







The Association of Coloproctology of Great Britain and Ireland consensus guidelines in surgery for inflammatory bowel disease

S. R. Brown¹ , N. S. Fearnhead² , O. D. Faiz³ , J. F. Abercrombie⁴ , A. G. Acheson⁴ , R. G. Arnott⁵ , S. K. Clark³ , S. Clifford⁶ , R. J. Davies² , M. M. Davies⁷ , W. J. P. Douie⁸ , M. G. Dunlop⁹ , J. C. Epstein¹⁰ , M. D. Evans¹¹ , B. D. George¹² , R. J. Guy¹² , R. Hargest⁷ , A. B. Hawthorne⁷ , J. Hill¹³ , G. W. Hughes⁸ , J. K. Limdi¹⁴ , C. A. Maxwell-Armstrong⁴ , P. R. O'Connell¹⁵ , T. D. Pinkney¹⁶ , J. Pipe⁵ , P. M. Sagar¹⁷ , B. Singh¹⁸ , M. Soop¹⁰ , H. Terry¹⁹ , J. Torkington⁷ , A. Verjee⁵ , C. J. Walsh²⁰ , J. H. Warusavitarne³ , A. B. Williams²¹ , G. L. Williams²² , R. G. Wilson⁹ ,

ACPGBI IBD Surgery Consensus Collaboration

¹Sheffield Teaching Hospitals NHS Foundation Trust, Sheffield, UK, ²Cambridge University Hospitals NHS Foundation Trust, Cambridge, UK, ³St Mark's Hospital, Middlesex, Harrow, UK, ⁴Nottingham University Hospitals NHS Trust, Nottingham, UK, ⁵Patient Liaison Group, Association of Coloproctology of Great Britain and Ireland, Royal College of Surgeons of England, London, UK, ⁶IA, Danehurst Court, Rochford, UK, ⁷University Hospital of Wales, Cardiff, UK, ⁸University Hospitals Plymouth NHS Trust, Plymouth, UK, ⁹Western General Hospital, Edinburgh, UK, ¹⁰Salford Royal NHS Foundation Trust, Salford, UK, ¹¹Morrison Hospital, Morrison, Swansea, UK, ¹²Oxford University Hospitals NHS Foundation Trust, Oxford, UK, ¹³Manchester Foundation Trust, Manchester, UK, ¹⁴The Pennine Acute Hospitals NHS Trust, Manchester, UK, ¹⁵St Vincent's University Hospital, Dublin, Ireland, ¹⁶University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK, ¹⁷Leeds Teaching Hospitals NHS Trust, Leeds, UK, ¹⁸University Hospitals of Leicester NHS Trust, Leicester, UK, ¹⁹Crohn's and Colitis UK, St Albans, UK, ²⁰Wirral University Teaching Hospital NHS Foundation Trust, Arrowe Park Hospital, Upton, UK, ²¹Guy's and St Thomas' NHS Foundation Trust, London, UK, and ²²Royal Gwent Hospital, Newport, UK

Received 20 June 2018; accepted 17 September 2018

Abstract

Aim There is a requirement of an expansive and up to date review of surgical management of inflammatory bowel disease (IBD) that can dovetail with the medical guidelines produced by the British Society of Gastroenterology.

Methods Surgeons who are members of the ACPGBI with a recognised interest in IBD were invited to contribute various sections of the guidelines. They were directed to produce a procedure based document using literature searches that were systematic, comprehensible, transparent and reproducible. Levels of evidence were graded. An editorial board was convened to ensure consistency of style, presentation and quality. 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 2 votes were included in the guidelines.

Results All aspects of surgical care for IBD have been included along with 157 recommendations for management.

Conclusion These guidelines provide an up to date and evidence based summary of the current surgical knowledge in the management of IBD and will serve as a useful practical text for clinicians performing this type of surgery.

