The current data demonstrate that it is a safe medication in this field [466,468]. Caution should be used in asthmatic patients and those predisposed to dysrhythmias. Patients should be made aware of the side effect profile, including bradycardia, of this medication before its use. If no initial response is seen in the first 3 h repeated doses can be given every 3 h for up to three doses [469–471]. Once there is resolution, oral polyethylene glycol solution should be given to prevent recurrence [472]

The choice of colonoscopy or neostigmine as initial management has been debated [451,465]. In one retrospective review [451] colonoscopic decompression performed by clinicians with the appropriate skill set as a first-line treatment was more effective as initial therapy in avoiding a second treatment modality. However, advocates of neostigmine point out that colonoscopic decompression requires access to emergency endoscopy and specific expertise, is more costly and takes more time than neostigmine administration.

Question 5.10

When should a surgical approach be considered?
Recommendation: Only if all conservative, pharmacological and endoscopic measures fail to achieve resolution, or there is clinical evidence of deterioration in a fit individual, should surgical intervention be considered. The decision to perform an operative intervention should take into account the underlying physiology and comorbidities of the patient. Where frailty is identified there should be documentation of a best interest meeting when planning definitive care, with the poor outcomes of surgery fully discussed and documented.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 88.9%, A 11.1%)

Surgery should be considered in all patients who fail conservative, medical pharmacological and endoscopic measures or who elicit evidence of peritonism or features in keeping with ischaemic bowel, but only if the patient is felt to be fit enough for operative intervention and a higher level of postoperative support is agreed and available. The specific operation is dependent on the operative findings and should follow the principles of an EGS laparotomy.

It should be emphasized that this cohort of patients often tends to be frail and mortality associated with operations is likely to be high [405,460,473]. This information should be used to counsel the patient and their family.

Percutaneous caecostomy is described in small case series [474–478] and has a reported high success rate. It should be considered in those patients deemed to be very high risk for open surgical intervention. However, it is associated with a high morbidity and mortality rate [469].

LOWER GASTRO-INTESTINAL BLEEDING

The emergency management of lower GI bleeding has been considered extensively by the BSG and is comprehensively covered in the BSG Guidelines.

Link: BSG Guidelines in GUT

Link: Oakland score calculator

STOMAS

Introduction

It has been estimated that in 2011 there were 176 824 people living with a permanent stoma in the UK [479]. Around half of these were colostomies, 40% ileostomies and the remainder urostomies [480].

The incidence of complications related to stomas is difficult to define due to variable reporting and use of definitions. A systematic review into the incidence of stoma complications found that only 14 of 21 studies defined complications at all and the definitions were inconsistent across these studies [481]. One of the most commonly used classification systems for parastomal hernias is the European Hernia Society classification, which has the benefit of being applicable to all stomas and can be used for intra-operative findings as well as radiological [482]. There are no standardized definitions for any other stomal or peristomal skin complication.

A recent systematic review of the incidence of stoma-related morbidity found the incidence of all stoma-related complications was significant at 26.5% (2%–100%) although this should be interpreted with caution as there was wide variability across studies [483]. Ileostomies have a higher rate of total complications than colostomies, mainly due to skin irritation and high stoma output [484]. A retrospective case–control study of 202 patients in the UK found that performance status and BMI were risk factors for patients developing a stoma-related complication, as was having the stoma formed during an emergency operation [485]. Studies of patients with IBD have shown that stoma complications are twice as common in patients with Crohn's disease compared with ulcerative colitis; this includes a rate of peristomal fistulation of up to 20% [486,487].

Common causes of stoma-specific complications presenting as an emergency will be discussed and recommendations are given for their emergency management.

Retraction

Question 7.1

Do all retracted stomas need intervention?

Recommendation: Acute retraction of a stoma in the early postoperative period requires close observation by an experienced surgeon and stoma therapist to detect signs of stomal dehiscence.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 77.8%, A 22.2%)

A stoma can be considered to be retracted if it is below the level of the skin. The estimated incidence is 1.3%–4.8% [483]. Retraction in the immediate postoperative period is usually due to tension on the bowel or its mesentery secondary to inadequate mobilization. Factors that predispose the patient to poor wound healing and obesity can also contribute and ischaemia at the distal part of the stoma can lead to a later presentation of retraction and stenosis [488]. Retraction is commonly seen without significant separation of the mucocutaneous junction.

In this case the main difficulty faced is in obtaining an adequate seal with stoma appliances. Use of a convex stoma appliance may result in decreased leakage and so decreased skin irritation [489].

Question 7.2

When is operative intervention required for stoma dehiscence?

Recommendation: Dehiscence resulting in acute retraction of the stoma within the abdominal fascia needs assessment by an experienced surgeon and stoma therapist. Retraction into the abdominal cavity requires immediate operative intervention to prevent peritonitis.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 88.9%, A 11.1%)

Complete stoma dehiscence and retraction can occur in the early postoperative period leading to superficial, subfascial or intraperitoneal contamination causing peritonitis [488]. CT may be useful to identify sepsis within the abdominal wall in the event of incomplete dehiscence and guide decision-making around drainage and revisional surgery. An acute complete dehiscence and retraction may be diagnosed by inspection in the context of an unwell patient and will not necessarily require further investigation.

In some situations, it may be possible to drain superficial sepsis in a local fashion but revision will probably be required, either locally or by laparotomy.

Question 7.3

What is the optimal operative approach for stoma dehiscence?

Recommendation: Re-look laparotomy or laparoscopy is required for an early acute dehiscence associated with retraction of a stoma into the abdomen. Mobilization and/or resection of sufficient proximal bowel to enable a viable stoma to be fashioned is probably necessary. In cases of delayed dehiscence, assessment by an experienced surgeon and stoma therapist is needed.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 100%)

Complete retraction into the abdomen requires washout and refashioning of the stoma including mobilization of additional length as required. Retraction into the abdominal wall may be managed by local revision if there is sufficient viable bowel without tension but as excessive tension is a risk factor for retraction laparotomy is frequently required [488]. If there is significant local contamination then stoma re-siting may be advised.

There have been a number of small case series describing minimally invasive techniques using a linear stapler to revise a retracted ileostomy [489,490]. These techniques will only be successful if the retraction is due to sliding serosal surfaces on an everted stoma and not underlying tension on the bowel proximal to the stoma. They are therefore not recommended for acute emergency management.

Prolapse

Question 7.4

What is the management of an acutely symptomatic prolapsed stoma?

Recommendation: Attempts should be made to promptly reduce an acute stoma prolapse to prevent worsening oedema and ischaemia. Osmotic therapies such as sugar are safe to use and may be helpful in aiding manual reduction.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 77.8%, A 22.2%)

Stoma prolapse occurs when the full thickness of the bowel protrudes through the stoma lumen [489]. Prolapse frequently coexists with parastomal herniation [491]. It occurs when there is redundancy in the intestine related to the proximal, distal or single lumen of a stoma. It is a considerably more common complication for transverse colostomies than for other types of stomas with rates of up to 42% in these cases [482,483,492]. The aetiology in these cases is thought to relate to redundant highly mobile distal transverse colon with prolapse of the distal limb with increases in intra-abdominal pressure (IAP) [493]. The rate is around 4%–5% for other types of stomas [482,492].

There are a number of techniques described for non-operative management of an acute prolapse in viable bowel. First-line management is gentle manual reduction which should ideally be undertaken promptly prior to the formation of significant oedema [494]. There are several reports of successful use of sugar as osmotic therapy to aid in treatment of oedema to allow manual reduction [495–498] as well as hyaluronidase [499]. Some simple devices have been described in case series to prevent recurrence of stoma prolapse [500].

Question 7.5

Is there a role for imaging a patient with an acutely symptomatic prolapsed stoma?

Recommendation: Patients presenting with a new acute irreducible stoma prolapse should undergo cross-sectional imaging to confirm there is no concurrent diagnosis such as obstruction due to adhesions or parastomal hernia to allow better operative planning.

Level of evidence: GP

Grade of recommendation: D

Consensus: 100% (SA 66.7%, A 33.3%)

CT should be considered to aid operative planning if concurrent repair of a parastomal hernia is planned or if there is doubt of the cause of the patient's symptoms.

Question 7.6

What are the indications for operative intervention of an irreducible stoma prolapse?

Recommendation: Ischaemia and obstruction are indications for urgent operative repair of an irreducible stoma prolapse.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 88.9%, A 11.1%)

An irreducible stoma prolapse complicated by ischaemia or obstruction requires urgent operative repair [489]. Symptoms such as pain and difficulty fitting appliances are also relative indications for urgent operative intervention.

End stomas can be disconnected at the mucocutaneous junction and the everted bowel re-inverted and resected to an appropriate length [489]. Loop stomas can be converted to end stomas and similarly the redundant bowel can be excised. Patients with a temporary stoma that is no longer required in whom it is otherwise appropriate can have intestinal continuity restored.

There are several described options to manage loop stoma prolapse via a minimally invasive technique including narrowing of the distal limb with a suture [501,502]. In patients not fit for resection and refashioning it may be possible to excise the excess bowel and mesentery without reduction using a linear stapler. Variations of this technique are described under general anaesthetic [503,504] and sedation [505–508]. A Delorme's prolapse technique involving muscularis plication has also been described as successful [509,510].

In severely comorbid patients not fit for more definitive repair there are several described options for simple local repair techniques but insufficient evidence to recommend any individual technique.

Ischaemia/infarction

Question 7.7

Is imaging useful in the assessment of an ischaemic/infarcted stoma?
Recommendation: Clinical and endoscopic assessment are more useful than imaging such as CT in the assessment of postoperative stoma ischaemia. Appearances on CT cannot be relied upon to exclude more proximal ischaemia.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 55.6%, A 44.4%)

Stoma ischaemia is an early complication caused by vascular compromise to the portion of bowel brought out as a stoma. It is commonest in end colostomies at around 5%–6% [483,484]. Mild ischaemia can be due to tissue trauma or vasospasm but infarction and necrosis can occur due to inadequate arterial supply due to ligation or damage of the end arterial supply with poor collateral circulation. Less commonly venous outflow obstruction can cause venous congestion with later necrosis [488].

Blood tests including inflammatory markers can help judge when there is likely to be significant ischaemia extending beyond the superficial stoma, as can a CT scan, which is good at assessing proximal ischaemia [361–363,511].

Mild ischaemia can lead to mucosal sloughing and a purple, greyish or dusky discolouration of the mucosal surface. This can progress to mucocutaneous separation, retraction and/or full thickness necrosis. Stomas of doubtful viability can be examined internally by use of a blood tube, proctoscope or similar to visualize the mucosa below the surface of the skin, which can demonstrate whether the ischaemia is superficial (and may recover) or extends more proximally [488].

Ischaemia may lead to areas of mucocutaneous separation which usually heal by secondary intention with appropriate stoma care [512]. Stomal stenosis and stricture may occur as delayed complications [488].

Question 7.8

What are the indications for operative interventions for an ischaemic/infarcted stoma?
Recommendation: Where the stoma is judged to be non-viable below the level of the fascia emergency operation should be considered.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 100%)

Question 7.9

Which operative intervention?
Recommendation: Revisional surgery by laparoscopy or laparotomy with the intention of further mobilization and probable resection is likely to be required. Local revision can be considered but is often not possible or appropriate.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 100%)

Patients with stomas that are infarcted below the level of the fascia require revision to determine the extent of the necrosis and prevent complete stoma separation and early retraction [488].

It may rarely be possible to revise the stoma locally if sufficient viable bowel can be brought out without tension but most cases require a laparotomy, assessment of the extent of the ischaemia, further mobilization and refashioning. If there is doubt about the point of viability of the remaining bowel in a critically unwell patient then a re-look laparotomy following a period of stabilization may be appropriate.

Peristomal skin complications

Question 7.10

How should persistent unexplained peristomal skin ulceration be managed?
Recommendation: Patients should undergo incision/core biopsy of a large area of ulceration or excision biopsy of a localized ulcer to exclude an underlying malignant process.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)
Recommendation: A multidisciplinary approach should be taken to patients with troublesome peristomal skin conditions including stoma therapists and dermatology specialists.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 88.9%, A 11.1%)

Peristomal skin complications are commonly a combination of chemical dermatitis from the stoma contents and damage to the peristomal skin from frequent appliance changes. They are commoner in ileostomies than colostomies due to the caustic nature of the small bowel effluent [488]. They are experienced by up to 47% of patients in the first 2 months after surgery [513] although reported rates vary considerably in the literature [483,484,488,489].

Irritant contact dermatitis from the stoma effluent usually takes the form of a mild rash of peristomal skin but can lead to ulceration. Allergic contact dermatitis towards the adhesive used in the stoma appliance can also occur [513]. Many patients with peristomal skin complications may not recognize or self-report these problems [479]. A minority of around 20% may have exacerbation of pre-existing skin diseases such as psoriasis and eczema [514].

A rare differential for peristomal ulceration is peristomal pyoderma gangrenosum, which is a neutrophilic dermatosis of unclear aetiology that is rare but most commonly occurs in patients with IBD. It is usually characterized by pain and undermined violaceous irregular borders. Investigations of the remaining bowel for signs of active IBD may be useful in patients with suspected peristomal pyoderma gangrenosum as the majority have active systemic disease at presentation [515].

The majority of these conditions are managed by expert stoma care nurses with the aim to remove or reduce the skin irritant and halt the progression of the condition. Topical corticosteroids can sometimes help [512,513]. Peristomal pyoderma gangrenosum can be treated with topical steroids but often respond well to systemic immunosuppressive therapies [516]. Difficult cases including those where a systemic dermatosis or peristomal pyoderma gangrenosum is suspected should be referred for specialist management by dermatology.

Question 7.11

Is there any indication for emergency surgery for peristomal skin problems?
Recommendation: There is no absolute indication for emergency surgery for peristomal skin conditions.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

Rarely some patients may come to revisional surgery for peristomal skin complications. In nearly all cases this is planned as an elective or expedited procedure. In these cases, it is likely that the stoma may need to be re-sited and, if any other complication such as retraction or parastomal hernia is thought to be contributing, then this requires addressing.

A number of case series of patients with peristomal pyoderma gangrenosum found that surgical closure of the stoma, if possible, cured the disease in all affected patients. In those in whom stoma closure was not feasible then resection of residual bowel with active inflammation also cured the large majority of patients but the disease recurred in 67% of patients treated with stoma revision and relocation as the sole procedure [514].

Stoma stenosis/stricture

Question 7.12

What are the underlying causes of stoma stenosis?
Recommendation: Always consider causes other than ischaemia, such as inflammatory and malignant diseases, in a new acute stomal stenosis.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 100%)

Stoma stenosis is a narrowing of the opening of the stoma; stricturing is a narrowing that usually occurs at the level of the fascia. Early ischaemia is the most common contributing factor but it can also occur due to recurrence of Crohn's disease, malignancy or after mucocutaneous junction separation [513], as well as from technical error when determining the size of the fascial defect [489]. The incidence is around 1.7%–10% [483,484,493].

Stenosis does not usually occur in the immediate postoperative period but can occur after a few weeks if due to ischaemia. Many cases occur after a number of years and may be due to chronic peristomal dermatitis, which can be exacerbated by concurrent retraction and difficulties obtaining a seal [493]. In rare cases of severe stenosis, obstruction and perforation are possible.

Biopsy, luminal and cross-sectional imaging may be helpful to exclude recurrent inflammatory or malignant disease [489].

Question 7.13

What are the management options for a stenosed stoma?
Recommendation: Dilatation of stomal stenosis can be performed under the guidance of a stoma therapist but patients should be counselled that this is unlikely to be a successful long-term solution.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 66.7%, A 33.3%)
Recommendation: Patients with stomal stenosis who develop complete obstruction require urgent operative management.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)
Recommendation: Local revision will be possible in most patients with a small number requiring more extensive surgery to mobilize sufficient bowel length to form a viable stoma. In patients with recurrent stomal stenosis use of a dermoplasty technique should be considered.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

Initial treatment is usually conservative with stoma appliances. Dilatation performed under the care of a stoma care nurse can provide temporary improvement but may need to be performed repeatedly [513] and the tissue trauma involved can lead to further fibrosis and stricturing [489].

There has been a case report of the use of a SEMS used in the palliative management of a malignant stricture causing large bowel obstruction [517].

Depending upon the cause of the stenosis, it is usually possible to perform a local correction by excising the scar tissue surrounding the mucocutaneous junction and mobilizing sufficient bowel to form a new stoma at the surface. Recurrent stenosis is common and in these patients re-siting should be considered [492]. An alternative is the use of a dermoplasty or skin flap technique although this has not been commonly described in the literature [518]. If the stenosed stoma is a temporary covering loop, then stoma reversal may be an option.

Parastomal hernia

Question 7.14

Is imaging useful in the assessment of an obstructed/strangulated parastomal hernia?
Recommendation: CT scan is recommended as part of the assessment of a patient with a suspected obstructed or strangulated parastomal hernia.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 88.9%, A 11.1%)

A parastomal hernia is an incisional hernia related to an abdominal wall stoma [519] and is recognized to be a common problem in patients who undergo stoma formation. The reported incidence varies widely in the literature depending upon whether the definition is dependent upon symptoms, physical examination or radiological assessment, but may be up to 59% at long-term follow-up [483,520–522]. It is likely that parastomal hernias are commoner in end colostomies than in other types of stomas [523,524].

The ongoing CIPHER study aims to answer these questions together with the impact of the surgical technique on subsequent parastomal hernia formation. Strategies to prevent and treat parastomal hernia were voted the second most important non-cancer-related research question on a Delphi exercise undertaken on behalf of the ACPGBI [525] and a recent position statement on this topic has been published [526].

Link: CIPHER study

Link: ACPGBI Position Statement

Parastomal hernias can be asymptomatic but more commonly cause symptoms such as bulging and effect on body image, pain, symptoms of intermittent partial bowel obstruction and reduction in overall physical functioning and quality of life [527,528]. Patients can present as an emergency with an obstructed or strangulated hernia with pain, vomiting and reduced stoma output with an irreducible parastomal hernia [524,527].

There is no gold standard examination or test for parastomal hernia but in the non-emergency setting CT and MRI may diagnose some hernias missed on clinical examination [529] and prone CT has lower interobserver variability than examinations performed supine [530]. There is no evidence regarding the role of CT in patients who present acutely obstructed with an incarcerated parastomal hernia but it very probably has a role in high risk patients with complex

abdominal wall pathology to confirm the site of obstruction and aid operative planning. This should not delay the resuscitation and management of an acutely unwell patient. In patients with acute worsening of chronic pain and intermittent symptoms of obstruction, contrast-enhanced CT scan in combination with inflammatory markers may be used to help aid decision-making about urgent intervention; if coexistent intestinal ischaemia is considered a multiphase CT maybe beneficial [360–362]

Question 7.15

What are the indications for emergency surgery?
Recommendation: Patients with parastomal hernias causing strangulation or unresolving obstruction should have urgent surgery.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

Patients who present with an irreducible parastomal hernia with associated obstruction that does not resolve or signs of strangulation require immediate operative intervention [530]. Unlike other abdominal wall hernias, a large proportion of patients who have an operation for a parastomal hernia have this performed as an emergency. This group of patients have a considerable mortality and morbidity [531].

Question 7.16

What is the operation of choice in the emergency setting?
Recommendation: Emergency surgery for a parastomal hernia is aimed at saving life and not definitive hernia management. Minimal intervention, for example suture repair, that allows the pathology to be dealt with and the patient's life to be saved is recommended.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

In the emergency situation where operative intervention is required for non-resolving bowel obstruction or bowel ischaemia there are three goals to be met:

1. save life,
2. minimize complications,
3. tissue preservation in order to allow attempt at future definitive repair.

Local suture repair has the advantage of being relatively simple to perform with less morbidity than that associated with an operation involving laparotomy [523]. However, a laparotomy may be necessary in order to allow or facilitate local repair. In a systematic review of retrospective series, the recurrence rate for planned non-emergency surgery was up to 70% [532]. Despite this it is recognized that this technique may be the only real option in the emergency situation where a 30-day mortality rate of 10% (>20% in elderly patients) is reported [531].

Stoma relocation is fraught with challenges. The great majority of this group of patients will have ES, often out of hours. A stoma nurse is unlikely to be available for re-siting. Stoma relocation is not to be recommended because of the high rate of parastomal hernia development at the new stoma site and incisional hernia development at the old site [533,534].

A variety of methods are used to perform mesh repair of parastomal hernias in the elective setting including laparoscopic intraperitoneal, preperitoneal/subfascial and fascial onlay [523]. Some retrospective case series have included the use of synthetic and biologic meshes to repair parastomal hernias as an emergency [535,536] but currently there is not sufficient evidence to recommend this over suture repair in emergency patients.

As well as a high rate of early mortality, there is around a 50% total morbidity rate in patients undergoing emergency repair with higher rates of systemic inflammatory response syndrome, sepsis and prolonged ventilatory requirements compared with elective patients [531].

Having ES has been found to be the single strongest predictor of reoperation or death following parastomal hernia repair [537]. However, patients that do recover sufficiently well from an emergency procedure would have the option of a more definitive repair as a planned elective procedure which is likely to entail much less perioperative morbidity.

Stoma closure will be possible in only a small number of patients.

THE OPEN ABDOMEN

Introduction

Leaving the abdomen open after an emergency laparotomy in a critically ill surgical patient is a recognized life-saving manoeuvre. However, the OA or laparostomy is associated with significant morbidity including fluid loss, infective complications, spontaneous intestinal fistulation (5%–17%) and mortality (28%); its immediate management is resource intensive [538,539]. It should be looked upon as a temporary measure rather than a definitive event. Failure

TABLE 4 Classification of the open abdomen

Grade	Description
1 No fixation	
1A	Clean, no abdominal wall fixation or bowel adhesions to abdominal wall
1B	Contamination, no abdominal wall fixation or bowel adhesions to abdominal wall
1C	Enteric leak, no abdominal wall fixation or bowel adhesions to abdominal wall
2 Developing fixation	
2A	Clean, developing abdominal wall fixation or bowel adhesions to abdominal wall
2B	Contamination, developing abdominal wall fixation or bowel adhesions to abdominal wall
2C	Enteric leak, developing abdominal wall fixation or bowel adhesions to abdominal wall
3 Frozen abdomen	
3A	Clean, frozen abdomen
3B	Contaminated, frozen abdomen
4 Frozen abdomen with established entero-atmospheric fistula	

to close the abdomen results in a 'planned' ventral hernia that requires subsequent reconstruction [540]. In the UK, peritonitis is by far the commonest indication for OA. This will form the focus of these guidelines.

A practical classification of the OA and its complications was developed by expert consensus in 2009 [541] and revised in 2013 [542] Table 4 describes the revised classification of the OA. The classification is used throughout these guidelines to describe the management of the OA (Kirkpatrick et al. 2013 [542], open access publication; written permission for reproduction was obtained by ASM 18 July 2020).

The classification has practical value in describing the OA that may be suitable for delayed primary closure (DPC). It is also dynamic in that patients may move between the different grades as their wounds evolve. Studies which have used this classification system have also demonstrated a correlation between mortality and rising grade of OA [543,544].

The vast majority of the world literature concerning the OA and abdominal wall management is derived from trauma patients. As such, not all conclusions are applicable to the septic abdomen, as trauma patients more frequently achieve definitive abdominal closure within 48 h of creation of the OA compared with patients who have an OA for peritonitis [545].

Patients with peritonitis are more likely to require an OA for longer, require more returns to theatre and have increased risks of visceral injury and failure of DPC. As a consequence, they have worse postoperative morbidity, including higher intestinal fistulation and wound complication rates.

There are only a handful of published RCTs specifically focused on the management and outcomes of patients with an OA. The lack of Level I evidence in many cases therefore restricts the Grade of recommendations produced by these guidelines.

Question 8.1

What are the indications for leaving an abdomen open?
Recommendation: Indicated as part of the definitive management of
Trauma following damage control laparotomy
Level of evidence: II
Grade of recommendation: B
Vascular events to allow reassessment of intestinal ischaemia
Level of evidence: II
Grade of recommendation: B
Selective cases of peritonitis/gross peritoneal contamination
Level of evidence: II
Grade of recommendation: C
Primary or secondary abdominal compartment syndrome (sustained elevation of intra-abdominal pressure above 20 mmHg associated with new organ dysfunction)
Level of evidence: II
Grade of recommendation: B
As a consequence of massive abdominal wall tissue loss from trauma, necrotizing fasciitis
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% for all above recommendations (SA 100%)

The primary role of an abbreviated damage control laparotomy (DCL) is to arrest life-threatening haemorrhage and limit enteric contamination. It allows resuscitation and reversal of the lethal triad of hypothermia, acidosis and coagulopathy prior to definitive surgical management. It is well established in trauma guidelines [538,546–548]. Others have confirmed the reduced mortality rates with DCL and OA [549]; consequently these principles have readily been transferred to general surgery and are widely used. In the last decade recognition of the significant morbidity associated with OA has led to suggestions that this approach should be used more selectively [550–552]. The specific indications for OA following DCL in trauma can be reviewed in separate trauma guidelines [547,552–554].

However, DCL does have a role in non-trauma patients. Achieving drainage of sepsis and definitive source control in peritonitis is crucial. This may require resection of all non-viable gut using bowel staplers to secure the intestinal contents, proximal gastric drainage via nasogastric tube, avoiding intestinal anastomosis and performing TAC at the index laparotomy. If control is not achieved, this inevitably leads to the development of organ failure which can result in death [389,555–557]. Re-laparotomy and further peritoneal lavage may be required. Early reports on the use of a damage control approach for severe peritonitis followed by an OA and re-laparotomy until source control could be achieved suggested a reduction in mortality [558]. Subsequent studies have shown that the benefits of an OA in reducing mortality may be less than previously thought.

More recent comparative studies have suggested that OA is associated with higher healthcare costs, postoperative complications

and mortality and may often be used inappropriately where primary closure of the abdomen should have been practised [559,560].