Keywords Inflammatory bowel disease, Crohn's disease, ulcerative colitis, surgery, consensus, clinical guideline

Correspondence to: Professor Steven R. Brown, Sheffield Teaching Hospitals NHS Foundation Trust, Herries Road, Sheffield S5 7AU, UK.
E-mail: steven.brown@sth.nhs.uk

Contents	
Introduction	1
Methodology	2
1 General principles in IBD surgery	3
2 Small bowel surgery in Crohn's disease	8
3 Ileocaecal resection in Crohn's disease	11
4 Colectomy for IBD	16
5 Proctectomy and proctocolectomy	27
6 Ileoanal pouch surgery	29
7 Ileorectal anastomosis	36
8 Continent ileostomy – the Kock pouch	39
9 Surgery for perianal Crohn's disease	45
10 Rectovaginal and pouch–vaginal fistula	51
11 Duodenal Crohn's disease	55
12 Surgery for recurrent ileocaecal Crohn's disease	57
13 Revision and excision pouch surgery	60
14 Intestinal failure in IBD	65
15 IBD surgery in adolescents and transition	71
16 Surgery for IBD in pregnancy	73
17 Modes of delivery in pregnant women with IBD	78
18 Impact of medication on surgery for IBD	81
References	86

Introduction

Although guidelines exist for the surgical management of inflammatory bowel disease [1–3] there are areas of practice that are not covered in detail. The British Society of Gastroenterology (BSG) have taken the view that there should be an expanded and updated version of the guidelines for medical management that is particularly relevant to a UK audience. These BSG guidelines will have some input from the surgical community but there was an opportunity to expand the surgical component. The Inflammatory Bowel Disease (IBD) Clinical Advisory Group of the Association of Coloproctology of Great Britain and Ireland (ACPGBI) have therefore commissioned a set of guidelines focusing specifically on surgery for adults and adolescents with IBD. The guidelines are procedure-based and are intended to dovetail with the BSG's comprehensive medically focused guidelines. The primary objective here is to provide detailed evidence-based guidelines on the surgical management of IBD for the target audience of colorectal surgeons practising in Great Britain and Ireland.

Methodology

The Editorial Board was convened to ensure consistency of style, presentation and quality across all the guidelines. The guidelines adhere to the published ACPGBI guidelines on consensus statements [4] and concentrate

on surgical aspects of IBD management. Each section was written around either a procedure or a specific situation. Authors were selected who are members of ACPGBI and who have recognized expertise in the management of IBD.

Specific consideration was given where possible to indications for surgery and patient selection, technical aspects of surgery, perioperative care, complications and their management, and long-term outcomes. Concerns about format and approach were discussed with the Editorial Board. Searches for evidence in the literature were systematic, comprehensive, transparent and reproducible. Each author was asked to provide a set of recommendations which was evidence-based and unambiguous for submission to the editorial group for review. Consensus statements were refined and collated by the Editorial Board.

The recommendations were then submitted to the entire colorectal expert panel, as well as representatives from the BSG (ABH, JKL), charitable representatives from Crohn's and Colitis UK (HT) and IA (the ileostomy and internal pouch support group) (SC), ACPGBI patient representatives (RGA, JP, AV) and a consultant gynaecologist and obstetrician (GWH). 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. ACPGBI members were obliged to vote on all consensus statements. All other participants were given the right to abstain on any guideline if they wished. Patient representatives were specifically invited to comment on any issues of which they had knowledge or experience. The consultant obstetrician and gynaecologist representative only voted on Sections 16 and 17.

The level of evidence and grading for each recommendation [5] are listed in Tables 1 and 2.

These guidelines represent ongoing work from the period October 2016 to March 2018. We hope that they will provide an updated and evidence-based summary of the current surgical knowledge in the management of IBD and will serve as a useful practical summary for clinicians practising in this area.

General principles in IBD surgery

Both ulcerative colitis and Crohn's disease are characterized by chronic inflammation of the gastrointestinal system in individuals with a genetic predisposition

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 nonexperimental 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

who have been exposed to risk factors in their environment, possibly linked to industrialization [6]. The most recent systematic review studied the worldwide incidence and prevalence of IBD, collating data from 147 studies [7]. The incidence and prevalence of IBD is highest in North America and Europe, with the highest prevalence of ulcerative colitis in Norway (505 per 100 000 population) and the USA (286 per 100 000) and of Crohn's disease in Germany (322 per 100 000) and Canada (319 per 100 000) [7]. Although most recent studies concur that the incidence and prevalence of IBD has stabilized in most Western populations, there is a steady overall increase globally [7–9]. Incidence has been rising particularly in the newly industrialized countries of Africa, Asia, Oceania and South America, with a global prevalence now surpassing 0.3%, which represents a significant health burden [7].