Abdominal compartment syndrome (ACS), defined as a sustained elevation of IAP above 20 mmHg associated with new organ dysfunction [542], may be seen after trauma, peritonitis, ruptured abdominal aortic aneurysm, acute severe pancreatitis and mechanical bowel obstruction often in combination with aggressive fluid resuscitation. Patients in these high risk groups should have regular IAP measurements, which must be clearly documented in the patient's clinical record [543]. Clinical assessments of IAP are unreliable. However, once ACS is recognized, it should be treated by a decompressive laparotomy within 24 h [561,562].

The routine use of OA for patients with severe intraperitoneal contamination undergoing emergency laparotomy for intra-abdominal sepsis is not recommended by the World Society of Abdominal Compartment Syndrome unless IAH is a specific concern [542].

There is very limited evidence to recommend a standard approach to the use of the OA in patients who require extensive emergency abdominal wall debridement due to trauma or necrotizing soft tissue infections (NSTIs). In the case of NSTIs, the GI tract can be an important source for causative organisms and intra-abdominal exploration may be required for treatment of the NSTI [563]. The use of the OA in these clinical settings should be guided by expert clinical judgement and no specific recommendations could be drawn from the literature on the best surgical approach to this challenging problem.

Question 8.2

What is the preferred temporary abdominal closure for the open abdomen and when should it be changed?

Recommendation: Negative pressure wound dressings with a visceral protection sheet (non-adherent sheet that covers the viscera and prevents the formation of adhesions to the anterior abdominal wall) should be placed at the conclusion of the initial laparotomy for all open abdomens.

Level of evidence: II

Grade of recommendation: A

Consensus: 100% (SA 100%)

Recommendation: Commercially available negative pressure wound therapy dressings designed for the peritoneal cavity should be used in all cases when available.

Level of evidence: I

Grade of recommendation: A

Consensus: 100% (SA 100%)

Recommendation: Intraperitoneal negative pressure wound dressings should be changed when there is heavy contamination or a requirement to return to the operating theatre due to other clinical needs. (Commercial company recommendation is that negative pressure wound therapy should be changed every 24–72 h.)

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 100%)

TAC refers to any method of dressing an OA. It is a misnomer in that in most cases it is just a dressing, not a closure method. The ideal TAC dressing should

1. be simple and quick to deploy,
2. cost-effective,
3. prevent loss of domain,
4. manage/prevent fluid losses,
5. protect abdominal contents,
6. prevent fascial retraction to facilitate primary closure,
7. prevent visceral injury and adhesions to the anterior abdominal wall.

Many different TAC methods have been described; however, most fail to meet the criteria of an ideal device. These techniques can be either 'static' or 'dynamic' depending on whether they actively prevent the retraction of the oblique abdominal wall muscles after the linea alba is divided at laparotomy.

Static techniques by their nature lead to delayed primary fascial closure and fail to prevent loss of domain and the development of visceral adhesions to the abdominal wall. They should be avoided if at all possible and really only have a role in the stabilization of an emergency patient prior to transfer. They include the following.

1. Deep retention sutures—heavy gauge, non-absorbable sutures, passed through all layers of the abdominal wall and tied tightly at the midline—have been shown to generate increased postoperative pain, skin and muscle damage. They do not reduce the risk of incisional hernia following closure of a burst abdomen (BA) [564,565]. There is no evidence to support their continued use.
2. A skin only closure fails to deal with the volume of fluid exudate produced, has a high risk of dehiscence and evisceration and may not lead to adequate decompression of ACS.
3. A Bogotá bag involves suturing a sterile plastic sheet to the fascia to cover the viscera. This technique fails to deal with the volume of fluid exudate produced and allows the formation of visceral adhesions to the abdominal wall as well as loss of domain.
4. A wound management bag is a very large sized bag needed to completely incorporate the wound and often requires specialist wound care nursing to apply.
5. Wound packing with gauze requires frequent changing and fails to deal with the volume of fluid exudate. In addition, after only a few hours, the gauze can adhere to the viscera causing serosal injury and subsequent fistulation on removal.

Dynamic TAC methods are preferred wherever possible. They provide traction to the anterior abdominal wall and facilitate delayed primary fascial closure. However, their use as stand-alone techniques fails to prevent visceral adhesions to the anterior abdominal wall, and shearing forces which are applied during progressive tensioning of the fascia may generate intestinal fistulation [566]. They include the following:

1. dynamic retention sutures which are placed through the fascial edges and sequentially tightened;
2. the ABRA™ abdominal re-approximation anchor system [567] which uses elastomer bands and buttons and skin traction to approximate the fascia;
3. the Wittmann™ patch [568] which is a Velcro™ patch sutured to the fascial edges that can be sequentially tightened;
4. mesh-mediated fascial traction between the fascia edges that again is sequentially tightened and ultimately removed.

It is important to recognize that negative pressure wound therapy (NPWT) dressings used alone are static with regard to the fascia but provide some traction on the skin and subcutaneous tissues.

Commercially available intraperitoneal NPWT systems specifically designed for the OA are now widely available across the UK and Ireland. Even in environments where resources are limited, there are cost-effective methods of creating customized 'in-house' intraperitoneal NPWT dressings for the OA (the Barker method, for example [569] often referred to as a 'sandwich pack' [570].

The components of an NPWT dressing for the abdominal cavity include

1. a non-adherent visceral membrane that is fenestrated to allow peritoneal fluid to be removed (e.g., mobile fluoroscopy unit cover—C-arm cover),
2. drains connected to low pressure suction,
3. an impermeable adherent dressing to completely cover the entire OA wound and secure the dressing to the skin surface,
4. a porous material that creates a space between the visceral membrane and impermeable outer dressing (this space collects fluid and the material prevents complete collapse of the space between the visceral membrane and outer dressing when negative pressure is applied),
5. a collection system for the exudate removed by the drains to monitor fluid losses.

Current NICE guidance together with several international guidelines support the safety and efficacy of NPWT dressings for management of the OA wound [547,554,571,572].

The use of a visceral protection sheet, placed deep into the lateral, pelvic and costal recesses, has been shown to reduce visceral adhesions to the anterior abdominal wall and to reduce the rate of spontaneous intestinal fistulation associated with OA from 26.5% to 2.9% [571].

It is imperative that the foam used in the interface between the visceral and impermeable outer layer is never able to come into contact with the bowel. If this is allowed to happen then the foam becomes densely adherent and may result in bowel damage when it is removed with subsequent enteric fistulation. Intestinal anastomoses or serosal repairs performed at previous operations must be protected by positioning them deep in the peritoneal cavity away from direct contact with the dressing surface. If present, the omentum can also be positioned to serve as an interface between the dressing or wound surface and the viscera.

There have been seven systematic reviews examining methods of TAC in the OA over the last 10 years [539,542,570,573–577] and three RCTs [559,578,579]. The overall strength of the reported outcomes is low due to the small number and poor quality of comparative observational studies.

With a variety of commercial dressings available it is recommended that all surgeons become familiar with their locally available technique [571].

Newer proprietary systems have been developed that also allow for the instillation of fluids with or without antibiotics into the peritoneal cavity [580–582]. This may reduce the requirement to return to theatre to perform peritoneal lavage for heavily contaminated abdomens but currently there is insufficient evidence to recommend their routine use.

Early concerns that NPWT in the OA increased the rates of intestinal fistulation have not been demonstrated in any of the systematic reviews comparing NPWT to other methods of TAC. The rates of fistula formation in the systematic review of TAC methods after OA for non-trauma indications (74 studies) varied from 5.7% after NPWT with fascial traction, 14.6% for NPWT only and 17.2% after mesh inlay [539]. The most recent systematic review comparing NPWT to non-NWPT techniques for all indications did not find any statistically significant difference in EAF rate (2.1% vs. 5.8%, $P = 0.57$) [576].

There is no evidence regarding the timing of dressing changes. The frequency of dressing changes is frequently not reported in NPWT studies but in most observational studies 2–3 days is used. It would seem prudent to avoid unnecessarily revisiting the operating theatre to change a dressing in the absence of heavy contamination or clinical need.

All dressing changes should involve an experienced multidisciplinary team and there should be clearly documented plans with regard to the timing of planned returns to the operating theatre.

Question 8.3

What are the short-term goals in managing a patient with an open abdomen?

Recommendation: Patients do not need to remain ventilated for the specific purposes of open abdomen management.

Level of evidence: III

Grade of recommendation: D

Consensus: 100% (SA 88.9%, A 11.1%)

Recommendation: Patients with an open abdomen can be fed enterally if the GI tract is in continuity and there are no other contraindications to enteral feeding; otherwise patients should receive parenteral nutrition.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

Management of the OA requires a multidisciplinary approach, led jointly by the surgical and intensive care teams with input from a nutritional team, physiotherapists, complex wound and stoma nurses and guided by microbiology.

Patients remain intubated following the creation of an OA after index laparotomy, primarily to facilitate repeated returns to the operating theatre for second look procedures or to perform delayed fascial closure and dressing changes. A concern that patients may fail extubation, because of disruption of the abdominal wall musculature, is often used as a further reason to prolong intubation. However, prolonged mechanical ventilation beyond 48 h increases the risk of ventilator-associated pneumonia in surgical patients by approximately 10%–20% and at least doubles the mortality risk [583]. Retrospective studies of OA patients have demonstrated that extubation prior to definitive closure of the abdomen is feasible and is associated with a significantly lower incidence of ventilator-associated pneumonia [583,584]. Early extubation, a joint decision between surgical and intensive care teams, should therefore be considered in patients with an OA.

Critically unwell patients following a significant inflammatory insult or sepsis are hypercatabolic and are at high risk of developing malnutrition. There are well-established guidelines for the management of nutrition in the critical care environment [585,586] and there are benefits for the early establishment of enteral feeding [587]. There is an established practice of withholding enteral feedings in OA patients that is not supported by the literature; however, the feasibility and safety of enteral feeding in OA patients is from retrospective studies mainly involving trauma patients [588–593]. There is some evidence that early enteral feeding may even improve rates of delayed primary fascial closure with subsequent reduction in intestinal fistulation following the OA for trauma [588,590].

Enteral feeding can commence in a patient with an OA if the GI tract is in continuity and there are no other contraindications to feeding. This can safely occur via oral, nasogastric or nasojejunal routes. If there is a clinical concern about the development of an intestinal fistula or an anastomotic leak from a prior bowel repair, enteral feeding should be ceased until this can be excluded. If patients cannot tolerate enteral feeding or if GI continuity cannot be confirmed, early parenteral feeding should be considered. Parenteral nutrition does not have to be exclusive; if the enteral route is safe then small amounts of trophic enteral feed (15–30 ml/h) can be started and increased as enteral function returns. The routine placement of enterostomy feeding tubes (gastrostomy and jejunostomy) in the OA is discouraged because, at least in trauma patients, this is a risk factor for intestinal fistulation especially if NPWT is used [578,594].

Question 8.4

When should a patient with an open abdomen return to theatre?

Recommendation: Return to theatre after the index laparotomy should be tailored to the individual patient's clinical condition with prioritization of resuscitation but should not be longer than 48 h from the index laparotomy.

Level of evidence: III

Grade of recommendation: D

Consensus: 100% (SA 88.9%, A 11.1%)

Recommendation: Further returns to theatre after the first re-look laparotomy should be 'on demand' and guided by the patient's condition rather than planned to occur after a certain period of time.

Level of evidence: I

Grade of recommendation: A

Consensus: 100% (SA 88.9%, A 11.1%)

There are no studies that have shown the optimum time for return to theatre following the index laparotomy for non-trauma patients. Intervals of 24 to 72 h between the index and first re-laparotomy are reported [595]. Earlier returns to the operating room following the initial laparotomy should be considered for patients who require definitive surgical arrest of bleeding or source control following correction of coagulopathy, development of significant enteric contamination of the OA wound or a failure of clinical improvement following the initial laparotomy.

A single retrospective study has reported that patients with secondary peritonitis who had returned to theatre after 48 h had a significantly higher mortality rate than patients who had returned within 48 h (77% vs. 28%, $P < 0.0001$) [596]. The trauma literature reports that the timing of the first take back after DCL is important. After the first 24 h, for every additional hour delay there was a 1.1% decrease in the odds of primary fascial closure and after 48 h there was an increase in intra-abdominal complications [597]. The limited evidence available suggests that patients should return to theatre within 48 h of the index laparotomy.

Definitive primary closure of the abdominal fascia should be performed at the time of the first re-look laparotomy, if appropriate. If there is still an ongoing requirement for the abdomen to be left open, then the patient should be returned to theatre based upon their clinical progress—the so-called 'on-demand' re-look. The long-standing debate of on-demand vs. planned re-laparotomy for patients with peritonitis has largely been resolved by the Dutch Peritonitis Study Group RCT. Patients having an index laparotomy for severe secondary peritonitis were

allocated to either planned re-laparotomy every 36–48 h (116 patients) or re-laparotomy on-demand (116 patients). It demonstrated improved outcomes in favour of the on-demand group [598]. Patients in the planned re-laparotomy group had significantly more laparotomies ($P < 0.001$), a higher number of negative laparotomies (66% vs. 31%, $P < 0.001$), longer stays in intensive care (median 11 vs. 7 days, $P = 0.001$), prolonged requirements for intubation (median 8 vs. 5 days, $P = 0.007$) and a longer stay in hospital (median 32 vs. 29 days, $P = 0.008$) [598]. Planned re-laparotomy did not reduce the need for percutaneous interventions (37% vs. 24% in on-demand, $P = 0.02$) [598]. There were no differences in all-cause mortality at 12 months, however (36% in planned vs. 29% in on-demand, $P = 0.22$), or major morbidity in survivors (44% planned vs. 40% on-demand, $P = 0.58$) [598]. Not unexpectedly, on-demand re-laparotomy is also associated with significantly lower healthcare utilization costs [599]. An earlier meta-analysis of observational studies (1266 patients with secondary peritonitis) reported similar outcomes and a non-significant trend towards lower mortality rates in patients who had on-demand re-laparotomy [595].

Clinical assessment can be difficult in the ventilated, unconscious patient and a low threshold for CT scanning is essential to determine the presence of collections or the development of a new, unexpected complication. Patients failing to progress without obvious alternative explanations or those who develop a new intra-abdominal complication that requires operative management may require re-laparotomy.

Question 8.5

When should delayed primary closure of the open abdomen be attempted?

Recommendation: The goal of open abdomen management is to achieve delayed primary closure of the abdomen as soon as the patient is clinically stable and definitive management of the primary problem has been achieved. Ideally this should occur as soon as possible after the index laparotomy.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 77.8%, A 22.2%)

Recommendation: Once fascial closure has been performed it is good clinical practice to monitor intra-abdominal pressure for the development of intra-abdominal hypertension.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 77.8%, A 22.2%)

Once the decision to create an OA has been made, it is the immediate responsibility of the surgical team to plan how and when to close it.

DPC refers to primary closure of the abdominal fascia in the OA at a subsequent procedure performed after the index laparotomy. DPC should always be considered in order to avoid the 'planned ventral hernia'. The ventral hernia defects following non-closure of the OA often require complex abdominal wall reconstruction techniques to restore abdominal wall integrity and function.

Once the linea alba is divided at laparotomy, the unopposed action of the oblique abdominal wall muscles immediately creates lateral retraction of the fascial edges. Over time there is also gradual shortening of the lateral abdominal wall muscles, muscle atrophy and fibrosis that results in further retraction of edges of the laparotomy wound. These changes are evident histologically as early as 35 days after the linea alba is divided in animal studies [600].

The OA is also inherently fistulogenic and fascial closure is crucial in limiting fistula formation. There is a strong relationship between reduced fistulation and successful DPC. The inability to close the abdomen and intestinal fistula are the two parameters that carry the highest mortality rates following the OA in both trauma and non-trauma patients. It is therefore essential to plan and achieve closure as early as is practically possible. The incidence of intestinal fistulation in the OA varies depending on methods of TAC and DPC from 0% to 17.2% [575,601]. In a UK-wide survey of OA for predominately non-trauma indications, the overall rate of intestinal fistulation was around 12% [538].

There are no RCTs addressing the most appropriate timing of DPC. A systematic review and meta-analysis of 32 mostly retrospective studies (3125 patients) for all OA indications identified that early fascial closure (2.2–14.6 days) was associated with a significantly lower mortality rate (12.3% vs. 24.8%, relative risk 0.53, $P < 0.0001$) than delayed fascial closure (32.5–300 days) [602] Overall complications were lower in the early fascial closure group (relative risk 0.68, $P < 0.0001$) and overall hospital length of stay and intensive care stays were significantly shorter but the heterogeneity of the included studies for these outcomes was very high [602].

When fascial closure is not possible at the first reoperation because either the fascial edges cannot be approximated or there is an ongoing requirement for the abdomen to be left open, measures need to be put in place to prevent further lateral retraction of the fascial edges. Expert consensus suggests that this should not happen at the index laparotomy as resuscitation and restoration of physiological derangements take priority. TAC with intra-abdominal NPWT alone should be performed at the index laparotomy and on further reoperations if the patient remains unstable or there is a risk of IAH or ACS. Following fascial closure,

routine measurement of IAP is recommended to monitor for the development of ACS.

Question 8.6

What is the preferred technique for delayed primary closure of the open abdomen?

Recommendation: When definitive management of the primary problem has been achieved and the abdominal fascia can be closed without tension, the abdominal fascia should be sutured closed according to best practice guidelines.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 88.9%, A 11.1%)

Recommendation: When definitive management of the primary problem has been achieved and the abdominal fascia cannot be closed at the first return to theatre but there is likelihood of delayed primary closure, mesh-mediated fascial traction in conjunction with negative pressure wound therapy should be employed to achieve delayed primary closure.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

Recommendation: When there is an ongoing requirement for access to the peritoneal cavity and further returns to theatre are anticipated, mesh-mediated fascial traction in conjunction with negative pressure wound therapy should be employed to avoid fascial retraction and the abdomen should be closed once the patient is clinically stable.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

The final stage in the management of the OA is fascial closure to prevent intestinal fistulation and planned ventral hernia. Following the decision to form an OA, most patients will fall into one of three categories:

1. definitive management of the primary problem has been achieved and abdominal fascia can be closed;
2. definitive management of the primary problem has been achieved and abdominal fascia cannot be closed;
3. there is an ongoing problem and requirement for the abdomen to be left open.

If definitive management of the primary problem has been achieved and the abdominal fascia can be re-approximated without tension, primary suture closure of the abdominal fascia should be performed. There is no high quality evidence to support any particular suture technique for laparotomy closure in the emergency setting but there are a small number of low quality studies which consistently report that the technique of continuous small bites with a slowly absorbable monofilament suture and a 4:1 suture to wound length ratio is safe and is not associated with an increased risk of fascial dehiscence [603–605]. Current best practice for elective laparotomy closure suggests that the ideal midline laparotomy closure is a continuous suture technique using a slowly absorbable monofilament suture with a suture to wound length ratio of at least 4:1 [606].

If the abdominal fascia cannot be closed at the first return to theatre due to tension or lateral retraction, or if there is an ongoing requirement to keep the abdomen open, a dynamic method of re-approximating the edges of the abdominal wall to oppose the lateral retraction of the abdominal wall should be employed to assist with closure at a later time. Excessive tension at the time of laparotomy closure is a risk factor for the development of incisional hernia and in the immediate postoperative period it can lead to the development of IAH and ACS.

Intra-abdominal NPWT alone if placed correctly can facilitate skin closure but on its own does not promote re-approximation of the fascial edges. It is crucial, however, in preventing the formation of adhesions to the anterior abdominal wall which, if allowed to form, contribute to fixation of the abdominal wall (OA Grades 2–3) preventing DPC. Intra-abdominal NPWT alone does not increase rates of DPC as it generates no significant traction on the fascial edges of the wound. Rates of DPC with NPWT alone in non-trauma patients are around 51% [539].

A number of different techniques and devices have been developed to achieve DPC of the OA. These include

1. dynamic retention sutures which are sequentially tightened,
2. an ABRA™ abdominal re-approximation anchor system [567],
3. a Wittmann™ patch [568]
4. mesh-mediated fascial traction (MMFT).

Historically, many of these techniques were used without a non-adherent visceral membrane to prevent the formation of acute adhesions to the anterior abdominal wall. This practice is considered likely to contribute to the development of intestinal fistulation due to shearing forces created when the abdominal wall is progressively tensioned. These techniques have evolved with time and are mostly now used in combination with either NPWT or a protective visceral membrane that is eventually removed when the fascial edges can be re-approximated without undue tension. Fascial closure using a dynamic fascial closure technique improves DPC rates. In a systematic review of outcomes from non-trauma patients, the highest primary fascial closure rates were seen in NPWT in combination with fascial traction (73.1%, 95% CI 63.3–81.0) and dynamic retention sutures (including ABRA™) (73.6%, 95% CI 51.1–88.1) [540]. The fistulation rate is lower in NPWT with fascial traction than with

dynamic retention sutures (5.7%, 95% CI 2.2–14.1 vs. 11.6%, 95% CI 4.5–26.9) [539]. Dynamic retention suture systems can also lead to ischaemia of the abdominal wall muscles or skin and are not well tolerated by patients. Wittmann™ patches have high DPC rates [607] however, the patch is not widely available and management of fluid exudate from the OA is difficult as the patch is an impermeable synthetic sheet. Inlay or bridging with meshes should be avoided as this technique is associated with the highest fistulation rates (17.2%, 95% CI 9.3–29.5) [539] and mesh adhesions to bowel can make subsequent planned ventral hernia repair risky.

NPWT-MMFT progressively re-approximates the linea alba to allow primary fascial closure while limiting damage to the abdominal fascia [608]. At each successive dressing change the mesh is windowed centrally and tightened using a strong non-absorbable running suture, such as No. 1 prolene. NPWT with a visceral protection sheet prevents the formation of adhesions to the abdominal wall and the abdomen can be reassessed as required prior to fascial closure. It is a simple, easily reproducible technique and any permanent synthetic mesh can be used. When primary fascial closure is achieved all the remaining mesh is removed and the fascia is closed directly. Observational studies of NPWT-MMFT across all OA indications are consistently associated with high rates of DPC (80%–100%) and low intestinal fistula formation (0%–10%) [609]. A recent comparative study of NPWT-MMFT and NPWT alone suggested that NPWT-MMFT was associated with significantly higher rates of DPC (95% vs. 5%, $P < 0.001$), better survival and shorter hospital and intensive care admissions [610]. Longer-term outcomes such as incisional hernia formation are uncommonly reported but range from 20% to 50% (follow-up range 20–63 months) [609].

Question 8.7

How should the open abdomen be managed if delayed primary closure is not achieved?

Recommendation: If delayed primary closure of the abdominal fascia cannot be achieved in a Grade 3 open abdomen (frozen abdomen, clean/contaminated), skin and subcutaneous fat should be approximated over the viscera, if possible. Split thickness skin grafting can be used on a granulating wound (± use of an absorbable mesh) to create a planned ventral hernia.

Level of evidence: III

Grade of recommendation: GP

Consensus: 100% (SA 66.7%, A 33.3%)

Recommendation: If delayed primary closure of the abdominal fascia cannot be achieved in a Grade 3 open abdomen (frozen abdomen, clean/contaminated) negative pressure wound therapy can still be used provided there is a non-adherent interface between the negative pressure wound therapy dressing and the viscera and direct contact with intestinal anastomoses is avoided.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 66.7%, A 33.3%)

Recommendation: Expert wound care is recommended to manage wound healing and prevent intestinal fistulation, if delayed primary closure cannot be achieved.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 77.8%, A 22.2%)

Recommendation: Acute component separation and myofascial releases should be avoided as they restrict potential surgical options for future incisional hernia repair.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 88.9%, A 11.1%)

There are a number of reasons why DPC might not be achievable including extensive loss of abdominal wall fascia and muscle (e.g., in the case of necrotizing fasciitis), pre-existing ventral hernia, and a failure to prevent abdominal wall retraction and visceral adhesions to the anterior abdominal wall during early management of the OA. The traditional method of managing the OA involved wound dressings until a layer of granulation tissue formed over the surface of the bowel prior to placement of a split thickness skin graft (STSG) [541]. This technique typically requires prolonged inpatient wound management and is very resource intensive [611].

The inherent problems of applying an STSG directly to the viscera are the issues related to shearing forces that occur due to

constant movement of the abdominal wall, and if applied too early it arrests the natural cicatrization of the wound preventing the defect from shrinking significantly. This leads to STSG failure in the short term as the abdominal wall cannot be splinted to reduce its movement and in the long term these shearing forces can result in a chronic non-healing skin wound due to disruption of the fragile blood supply from the bowel surface.

The end result is a 'planned ventral hernia', and after recovery from the acute insult patients will typically require further reconstructive surgery to restore abdominal wall integrity and function. Despite this being a historically established technique for the management of the OA, there are very few published outcomes and the majority of studies in the literature are retrospective case series or cohort studies with small patient populations.

Application of the STSG is usually performed after a layer of healthy granulation tissue has formed to cover the bowel. Polyglactin 910 (Vicryl™) mesh has been used to serve as a framework for the formation of granulation tissue [540,612]. This synthetic rapidly absorbable mesh can safely be placed directly onto the surface of the bowel and does not require removal prior to STSG as it is completely reabsorbed by hydrolysis. Three studies using polyglactin 910 with the largest sample sizes have inconsistent findings with respect to intestinal fistulation: 0% vs. 4% vs. 6% [612,613].

The expert consensus panel involved in the review of these guidelines recommends that polyglactin 910 mesh in a single, double or quadruple layer can be safely sutured to the edges of the fascia prior to skin and subcutaneous fat closure without risk of intestinal fistulation [614,615]. Polyglactin mesh may also serve as a framework for granulation tissue formation to prepare the wound for STSG.

NPWT can continue to be safely used when there has been failure of DPC providing that there is a non-adherent interface between the dressings and the visceral surface. This manages the exudate produced by the peritoneum and wound surface and allows wound healing to progress. Any areas of superficial skin dehiscence should be managed with caution as the absence of abdominal fascia increases the risk of inadvertent intestinal injury and absorbable meshes do not offer durable protection of the viscera.