Multidisciplinary management of patients with IBD

A multidisciplinary approach is essential to achieving good outcomes for patients with IBD [10,11]. The multidisciplinary team should function well in all settings where IBD patients have contact: community, outpatient clinics and ward-based care in elective and emergency circumstances. Definition of the IBD multidisciplinary team is comprehensively covered in the IBD Standards [12] and National Institute of Health and Care Excellence (NICE) Quality Standard 81 [13]. The same NICE Quality Standard also recommends that 'People having surgery for inflammatory bowel disease have it undertaken by a colorectal surgeon who is a core member of the inflammatory bowel disease multidisciplinary team' [13]. Integration of specialist nurses for counselling, support and clinical expertise is essential

[14,15]. The multidisciplinary team should ideally be sufficiently flexible to accommodate the needs of individual patients and may be extended as required. There is increasing recognition among healthcare professionals that psychological distress [16–18], fatigue [19] and pain [20] must be addressed alongside physical symptoms in patients with IBD.

Statement 1.1

Patients with IBD should be managed in a coordinated fashion within a multidisciplinary team including IBD gastroenterology, colorectal surgery, specialist nursing, stoma therapy, gastrointestinal and interventional radiology, pathology, nutrition support and other specialities according to their individual needs.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.1% (SA 85.7%, A 11.4%)

Ulcerative colitis and Crohn's disease are both characterized by relapsing and remitting symptoms, affecting patients in different ways at different stages of the disease and with variation in severity. Management involves combinations of medical and surgical treatments, each with their own risk–benefit profile. It is therefore imperative that the wishes of individual patients are incorporated in decisions about their care, preferably in the presence of a multidisciplinary team [21–23]. Communication among members of this multidisciplinary team is essential to ensure timeliness of escalation in medication, admission when required and management of surgical complications [10]. Self-monitoring by patients shows considerable promise, particularly when coupled with central monitoring of changes in their disease state [24].

Statement 1.2

Patients with IBD should be involved in decision-making about their care to ensure acceptability of treatment options and potential complications, realistic expectations and optimal outcomes.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 88.6%, A 11.4%)

Statement 1.3

Service provision for IBD patients should prioritize effective communication between teams, including combined clinics and inpatient ward rounds, and co-location of services.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 91.4% (SA 54.3%, A 37.1%)

The chronicity of IBD means that patients may require multiple endoscopic and radiological investigations. Where possible, imaging modalities that do not involve ionizing radiation should be used: ultrasonography and especially magnetic resonance imaging (MRI) offer high diagnostic accuracy [25]. Computed tomography (CT) is increasingly used to inform and direct management, especially in the emergency setting [26]. A recent meta-analysis concluded that 11% of patients with Crohn's disease and 2% of patients with ulcerative colitis received potentially harmful levels of radiation exposure, with patients requiring surgery being at particularly high risk [27]. Modern CT techniques to minimize radiation dose should ideally be employed when CT is required in IBD patients [28]. Where young patients may need multiple investigations over time, particularly with CT, the use of radiation diaries is advisable to minimize radiation exposure and associated radiation-induced cancer risk [25].

Statement 1.4

Radiation-free imaging techniques are preferable when investigating patients with IBD. Judicious use of computed tomography (CT) may be necessary to guide management, particularly in emergency situations.

Level of evidence: I

Grade of recommendation: A

Consensus 97.0% (SA 2.4%, A 54.5%)

Surgeons should also be aware that surgical intervention may interrupt the normal arrangements for follow-up of patients with IBD. Given the ongoing requirement

for gastroenterological input in the care for the majority of IBD patients, in order to ensure appropriate medical prophylaxis and stratification of patients to identify those at highest risk of recurrence [29], allow multimodal decision-making [30] and minimize the impact of ongoing problems after surgery [31], it is deemed best practice to ensure adequate gastroenterological follow-up or involvement after surgical intervention.