Management of complex abdominal wall defects in the elective setting of planned ventral hernia management has seen the adoption of component separation techniques to achieve fascial closure [616,617]. A number of small case series were identified in the literature reporting on the outcomes of these techniques [618,619] and other myofascial releases [620,621] in the acute setting for the purpose of achieving DPC in OA for peritonitis. These techniques should be discouraged in the acute setting due to the increased risk of incisional hernia formation following OA and the impact it has on future reconstruction.

Question 8.8

What is the role for prosthetic mesh in achieving delayed primary closure of the open abdomen?

Recommendation: The use of mesh placed in either a bridging or inlay configuration to achieve delayed primary closure should be avoided due to risks of mesh infection, intestinal fistulation and incisional hernia formation.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 66.7%, A 33.3%)

Recommendation: The placement of heavily crosslinked biological collagen grafts directly in contact with the viscera should be avoided.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 66.7%, A 33.3%)

Early accounts of the use of permanent synthetic meshes for TAC without visceral protection barriers and subsequent removal of these materials for DPC were associated with fistula rates as high as 75% [610] and this practice has been largely abandoned. Permanent synthetic mesh or biological collagen grafts as a bridge or inlay between the fascial edges continue to be used in some settings [537]. This technique is not recommended as a method for either TAC or DPC due to the high rate of associated intestinal fistula formation. It is also well established that mesh placed as a bridge or inlay configuration for incisional hernia repair is associated with a high rate of incisional hernia recurrence [622,623].

The expert consensus panel also expressed particular concern about the specific use of heavily crosslinked biological meshes placed in any plane where they are in direct contact with the viscera. These products in particular are associated with the formation of dense adhesions between the mesh and viscera and associated intestinal fistulation when used to achieve abdominal wall closure [624,625]

There is insufficient evidence to recommend mesh reinforcement as an onlay following delayed fascial closure. The majority of patients from four observational studies identified where onlay mesh was employed were predominately trauma patients and therefore not applicable to the current clinical question. There appears to be sufficient evidence to recommend the use of mesh reinforcement of midline elective laparotomy closure with RCTs and comparative studies all showing a reduced incidence of incisional hernia formation in the long term [626,627]. A recently reported RCT of an onlay permanent synthetic mesh in emergency laparotomies showed that it reduced fascial dehiscence at 30 days but was associated with a high rate of SSI (20.6% vs. 7.7%; $P = 0.05$), seroma

(19.0% vs. 5.8%; $P = 0.03$) and non-healing incisional wound (23.8% vs. 5.8%; $P = 0.008$) compared with the non-mesh group [628].

Question 8.9

What are the management principles of enteric leak or entero-atmospheric fistula in the setting of the open abdomen?

Recommendation: If an entero-atmospheric or enterocutaneous fistula develops as a complication of managing an open abdomen, immediate management should be guided by the Sepsis/Skin/Nutrition/Anatomy/Plan principles as for the management of any enterocutaneous fistula.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 100%)

Recommendation: Delayed primary closure of the abdominal fascia cannot be achieved in a Grade 4 open abdomen with entero-atmospheric fistula formation. Management consists of expert wound care which may include wound management pouches, negative pressure wound therapy and split thickness skin graft with resultant planned ventral hernia formation.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 100%)

Intestinal fistulation is one of the perils associated with the OA and its development can result in recurrent peritonitis, sepsis, intestinal failure and death. The aetiology for the development of intestinal fistula is multifactorial and can occur due to

1. anastomotic leak,
2. unrecognized enterotomy,
3. desiccation from inadequate visceral protection,
4. damage during dressing changes for TAC or DPC and
5. shearing forces due to the development of acute adhesions to the abdominal wall.

Intestinal fistulas opening into the OA are termed EAFs and commonly arise at the margins of the OA wound. It has been postulated that this is due to shearing forces between the abdominal wall and intestinal adhesions that have been allowed to develop [566]. EAFs can also develop following the breakdown of previous anastomoses or unrecognized intestinal injury from preceding laparotomy.

The initial management of an EAF includes control of sepsis, control and collection of effluent from the wound, skin protection and safe parenteral nutritional support. The mnemonic SSNAP (Sepsis/Skin/Nutrition/Anatomy/Plan) encapsulates this approach [629]. This will often involve the input of a wound specialist nurse or stoma therapist. Initially if the fistula cannot be isolated or if there are multiple fistulas, a wound management bag is placed over the wound to collect the effluent, protect the skin and also protect the bowel from further desiccation. The details of further intestinal fistula management are covered completely in the ASGBI 'Issues in Professional Practice: The surgical management of patients with acute intestinal failure', September 2010.

Link: ASGBI Issues in Professional Practice: The surgical management of patients with acute intestinal failure

If EAF formation has occurred early during the staged closure of an OA, it may be possible to convert the fistula into a stoma which can greatly assist with wound management. Usually, however, there are multiple interloop adhesions that prevent this from being safely accomplished. At this stage it is prudent to abandon DPC and if MMFT has been instituted it is recommended that all residual mesh be removed.

Ongoing management and healing of the OA wound should be performed as for a Grade 3 OA, and the goal of management changes to that of a planned ventral hernia. NPWT is not contraindicated in the presence of an EAF and it can continue to be used to promote granulation of the abdominal wound providing that all measures are put in place to protect the exposed viscera from dressing foam. If possible, isolating the fistula from the negative pressure component of the wound dressing can also accelerate the formation of granulation tissue and wound healing. There have been a number of retrospective case series which have demonstrated that NPWT is safe and may contribute to healing of some enterocutaneous fistulas [630–632]. Once granulation has been achieved and wound contracture is obvious, STSG may be used to achieve skin coverage of the wound.

Patients with an EAF may be suitable for enteral feeding if there are no concerns about feeding abscess cavities, unidentified perforations and if fistula outputs can be controlled. Distal feeding into the fistula (fistuloclysis) may be appropriate in some patients [633]. Fistuloclysis should be delayed until the EAF has matured and distal obstruction is excluded. Patients who develop an EAF should be referred to a specialized intestinal failure unit for further management.

Question 8.10

What is the management of a patient with a burst abdomen?

Recommendation: If fascial dehiscence is early and there is an absence of intra-abdominal infection and abdominal wall adhesions, primary re-suturing of the fascia is recommended if this can be achieved without tension.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 66.7%, A 33.3%)

Recommendation: If fascial dehiscence is late, there is intra-abdominal infection and/or adhesions to the abdominal wall or the fascia cannot be re-approximated, the wound should be managed as for a Grade 3 open abdomen.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 66.7%, A 33.3%)

The BA or abdominal fascial dehiscence is an early postoperative complication where there is unintended disruption or failure of the abdominal wall fascial closure. Despite advances in suture materials and studies of abdominal wall closure methods, the incidence of BA following colorectal surgical operations has remained relatively unchanged and is around 1.3% [634]. Risk factors for BA include older age, ES, peritonitis, SSI, malignancy, hypoalbuminaemia, ascites, corticosteroid use, smoking, severe chronic obstructive pulmonary disease and obesity [564,634,635]. Fascial disruption is typically seen around 8–10 days postoperatively and heralded by the sudden discharge of pink serous fluid from the wound [564,634].

The consequences of a BA are akin to those of a deliberately created OA. It carries a significant mortality of up to 45% and a risk of intestinal fistulation of around 20% [636,637]. Other early postoperative complications including deep venous thrombosis, intra-abdominal infection, sepsis and septic shock are all increased in patients with a BA [634]. In the long term, the frequency of incisional hernia formation is up to 80% [638,639].

A number of retrospective studies (mostly case series of small numbers of patients) have reported the outcomes of several different closure techniques. Deep retention sutures appear to be associated with increased incisional hernia formation at 12 months and should be consigned to the surgical museum [564]. The pooled proportion of cases from four observational studies developing an incisional hernia with continuous suture techniques was 33.6% (95% CI 19.3%–49.7%) vs. 33.6% using interrupted sutures (95% CI 25.1%–42.6%) [575]. An early abdominal wall dehiscence probably represents a technical failure and the fascia may be partially damaged by the previous suture.

The expert consensus panel was in agreement that the technique for re-suturing the fascia should aim to distribute tension as much as possible; therefore, using a greater than 4:1 wound to suture length ratio and small bites is the most appropriate way to achieve this, which is also in accordance with other guidelines [572]

Permanent synthetic mesh for repair of dehiscence should be avoided as wounds are often contaminated and there is a high incidence of postoperative complications including mesh infection (77%) without any significant reduction in the prevention of incisional hernia [636]. If the fascia cannot be approximated due to tension or damage to the fascial edges, then intraperitoneal placement of a polyglactin 910 mesh and closure of the skin and subcutaneous fat over it is entirely reasonable but will lead to a planned ventral hernia.

The use of TAC in the BA is not well evaluated; however, if re-suturing of the fascia cannot be achieved due to adhesions, tension or intra-abdominal infection being present, the viscera need to be protected and treated as for an OA to prevent the development of EAF. NPWT can be safely extended to the BA. NPWT as a static technique has been described in the BA in a small number of retrospective series [640,641]. NPWT-MMFT as a dynamic technique to achieve fascial closure has also been described but the small patient numbers, retrospective studies with disease and patient heterogeneity do not allow any recommendation to be made [642,643].

Due to the critical condition of potential study participants and the heterogeneity of their clinical presentation, high quality randomized clinical trials in this field are uncommon. We anticipate further useful data from current trials recruiting patients [644].

ANORECTAL PROBLEMS

Introduction

Anorectal abscesses are common, with 18 000 patients affected annually in England [645]. English HES data show that a primary abscess has an incidence of 20/100 000 and are more common in men than women [646]. The location of the anorectal abscess may indicate a likely pathogenesis, with superficial 'perianal' abscesses arising from a superficial source and ischio-anal fossa and intersphincteric abscesses more commonly leading to fistula formation and probably arising according to the cryptoglandular hypothesis [647,648]. In patients presenting with an anorectal abscess, 2.8% will ultimately be diagnosed with Crohn's disease [646].

An anal fistula occurs, following primary anorectal abscess, in 17% of patients, usually within the first year (67%), and is more likely in patients with underlying IBD [646].

An anorectal abscess is a painful condition but the abscess is not always apparent to the patient or initial treating clinicians, and some patients are treated empirically with antibiotics or for other anorectal conditions (such as fissure or haemorrhoids) before the abscess is diagnosed. Intersphincteric abscesses seem to present earlier, with pain as the predominant symptom, whereas abscesses in the ischio-anal fossa may present later and with inflammatory or septic features as well as pain, perhaps due to the larger space within which the abscess may expand without meeting restrictive structures.

Acute anal fissures are longitudinal tears in the anal mucosa and present with symptoms of duration less than 6 weeks and without features of chronicity (visible internal sphincter fibres in the base of the wound, a hypertrophied anal papilla at the apex of the fissure (cephalad) and a sentinel tag at the caudad extent of the fissure). They cause pain, particularly during and after defaecation, and may also present with bright red rectal bleeding. The majority of anal fissures occur in the posterior midline with the anterior midline the second most common location, particularly in women. Multiple or lateral fissures should prompt a search for an underlying condition such as IBD or infective causes. Such atypical features will usually present in the chronic setting.

Haemorrhoids are common and often asymptomatic, but 30 000 interventions are nevertheless undertaken annually in the UK [649]. Prolapsing haemorrhoids are those which are likely to present acutely with pain, usually caused by strangulation or thrombosis. Management is usually conservative.

Rectal prolapse or procidentia is an intussusception of the rectum externally through the anal sphincter complex. It should be distinguished from an internal rectal intussusception and solitary rectal ulcer syndrome. Whether internal rectal intussusception and rectal

prolapse form a spectrum of conditions or are two separate conditions is still widely debated [650,651].

Although it is a benign condition, rectal prolapse can be debilitating, mainly due to the discomfort associated with the physical presence of the prolapse, passage of mucous and blood, together with the symptoms of faecal leakage and incontinence and on occasions constipation [652].

Rectal prolapse is most commonly seen at the extremes of age. In children it usually presents under the age of 4 years and is seen equally in boys and girls. The peak incidence in adults is in the seventh decade of life with in excess of 90% of cases occurring in women. Although it is seen less commonly in men, its age of incidence in men is under 40 years of age. It rarely presents as an emergency.

Anal fistula/abscess

Question 9.1

Which patients with perianal abscess/infection are at a higher risk of necrotizing soft tissue infections and should undergo expedited surgery?

Recommendation: Patients with diabetes, steroid use, immunocompromised, chronic renal failure, obesity, liver disease, peripheral vascular disease and intravenous drug abuse who have evidence of systemic sepsis should undergo surgery as soon as possible after institution of a Sepsis Six bundle including broad-spectrum antibiotic administration.

Level of evidence: III

Grade of recommendation: D

Consensus: 100% (SA 77.8%, A 22.2%)

Recommendation: Patients with perianal abscess/infection who are at risk of necrotizing soft tissue infections but without systemic sepsis should undergo surgery at the earliest opportunity once appropriately starved and prepared for theatre; this should include overnight.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 77.8%, A 22.2%)

NSTI, also known eponymously as Fournier's gangrene, carries a mortality of 7.5%–16% in population studies and can result in significant tissue loss, scarring and loss of function [653,654]. Early surgical intervention improves outcome. Systemic illness should raise the suspicion of NSTIs. Evidence of tissue crepitus, 'dishwater' discharge, visible ischaemia or a characteristic odour may be present in NSTI but may also be absent or hidden beneath cellulitic but not ischaemic skin initially. A high index of suspicion should be maintained, particularly in patients with risk factors such as immunosuppression or impaired microcirculation, diabetes, obesity and high alcohol intake [655].

Question 9.2

What is the immediate management of necrotizing soft tissue infections?

Recommendation: Immediate management of necrotizing soft tissue infections should include the use of a sepsis bundle, early broad-spectrum antibiotics, involvement of the critical care team and immediate wide surgical debridement.

Level of evidence: III

Grade of recommendation: D

Consensus: 100% (SA 88.9%, A 11.1%)

The treatment of NSTI is the immediate and complete debridement of all necrotic tissue. Early surgery has been shown to improve outcomes [656,657]. Management of the patient's systemic sepsis, including the use of a sepsis bundle and involvement of the critical care team, should occur immediately and continue during and after surgery but no delay to surgical intervention should occur. Frequent assessment, under general anaesthesia initially in most cases, will ensure early detection of the need for further debridement, which may be required two to three times during the hospital stay [655,657]. Defunctioning of the urinary system, with urethral or suprapubic catheter, or bowel with a bowel management system or surgical ostomy may be needed. High quality wound care, sometimes including negative pressure dressings and plastic surgical reconstruction, will be required in the aftermath of NSTI.

Question 9.3

When should imaging precede examination under anaesthetic in the acute presentation of anorectal abscess?

Recommendation: MRI imaging could be performed in the setting of 'occult' or recurrent anorectal abscess to identify anatomy and determine appropriate drainage.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100% (SA 66.7%, A 33.3%)

In general, anorectal abscesses can be clearly identified on clinical examination or during examination under anaesthetic (EUA). An MRI should not precede definitive incision and drainage in such a situation. However, occult abscesses, those undetectable on EUA, may be identified using MRI or endoanal US (the latter usually performed under anaesthetic to avoid pain). One retrospective case series highlighted the value of MRI in detecting and classifying occult anorectal abscesses in 13 patients [658]. The MRI enabled appropriate drainage either via the ischio-anal fossa or internally based on the location of the abscess relative to the levator ani muscle. Needle aspiration may aid localization of an abscess which is difficult to locate.

If symptoms continue after incision and drainage, further EUA may be of value. A more senior surgeon undertaking EUA may identify an unappreciated and undrained cavity. If the patient is well and urgent imaging can be obtained, this may aid identification of occult abscesses, but should not delay further EUA with evidence of systemic illness, spreading cellulitis or severe pain.

If no abnormality explaining the patient's symptoms is identified at EUA, MRI will exclude occult abscesses or aid localization.

Question 9.4

What is the optimal technique for drainage of perianal abscess?
Recommendation: Operative techniques that should be employed are as follows.

1. Create an aperture wide enough to facilitate drainage without the need for packing.
2. Loculations should be broken down and the full extent of the abscess cavity should be drained.
3. Use a circumanal incision rather than radial incision to avoid damage to the external sphincter complex.
4. Incisions to drain ischio-anal fossa collections should be placed as close to the external anal sphincter as possible (whilst occurring over the fluctuant swelling and allowing adequate drainage in order to avoid an unnecessarily long potential fistula tract).
5. There should be internal drainage of intersphincteric abscesses which do not reach the perianal skin and also of supralevator abscesses.
6. The use of drains (Malecot catheters, Yates/corrugated drains) is sometimes advocated for deeper cavities with narrow necks which are at risk of early skin closure.

Microbiology sampling is of limited value in the management of anorectal abscess and antibiotic use is not required in patients undergoing incision and drainage for uncomplicated anorectal abscess. A rigid sigmoidoscopy could be considered. It may detect underlying rectal inflammation.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 77.8%, A 22.2%)

There is very little evidence to recommend one drainage technique over another. Expert opinion supports all of the above techniques. Proctitis diagnosed at the time of EUA may point towards a diagnosis of Crohn's disease. Crohn's disease is present in 3% of patients undergoing drainage of a primary abscess in the UK [646].

Question 9.5

What is the optimal timing of surgery?
Recommendation: Evidence of necrotizing soft tissue infection—operate within 30 min. Evidence of systemic features or risk factors for necrotizing soft tissue infections (diabetes, systemic immunosuppression, systemic inflammatory response syndrome, cellulitis)—operate within 6 h of decision. If patient is systemically well with no features or risk factors for necrotizing soft tissue infections—operate within 24 h of decision.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 88.9%, A 11.1%)

Question 9.6

Should packing be used after drainage of perianal abscess?
Recommendation: There is insufficient evidence to recommend regular packing of perianal abscesses. Initial haemostatic packing can be used if there is bleeding. Dry dressing only can then be used.
Level of evidence: IV
Grade of recommendation: D/GP
Consensus: 100% (SA 77.8%, A 22.2%)

Traditionally, abscess cavities have been 'packed' (had internal dressings applied) after drainage of the abscess, to ensure that the aperture remains open until the cavity has healed by secondary intention.

A Cochrane review [659] identified two studies reporting 64 patients randomized to packing or external dressings. Quality of life data were not assessed in these studies and no difference was seen in abscess recurrence, fistula occurrence or time to wound healing between the groups.

The PPAC observational study identified that packing is painful and expensive [645]. German [660] and US [661] guidelines do not support packing. Some centres in the UK eschew packing in favour of wound digitation which can be practised by the patient, aiming to prevent premature closure of the wound but avoiding the pain and expense of packing. On discharge, patients should be given written advice to return to their GP for referral to a colorectal surgeon if they have persistent problems. Approximately 17% of patients who

undergo primary abscess drainage will re-present with a persistent discharge/recurrent abscess suggestive of an underlying fistula.

Question 9.7

Should an underlying fistula be sought and treated at the time of primary abscess drainage?
Recommendation: In a primary abscess, an internal opening should not be sought nor should treatment of the underlying fistula (including with seton insertion) be performed at the time of abscess drainage.
Level of evidence IV
Grade of recommendation B
Consensus: 100% (SA 88.9%, A 11.1%)

Traditionally, the frequency of fistula following abscess drainage was thought to be around 1 in 3. Recent data derived from the HES database suggests that this rate is 17% overall, 16% in patients without a diagnosis of IBD and 47% in those with Crohn's disease [646]. Two systematic reviews, one from the Cochrane library [662], have suggested that any fistula identified at the time of abscess drainage should be treated immediately, either by fistulotomy or by seton insertion, in order to prevent recurrent abscess and reduce the number of operations required to resolve the perianal sepsis, and that this practice is safe given only a modest risk of continence impairment seen across the five to six randomized trials of abscess drainage vs. immediate fistula treatment included in the two reviews.

However, in these trials internal openings (IO) were identified in 83%–100% of patients (two of the trials only enrolled and randomized patients in whom an IO was seen), whereas fewer than a third of patients treated with simple drainage went on to develop a fistula during study follow-up, including 14% and 25% of patients in the two trials with ubiquitous IOs. More than half of patients with an 'acute fistula' therefore required no fistula treatment, immediately or subsequently. These patients would be put unnecessarily at risk of the continence impairment associated with fistulotomy or of a persistent fistula if a seton was inserted.

The perceived benefit of reduction in number of operations and abscess/fistula recurrence applies to around a quarter of patients or fewer, since between 14% and 31% of patients in the drainage-only arm developed a fistula, and around 5% of patients in the immediate treatment arm developed a recurrent fistula even after fistulotomy.

The authors of these reviews considered that this benefit outweighed the risk of fistula treatment since the difference in continence between the two groups was non-significant in half of the studies and overall. However, the fistulotomy literature is clear and consistent in identifying a risk of continence impairment, usually to wind and minor soiling, associated with sphincter division. The risk is reported at various rates but has been consistently reported at a level of around one in three patients in some studies [663]. Some of the trials of immediate fistula treatment vs. abscess drainage alone did identify a significant difference in continence disturbance between the two arms. Given this, and in the context of the fistulotomy literature, the risk of continence impairment is likely to be higher than estimated in the two reviews, so the balance of risk and benefit upon which their recommendations are based is insecure.

Instead, in the context of primary abscess drainage, IO should not be sought and neither fistulotomy nor seton insertion (which also condemns the patient to the risks of future fistula treatment, or of lifelong fistula persistence) should be performed.

Postoperative antibiotics do not seem to prevent fistulas [664].

Question 9.8

Should an underlying fistula be sought and treated at the time of recurrent abscess drainage?
Recommendation: In recurrent abscesses, insertion of a seton should be the routine management of the underlying fistula, unless it is clearly superficial. An MRI is recommended if no fistula is found.
Level of evidence IV
Grade of recommendation GP
Consensus: 100% (SA 100%)

In the context of recurrent abscess in the same location, it has been demonstrated that the underlying fistula will not resolve spontaneously and should be treated. In active inflammation, appropriate assessment of fistula anatomy is more difficult and full assessment of the risk of continence impairment which would follow fistulotomy is more difficult, so seton insertion rather than immediate fistulotomy may be safer if there is any uncertainty.

Question 9.9

What, if any, investigation for underlying disease (e.g., Crohn's) should be undertaken after abscess drainage?
Recommendation: Crohn's disease should be considered in patients with risk factors for Crohn's disease, complex fistula or fistula presenting at a younger age. Investigations where the risk of Crohn's is thought to be elevated include faecal calprotectin, luminal investigation and histological analysis of perianal fistula biopsy specimens.
Level of evidence: IV
Grade of recommendation: GP
Consensus: 100% (SA 88.9%, A 11.1%)

There are limited data to support a recommendation in this area. Up to 5% of perianal Crohn's disease may be isolated and up to 10% of Crohn's disease may present with perianal symptoms. Recent HES data analysis found that luminal disease presented a median of 14 months later [646]. Risk factors for Crohn's disease including family history of IBD, complex fistula in younger patients and the presence of luminal symptoms should be sought. Options for identifying luminal disease include faecal calprotectin, colonoscopy and small bowel imaging. Isolated perianal Crohn's can be confirmed on the finding of granulomas in biopsy specimens. The frequency of this finding in confirmed Crohn's disease is unknown.

Fissure

Question 9.10

How should acute fissures be managed in the emergency setting?
Recommendation: Acute anal fissure should be managed using dietary modification and analgesia in the first instance, with a topical calcium channel blocker or nitric oxide donor added if symptoms do not settle.
Level of evidence II
Grade of recommendation B
Consensus: 100% (SA 77.8%, A 22.2%)

An anal fissure is a linear ulcer in the anoderm, most commonly found in the posterior or anterior midline. Acute fissures have an onset within 6 weeks of presentation and will not display features of chronicity such as sentinel tags or hypertrophied papillae. Most occur following mechanical trauma associated with constipation and straining at stool with sphincter spasm and relative ischaemia thought to contribute to persistence. Fissures in the presence of Crohn's disease are addressed in IBD guidelines.

A Cochrane review updated in 2012 considered non-surgical approaches to the management of acute (and chronic) anal fissures, based mostly on older studies examining high fibre diets and analgesia, or topical agents such as glyceryl trinitrate and calcium channel blockers [665]. US [666] and previous UK [667] guidelines have commented on the deficiency in evidence to support any specific management of acute anal fissures.

Some authors advocate early surgery (Botox or even sphincterotomy) in cases of severe pain [668], but the known risk of minor continence disturbance (up to 30%) and the recognized healing rate of acute fissures (around 50%) from simple measures do not support this approach.

In the 1980s, a high fibre diet was shown to induce healing in the majority of acute fissures [669] and reduce the recurrence if used as a maintenance therapy [670]. Dilators and more recently 'anal self-massage' (10 min of intra-anal digitation twice a day) are reported to reduce the pain of acute fissures and encourage healing but are not in regular use in the UK.

It is important to note that a patient presenting with anal pain without any obvious cause should undergo an EUA by an experienced surgeon.

Haemorrhoids

Question 9.11

How should acutely thrombosed piles be managed in the emergency setting?
Recommendation: Acutely thrombosed or strangulated haemorrhoids should initially be managed non-operatively in the majority of cases.
Level of evidence IV
Grade of recommendation D
Consensus: 100% (SA 100%)
Recommendation: In a very small number of patients who have ulcerated or ischaemic haemorrhoids a limited acute haemorrhoidectomy could be considered by an appropriately competent surgeon.
Level of evidence IV
Grade of recommendation D
Consensus: 100% (SA 66.8%, A 33.3%)

Haemorrhoids may become acutely thrombosed or strangulated and cause considerable pain. This is usually an acute event on a background of known haemorrhoidal disease and has a natural history with a peak of symptoms during the first week although symptoms may persist for much longer. The venous congestion and oedema associated with acute strangulation drive a conservative approach to management which includes bed rest, topical analgesia, ice packs, stool softeners and a myriad other interventions (warm baths, topical sugar, Trendelenburg position etc.).