Statement 1.5

In addition to postoperative surgical review, follow-up with a gastroenterologist or gastroenterology advice should be arranged for all patients after IBD surgery where required.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 94.3% (SA 51.4%, A 42.9%)

Relationship between volume and outcomes in IBD surgery

Inflammatory Bowel Disease is relatively uncommon in the general population and many clinicians may have relatively little experience of managing patients with IBD. It is therefore perhaps not surprising to find that there is a volume–outcome relationship in several aspects of managing patients with IBD, and that there is a trend towards concentrating management of IBD patients in higher-volume centres [32].

Volume becomes especially important when the risks of surgical intervention for IBD are considered. High-volume centres have lower mortality rates after colectomy for acute severe colitis [33] and primary ileocaecal resection in Crohn's disease [34]. Similar associations for mortality after emergency IBD surgery have also been demonstrated in other healthcare systems [35].

In elective pouch surgery, lower-volume units tend to have a longer length of stay and higher pouch failure rates [36]. Managing complications proactively requires experience, but this is difficult to accumulate at either individual surgeon or institutional level, given the extremely low volumes of pouch procedures carried out at the majority of institutions in the UK [37,38]. There is also significant variation among centres in other outcomes after pouch surgery, including rates of laparoscopic approach, undiverted pouch surgery, reoperation and readmission [38,39]. Overall, high-volume centres are also more likely to offer a variety of restorative options in well-selected patients [40].

Evidence from qualitative research on patient experience in centralized stroke and cancer services suggest

that the disadvantage of travelling further was outweighed by the opportunity to receive best care [41,42]. In cancer care, patients were willing to travel 75 min longer to reduce their risk of complications by 1% and over 5 h longer to reduce their risk of mortality by 1%. [42]. The same principle will undoubtedly be true for IBD patients accessing IBD services.

While some low-volume centres may undoubtedly offer high-quality care, this is normally dependent on a few individuals with expertise. More commonly, high-volume centres tend to concentrate institutional experience of not just the surgical procedure but also knowledge of when and how to manage postoperative complications or long-term functional problems [43]. Just making the correct diagnosis may improve patient outcomes; the ability to differentiate between peripouch sepsis and pouchitis is one such example [44].

Statement 1.6

Patients undergoing surgery for IBD tend to have better outcomes in high-volume centres. In the absence of local expertise, patients requiring either elective or urgent surgery should be referred to a specialist unit.

Level of evidence: IV

Grade of recommendation: GP

Consensus 94.3% (SA 57.1%, A 37.1%)

The volume–outcome relationship becomes even more important when dealing with rare manifestations or uncommon complex procedures. Patients with complications of IBD surgery including anastomotic leak, enterocutaneous fistula, chronic pelvic sepsis and pouch–vaginal fistula are likely to achieve better outcomes if they are referred to a specialist centre with sufficient experience and expertise in managing complications [45] and minimizing impact on patients' quality of life. Most IBD clinicians will have limited experience of patients who are adolescents [46], require revision surgery [47] or are considering complex procedures such as continent ileostomy [48] or surgical repair of Crohn's rectovaginal fistula [49]. In these circumstances, the treating clinician should ideally consider onward referral to a centre with subspecialist expertise in the required area.

Statement 1.7

Consideration of referral to a unit with specialist expertise should be considered for IBD patients with complex or recurrent disease, including revision and excision pouch surgery, rectovaginal fistula, Kock pouch and in adolescence.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 94.3% (SA 91.4%, A 2.9%)

Optimization of the IBD patient and timing of surgery

Timing of surgery for IBD patients is crucial in emergency and elective situations. A patient admitted with acute severe colitis may avoid colectomy due to increasing advances in medical therapy [50], but may also face increased risk of morbidity and mortality due to poorly judged delays in proceeding to colectomy when failing to respond with poor prognostic factors [35,51]. A particular case for early referral for consideration for colectomy may be made in the frail patient with multiple comorbidities who, while not necessarily a good candidate for surgery, nevertheless still has much less reserve to withstand further deterioration after prolonged attempts at medical salvage [52,53].