Traditional and current advice tends to favour conservative management on the grounds of safety, since patients avoid the risks associated with acute haemorrhoidectomy. Whilst patients usually require further intervention when initially managed conservatively [671], options in the elective setting may include less invasive procedures.

In retrospective studies, bleeding and recurrence do not seem elevated after surgery in the emergency setting but anal stenosis may be more common [672,673]. A more limited approach of excision of the problematic pedicle and leaving the others (without the anal stretch advocated in the original paper from 1986) may be a safer approach when surgery is required [674], facilitating a more limited subsequent approach in the elective setting.

Whilst there is evidence to support acute limited haemorrhoidectomy, practice is generally centred around conservative management and that is the approach advocated within these guidelines. Factors which fall outside the remit of many interventional studies such as the training and seniority of surgeons staffing the Confidential Enquiry in Patient Outcome and Death (CEPOD) theatre which might undertake acute surgery, and the relative safety of an initial conservative approach with options for a less invasive definitive operation in the longer term, may drive a more conservative approach. Our recommendation is based on the principle that, whilst limited acute haemorrhoidectomy is safe, a more conservative initial approach can be followed safely in almost any setting and leaves options open for consideration at a later date by a patient who is not influenced by severe pain and strong analgesia.

Streptokinase suppositories have been compared with hydrocortisone suppositories for the treatment of acute haemorrhoids in a large randomized, non-blinded trial using mostly subjective outcomes such as pain, bleeding and lesion size. The streptokinase suppositories were markedly superior to hydrocortisone alone [675]. This practice is not widely used in the UK and all evidence comes from a single centre.

Haemorrhoidal bleeding in patients on direct oral anticoagulants or warfarin can usually be treated non-operatively, with appropriate advice from the haematology team regarding anticoagulant management. If surgery cannot be avoided because of persistent or life-threatening bleeding then a senior surgeon should be directly involved in any operative intervention. The recommendation would be to undertake the minimal effective procedure. This may be a simple suture rather than excision of a pedicle.

Rectal prolapse

Question 9.12

In the emergency setting how should rectal prolapse be managed?
Recommendation: Initial treatment should be non-operative. A prolapse can usually be reduced and if appropriate an early expedited procedure can be planned.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 66.7%, A 33.3%)

Rectal prolapse rarely presents as an emergency. Simple manual manipulation will often reduce a prolapse. If the prolapse has been 'out' for some time, however, then application of an osmotic substance, for example sugar [676], can help reduce swelling and aid the reduction of an incarcerated prolapse. Other substances frequently used include honey or caster sugar. Occasionally, these simple manoeuvres will result in resolution of the prolapse. However, in the majority of cases these are only temporizing and, in order to avoid frequent readmission, it is often pragmatic to expedite the prolapse repair within days of the presentation to the emergency surgical service.

Question 9.13

If emergency surgery for an acute rectal prolapse is necessary, what operation should be performed?
Recommendation: If emergency surgery is unavoidable, both abdominal and perineal approaches are appropriate. The operative approach should be tailored to the individual patient after a full risk assessment and discussion.
Level of evidence: IV
Grade of recommendation: D
Consensus: 100% (SA 77.8%, A 22.2%)

The operative approach will need to tailored to the individual patient, taking into account the patient's comorbidities, pre-existing bowel dysfunction and wishes. Laparoscopic ventral mesh rectopexy has been reported to be feasible and safe for emergency repair [677], although in all cases in this series the prolapse was always reducible and there were no cases of ischaemic or incarcerated bowel.

Perineal rectosigmoidectomy has also been reported for incarcerated prolapse [678,679]. All of the series reporting ES for rectal prolapse are small and so it is difficult to make a strong recommendation for one approach over the other.

POSTOPERATIVE PROBLEMS

Introduction

Complications are an inevitable consequence of surgery and are commonly seen after colorectal resections. The mortality of emergency and elective colorectal resection although improved in recent reports remains significant at 11% and 2% respectively [172].

Complications cause significant problems for patients in terms of morbidity and quality of life. Clinicians are also affected and complications can be the cause of guilt, burnout and distress. The healthcare system is impacted too. Organizations vary in their ability to manage complications. The term 'failure to rescue' means the failure to prevent a death resulting from a complication of medical care, underlying illness or surgery. 'Failure to rescue' is a measure of institutional competence in this context [680]. The proactive management of complications and the open and honest discussion of organizational contributing factors is one way of addressing this. In the event of a complication, either intra-operatively or postoperatively, then a second opinion from a colleague is strongly advised. Colleague support is all the more important if a patient requires surgical intervention for a complication. All cases in which complications have occurred should be discussed at local morbidity and mortality meetings.

This guideline aims to emphasize practice that will lead to the early recognition and effective treatment of complications.

Question 10.1

How should the surgeon deal with an intra-operative colorectal injury?

Recommendation: Primary repair can be performed if the injury is immediately recognized, the patient is haemodynamically stable and there is no or minimal localized contamination of the peritoneal cavity.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 66.7%, A 33.3%)

Recommendation: If there is gross peritoneal contamination or the patient is haemodynamically unstable bowel diversion is recommended. A bowel resection may also be necessary if there is concern regarding bowel viability.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

There is little high quality evidence on this topic and most of it is extrapolated from trauma literature [681]. If the intraperitoneal colorectal damage has occurred during an elective colorectal procedure, then asking for help and support from a colleague is advised. If the injury has occurred during surgery of a non-colorectal nature and a colorectal opinion has been requested, then the decision will be yours. The decision to be made is the same in both instances—is a primary repair appropriate or is a resection necessary?

If the injury requires resection then a primary anastomosis can often be performed safely. The decision to perform an anastomosis depends on the patient's comorbidity, the state of the tissues (mechanism and extent of the injury) and the presence or absence of any significant physiological disturbance at the time of assessment. Should the patient be unstable then the surgeon should revert to a damage limitation approach of haemorrhage control and elimination of contamination first before considering any form of precision repair. Definitive surgery made need to occur at a later time. If the tissues are unhealthy due to malignancy, diverticular disease or prior radiotherapy then diversion should be considered. This should also be the case if the patient is frail or has comorbidity with limited physiological reserve to deal with a further complication.

Rectal injury may occur in the context of prostatic resection. In these cases, failed recognition at the time of surgery may lead to rectourethral fistula. Successful sutured repair can be performed if the injury is recognized at the time. If there are any concerns regarding the physiological status of the patient then, again, a damage limitation approach should be followed with proximal faecal diversion, and rectal irrigation should be considered.

Rectal injuries that occur during any pelvic surgery and which are recognized are treated in the same manner.

Question 10.2

What are the indications for a postoperative CT scan?

Recommendation: A CT scan should be performed when the patient's recovery fails to follow the anticipated course and an intra-abdominal cause is suspected. It should only be omitted if the patient clearly needs immediate life-saving surgery.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100% (SA 77.8%, A 22.2%)

The postoperative recovery of patients should have a recognized and anticipated course. In elective colorectal patients this may be quite rapid with no ileus and only a mild perturbation of blood tests and minimal systemic inflammatory response. In emergency patients or those in whom there was an abscess or phlegmon in the index operation there is a higher chance of a significant inflammatory response in the postoperative period—a high index of suspicion is needed in these patients.

Simple bedside manoeuvres should be performed to exclude problems such as acute urinary retention, acute gastric dilatation or inadequate analgesia. Increased abdominal pain, signs of systemic sepsis and increasing inflammatory markers may indicate the need for a scan. The threshold for a scan should be lower in those who have had an anastomosis formed at the index operation.

A catastrophic complication in any patient is that of an anastomotic leak. This may affect any anastomosis. As already noted, the ESCP snapshot audit reported a rate of 14.3% for right-sided anastomoses [237]. There have been recent publications reporting the benefit of serial CRP measurements in the prediction of

anastomotic leak after anterior resection [682,683]. In the PREDICT study, a change in CRP level exceeding 50 mg/l between any two postoperative days had a sensitivity of 0.85 for detecting a leak and a high negative predictive value of 0.99 for ruling it out. A change in CRP concentration of more than 50 mg/l between either day 3 and 4 or day 4 and 5 after surgery had a high specificity of 0.96–0.97. In a separate study, Reynolds et al. [683] reported that a CRP value of 132 mg/l on postoperative day 5 had an area under the curve of 0.75, corresponding to a sensitivity of 70%, a specificity of 76.6%, a positive predictive value of 16.3% and a negative predictive value of 97.5%.

If there is clinical suspicion of an anastomotic leak, then a contrast-enhanced CT scan is recommended. It is sensitive for the presence of anastomotic leak indicated by the finding of air and/or fluid adjacent to the staple or suture line [684]; other findings include localized peritoneal enhancement and a 'gap' either in the staple line or in the mucosal enhancement at the anastomosis. The addition of enteric contrast, oral for right-sided anastomoses and rectal for distal anastomoses, improves diagnostic certainty for anastomotic leak when contrast is seen outside the bowel lumen [685,686]. However, it is important to appreciate that it is not infallible and has a significant false negative rate. Moreover, a false negative scan may lead to a delay in definitive management with disastrous results [687]. A CT scan should never be performed when the patient clearly needs emergency life-saving surgery. If there is any uncertainty then a second opinion from an experienced colleague should be sought. With the best will in the world it can be difficult for the surgeon who has created the anastomosis to remain wholly objective.

The ACPGBI and ASGBI produced a detailed document entitled 'Issues in professional practice: prevention, diagnosis and management of colorectal anastomotic leakage', March 2016 [688]

Link: Prevention, Diagnosis and Management of Colorectal Anastomotic Leakage

There is some evidence that CT scans are more useful if performed later in the recovery period. This appears to be the case with the detection of a walled off abscess which is usually a later complication. In the first 72 h following surgery CT is of less use and patients who are seriously unwell at this time should be re-explored. CT should not be used for the diagnosis of postoperative bleeding unless it is anticipated that this is to be treated by interventional radiological techniques.

In addition to an anastomotic leak, other iatrogenic injuries can befall the colorectal surgeon, in particular ureteric and vascular injuries. Preoperative planning and liaison with the appropriate specialist, either a urologist or vascular surgeon, in cases where the ureters or vascular structures will be at risk during surgery is paramount in order to minimize the likelihood of inadvertent damage. This may be possible in some ES cases. However, in the majority of cases these injuries occur unexpectedly.

The European Association of Urology list surgery for diverticulitis, cancer and endometriosis together with redo surgery and prior radiotherapy as the highest risk groups [689]. However, the ureter is at risk in all abdomino-pelvic surgery. The commonest site of injury is the pelvic ureter. Prophylactic stenting does not prevent ureteric injury but does help with localization of the ureter [689]. If a ureteric injury is identified at the time of surgery then direct input by a urologist is recommended. If possible, immediate reconstruction gives the best long-term outcome for the patient.

However, if a ureteric injury is not identified at the time but suspected in the postoperative period (urine in drain, worsening renal function together with abdominal pain and sepsis), then a CT abdomen and pelvis with intravenous contrast and a delayed urographic phase is the investigation of choice [690]. A delayed diagnosis of ureteric injury results in increased complications, both short and long term [691].

There is virtually nothing in the literature regarding major vascular injury during non-vascular abdomino-pelvic surgery. In the case of inadvertent vascular injury, the help of a vascular surgeon is recommended. Most of the UK is served by regional vascular networks and so the help and input from a vascular specialist should be available.

Link: Guidelines for the management of urological trauma

Question 10.3

What measures may reduce postoperative ileus following abdominal surgery?

Recommendation: Minimally invasive surgery and reduction in visceral inflammation may reduce postoperative ileus. Early feeding is of uncertain benefit. Trials in this area are ongoing.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 66.7%, A 33.3%)

Postoperative ileus is a common problem after major abdominal surgery. Its causes are multifactorial. Peritoneal and bowel inflammation, anaesthetic and opiate analgesic drugs, fluid and salt overload, preoperative starvation and lack of mobility may all contribute. Many measures have been trialled in an attempt to reduce ileus. Carbohydrate pre-loading, minimally invasive surgery, multimodal analgesia to minimize the use of opiate analgesia, lidocaine infusion, early mobilization, chewing gum, prokinetic agents such as metoclopramide and erythromycin and the use of μ-opioid receptor antagonists such as alvimopan have all been used [692]. Some of these have shown benefits including chewing gum but the trials are all small and the evidence is not of high quality [693]. Lidocaine infusion and prokinetic agents have not been shown to have any benefit on return to normal gut function [694]. Alvimopan has been shown to reduce

length of stay and time to return of bowl function in patients undergoing cystectomy and reconstruction although this has not been shown in a trial in colorectal or general surgery patients.

Question 10.4

When should total parenteral nutrition be started in a patient with postoperative ileus?

Recommendation: Total parenteral nutrition should usually be given when the patient has had a non-functioning gut for over 7 days. This should include the period of preoperative starvation. A formal nutritional assessment of the patient is essential.

Level of evidence: II

Grade of recommendation: B

Consensus: 100% (SA 77.8, A 22.2%)

Malnutrition and weight loss are associated with higher risks of surgical complications. Whilst total parenteral nutrition (TPN) may deliver a patient's metabolic needs it brings its own complications and trials do not show any benefit from starting TPN early. It is essential, however, to consider the duration of preoperative starvation and the likely timing of resumed gut function. In many cases where there has been a prolonged degree of preoperative starvation, for example due to an impending obstruction, the duration of starvation may be much longer than simply the time from operation to resumption of normal gut function. A formal assessment of the patient's nutritional status is essential. It is preferable to give nutritional supplementation enterally rather than by TPN as this is cheaper and, in some trials, has been associated with lower risks of infection [695]. Parenteral nutrition may be given to supplement inadequate enteral nutrition. It is not recommended to start TPN unless it is likely to be needed for a full 7 days [696].

Question 10.5

When should patients undergo reoperation for postoperative small bowel obstruction?

Recommendation: If small bowel obstruction occurs within the first 24 h of the index operation then re-laparoscopy or re-laparotomy will often identify a definitive cause that requires surgical correction. If proven mechanical small bowel obstruction is identified later and it fails to settle with non-operative management, then surgery should be considered, accepting that there is an increased risk of small bowel injury.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 77.8%, A 22.2%)

In the patient who has not recovered bowel function postoperatively, mechanical obstruction needs to be considered as a possible cause. This may be due to adhesions but an incisional hernia, internal herniation through a mesenteric defect and parastomal hernia should always be considered. In cases of a laparoscopic index procedure, port site hernias (especially with a 12-mm port) can and do occur early in the postoperative period. Surgery is nearly always necessary in cases where there is an obstructed hernia, in order to prevent strangulation and bowel injury. CT scanning will clearly diagnose most of these cases. In cases where there is an equivocal obstruction administration of water-soluble contrast and an abdominal film after 4 h may help to determine if there is a complete mechanical obstruction [697]. Proven mechanical small bowel obstruction that fails to settle with non-operative management is likely to require surgery. After 2 weeks, the degree of inflammation and adherence particularly after open surgery may make reoperation very hazardous due to the risk of visceral injury [698], in particular small bowel. In this situation nasogastric drainage, TPN and careful operative planning is necessary (daytime CEPOD activity, adequate time, direct consultant supervision or dual consultant operating). A second opinion from an experienced colleague is always useful and should be sought when there is uncertainty. A discussion with a regional intestinal failure unit is also an option.

Question 10.6

When is it safe to discharge patients following colorectal surgery?

Recommendation: Discharge should be goal directed and is likely to be safe in a patient who is tolerating free oral fluids ± diet, has normal vital signs and satisfactory blood results, in particular a CRP <125 mg/l on day 3 postoperatively. Earlier discharge may be safe provided that there are adequate contingency plans for early review in the event of an unexpected deterioration.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 88.9%, A 11.1%)

Despite the advent of enhanced recovery after surgery and minimally invasive surgery the median length of stay for elective colorectal surgery patients in the NHS remains high at 7 days in the National Bowel Cancer Audit annual report 2019 [699]. The most feared postoperative complication for the colorectal surgeon is anastomotic leak and this is predominantly a late phenomenon occurring after 3 days. A more commonly experienced complication is that of an SSI. Enhanced recovery programmes in most hospitals can mean that patients may be discharged home before an anastomotic leak or SSI becomes clinically apparent or problematic. As discussed previously the diagnosis of a leak depends on clinical features (increased pain, ileus, signs of sepsis and abnormal laboratory results). The intolerance of oral intake on day 1 postoperatively is a strong risk factor for

further problems. At day 3 postoperatively a CRP <125 has a good negative predictive value for leak [700]. The combination of clinical features and CRP should allow for early discharge on day 3. Earlier discharge is possible and even same day discharge has been described following colorectal surgery [701]. Whatever day the patient is discharged on, there needs to be a clear contingency plan in the event of poor progress after discharge. This means that the patient must be able to be reassessed by a sufficiently qualified surgeon, to undergo CT scanning and reoperation in a timely fashion. Local arrangements need to be robust and patients need a clear plan of who to contact or what to do in the event of poor progress.

Emergency colorectal surgery by its very nature is associated with a high incidence of SSI. The ongoing SUNRISE study is looking at the role of negative pressure dressings and the ROSSINI 2 trial at the impact of three interventions either individually or in combination on SSI.

Link: SUNRISE study

Link: ROSSINI 2 study

Question 10.7

How should rectal bleeding that occurs after a colorectal resection be managed?

Recommendation: Postoperative rectal bleeding will usually settle spontaneously. If not, then it may be treated safely and successfully by an experienced therapeutic colonoscopist without damage to the anastomosis.

Level of evidence: III

Grade of recommendation: B

Consensus: 100% (SA 77.8, A 22.2%)

Rectal bleeding is seen in a small but significant number of patients following colorectal resection. It is usually from the anastomosis. The reported numbers vary from 0.3% up to 6.4% [702]. A significant number of these may settle spontaneously and may not need intervention or blood transfusion [703]. In those patients that have ongoing bleeding and need intervention, endoscopic control of the bleeding point may be achieved successfully by injection of adrenaline, clipping or by haemostatic spray [704]. There are inevitable concerns that endoscopic intervention may disrupt the anastomosis; however, this seems infrequent in the hands of expert therapeutic colonoscopists. Surgery is usually not required unless endoscopic means fail or if there are signs of failure of the anastomosis at endoscopy. Angiography and embolization have been described in this situation. There are concerns that whilst stopping the bleeding this may render the anastomosis ischaemic.

Question 10.8

Should all colonoscopic perforations be treated by operation?

Recommendation: Colonoscopic perforations can be treated non-operatively in the absence of signs of generalized peritonitis. Regular reassessment is needed. In patients with evidence of peritonitis, urgent surgery, either laparoscopic or laparotomy, is recommended.

Level of evidence: III

Grade of recommendation: C

Consensus: 100% (SA 100%)

Perforation is an infrequent but potentially fatal complication of colonoscopy. Its incidence in diagnostic colonoscopy is between 0.016% and 0.2%. It is more commonly seen in patients undergoing therapeutic colonoscopy, with an incidence up to 8%. The highest risk factors are larger lesions sited in the right colon [705]. Lower BMI, increased age and previous surgery are additional risk factors. Some patients develop a post polypectomy coagulation syndrome, where a full thickness burn of the colonic wall has occurred at the time of the index colonoscopy, and this may result in pain, leucocytosis and sepsis without overt perforation. These symptoms can develop anywhere from a few hours to several days later [706]. Extraperitoneal perforations of the colon may result in similar symptoms as those seen in the post polypectomy syndrome with significant extraluminal air on cross-sectional imaging. This may be retroperitoneal, mediastinal or subcutaneous and has been described as a pneumothorax. Early recognition of a perforation is important as delay to definitive treatment is associated with a worse outcome [707]. Units should have a well-defined pathway for urgent surgical assessment of those patients who have suffered a perforation or if they develop symptoms days after the index colonoscopy, particularly if they have had a high risk procedure. In the event of acute abdominal symptoms, a CT is essential to identify or exclude perforation.

Approximately 50% of colonoscopic perforations may be treated non-operatively [708], with antibiotics and close observation. This is particularly the case if there is no evidence of peritonitis, systemic sepsis or free intraperitoneal fluid on CT. However, failure of initial non-operative management has been associated with poor outcome. Therefore, if there is any doubt, the patient should be explored to avoid undertreatment of the development of multiorgan failure. The surgical approach will be determined in part by the nature of the injury, but both laparoscopic and open approaches may

be used. Clean injuries may be repaired primarily as described above for intra-operative colonic injuries. Injuries with delayed recognition or in which there is significant contamination may need to be exteriorized. Whilst the main consideration is the immediate stabilization of the patient, the pathology of the lesion that has been removed at the time of the index colonoscopy may have a bearing. For example, if a complex polyp has a focus of cancer or is incompletely excised necessitating a resection it may be best to do it whilst treating the perforation rather than later. Knowledge of the colonoscopy and the histology result of any resected polyp will therefore be helpful, if it can be obtained.

EMERGENCY SURGERY DURING PREGNANCY

Introduction

Pregnant women frequently present to general surgical teams with abdominal pain and some of them will require surgery. The risks directly attributable to surgical intervention are miscarriage in early pregnancy or premature labour. However, the surgical pathology itself has similar or worse risks. Pregnancy does not obviate the need for ES but it raises the stakes and calls for careful multidisciplinary decision-making, communication and planning. A fully informed consent process is mandatory.

Question 11.1

Which imaging modalities can be used in the acute abdomen in pregnancy?
Recommendation: Ultrasound and MRI are safe at all stages in pregnancy. CT should only be used in emergency situations after multidisciplinary discussion.
Level of evidence: III
Grade of recommendation: B
Consensus: 100% (SA 100%)

Pregnant patients commonly present to surgical teams with abdominal pain. It is important that all women of child bearing age presenting with abdominal pain have pregnancy excluded on the basis of urinary beta human chorionic gonadotropin. Those who are pregnant should have the diagnosis of an ectopic pregnancy excluded by US. US has no known risk in pregnancy [709]. MRI also is safe [710]. There are few human data regarding the use of gadolinium-based contrast agents in pregnancy. Current available data are reassuring but gadolinium-based contrast agents should not be used in pregnancy unless the clinical condition of the patients makes their use absolutely necessary [711]. Radiation has both deterministic and stochastic effects on the foetus. Deterministic effects are those of tissue damage which can result in foetal death, growth retardation and learning difficulties. These do not occur below a dose of 100 mGy. Stochastic effects such as teratogenesis or childhood leukaemia may result from damage to individual cells. The risk is increased at higher doses. For a chest X-ray the exposure of 0.01 mGy leads to a very small increased risk of 1 in 1 000 000. For a CT of chest abdomen and pelvis the exposure of 50 mGy leads to a doubling of the background childhood cancer risk to 1:200. Any decision to use CT should therefore be taken only if absolutely necessary. A fully informed discussion with the patient (and partner) and a clinical radiologist and full exploration of alternative imaging techniques are all essential.

Question 11.2

Can emergency surgery be carried out safely during pregnancy?
Recommendation: Emergency surgery during pregnancy has small increased risks for both the mother and foetus which need to be balanced against the risks of not treating the surgical problem. When surgery cannot be delayed, careful discussion with the patient and partner together with agreed shared decision-making between the obstetric, neonatal, surgical and anaesthetic teams is essential.
Level of evidence: III
Grade of recommendation: B
Consensus: 100% (SA 88.9%, A 11.1%)

Surgery in pregnancy may be complicated by miscarriage in the first trimester or later by premature labour. This risk is small. In a UK cohort study of 6.5 million operations performed during pregnancy there was an increased risk of one extra stillbirth for every 287 operations and one additional preterm delivery for every 31 operations [712]. The condition which requires surgery may itself risk the health of both mother and foetus. In the case of appendicitis, it has been found that non-operative management is associated with higher rates of peritonitis, sepsis and venous thromboembolism compared with surgery. Appendicitis is associated with a higher risk of preterm labour, abortion and caesarean section compared with normal pregnancies. However, the risk of preterm labour is higher in those with a diagnosis of appendicitis who are treated non-operatively compared with those who are treated by surgery [713]. Recent trials in non-pregnant patients have identified a group of patients with uncomplicated appendicitis on CT who may be treated non-operatively. This approach may be hazardous in pregnancy especially as CT should not be used. It is difficult to be exact about the magnitude of the risk in

conditions less common than appendicitis. In these cases, careful shared decision-making is mandatory. In patients who have a viable foetus there should be both neonatal and obstetric teams available on site in the event of the preterm labour or if there is a need for emergency caesarean section. Tocolytic drugs should not be given routinely unless the patient goes into labour. Those patients in the third trimester should be managed on their left-hand side to minimize compression of the vena cava [714]. These patients need prophylaxis against venous thromboembolism.

Question 11.3

Is laparoscopy safe during pregnancy?
Recommendation: Laparoscopy can safely be performed during pregnancy. However, it should be performed by an experienced laparoscopic surgeon, ideally one who has experience of operating at all stages of pregnancy.
Level of evidence: III
Grade of recommendation: B
Consensus: 100% (SA 77.8%, A 22.2%)

There are concerns that laparoscopic surgery may be associated with higher rates of pregnancy loss than open appendicectomy. It has also been observed that pneumoperitoneum causes foetal hypoxia in pregnant ewes. This has not been observed in humans and the most recent studies have shown no increased risk with laparoscopy. No difference in preterm labour was observed in a large Australian study of 1024 mothers who underwent appendicectomy during pregnancy [715]. Differences in previous studies may well be explained by the fact that laparoscopy may be used more frequently in early pregnancy where rates of miscarriage are higher.

During later pregnancy the height of the fundus should be carefully assessed whilst planning the point of trocar insertion and may need to be supraumbilical. There is no evidence that an open Hasson or closed Veress needle approach is superior but the surgeon must be confident and safe with the particular technique [715,716].

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CONFLICT OF INTEREST

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