Optimizing the IBD patient for elective surgery requires resolution of sepsis after radiological intervention and antibiotic therapy, reversal of nutritional depletion and reducing or eliminating immunosuppressant (especially steroid) use while maintaining disease quiescence. Surgery should then be timed to coincide with the small window of opportunity when these ideals are met, and certainly prior to further deterioration from loss of disease control [54]. Multidisciplinary management of patients with fistulating perianal Crohn's disease poses particular challenges, as optimal therapy involves integration of surgical drainage of abscesses with seton insertion followed by initiation and then optimization of biological therapy, which in turn are followed by attempts at fistula healing in selected patients [55,56]. The median time from presentation of symptoms to initiation of biological therapy is currently around 7 months in UK teaching hospitals, with a quarter of patients waiting over 18 months for biological therapy even when the diagnosis of Crohn's disease is established [57]. Centralization of services may allow for the creation of more efficient integrated care pathways for such patients.

Inflammatory Bowel Disease surgeons may well have to act as strong patient advocates to ensure timely access to surgery for urgent or elective patients within a National Health Service policy which stipulates that over 92% of patients should receive treatment within 18 weeks of listing [58], a target that appears increasingly unattainable [59]. The problem of undue waiting times is not unique to the UK according to recent data

from the Netherlands, which suggests that a significant proportion (16%) of IBD patients suffer physical complications while on waiting lists [60].

Statement 1.8

Surgery in IBD patients requires complex decision-making and planning to ensure the balance between achieving optimization of the patient and maintaining relatively quiescent disease. Once optimized, patients should undergo surgery within the tight window of optimization to ensure the best outcomes.

Level of evidence: III

Grade of recommendation: C

Consensus: 87.9% (SA 63.6%, A 24.2%)

Statement 1.9

Optimization of the patient prior to IBD surgery requires resolution of sepsis, ensuring adequate nutritional status and reduction or cessation of medications, including steroids and biological therapy, where feasible.

Level of evidence: III

Grade of recommendation: C

Consensus: 88.2% (SA 58.8%, A 29.4%)

Risk of venous thromboembolism in patients requiring surgery for IBD

Venous thromboembolism is a well-recognized complication in patients with active IBD [61], with such patients having around a 2.85 times excess risk of thromboembolic events [62]. Venous thromboembolism remains a significant cause of excess mortality in patients with IBD [63]; this is of particular importance when coupled with the additional excess risk associated with surgical intervention.

In a retrospective study of just under 9000 patients who had undergone abdominal and pelvic surgery for IBD, the 30-day postoperative venous thromboembolic rate was 2.7%, giving an odds ratio (OR) of 1.26 (95% CI: 1.021–1.56) compared with 37 000 patients undergoing cancer surgery [64]. The strongest predictors of thromboembolic complications after surgery for IBD were stoma formation, with an adjusted OR of 1.95 (95% CI: 1.34–2.84), preoperative steroid administration [adjusted OR 1.57 (95% CI: 1.19–2.08)], ileoanal pouch formation [adjusted OR 2.66 (95% CI: 1.65–4.29)] and longer length of stay [adjusted OR 1.89 (95% CI: 1.41–2.52)] [65].

In a large population-based study examining venous thromboembolism after colectomy for a variety of indications, and including 9850 patients with IBD, the 30-day incidence of venous thromboembolism was 3.1% in IBD patients. The 30-day incidence of venous thromboembolism was noted to be higher in patients with ulcerative colitis than in patients with Crohn's disease (4.1% *vs* 2.1%, $P < 0.001$). Importantly, the cumulative incidence of venous thromboembolism increased from 1.3% at 7 days to 4.3% at 90 days after surgery in patients with IBD [66].

Rates of postoperative venous thromboembolism are consistently around 2.5–3.5% across the IBD surgical literature and are a major reason for readmission after IBD surgery [67], but extended chemoprophylaxis remains the exception rather than the norm, with < 1% of postoperative IBD patients receiving extended prophylaxis in one recent retrospective population-based study [65]. This is perhaps surprising given that over 40% of postoperative thromboembolic events following colectomy for ulcerative colitis occur in patients after discharge from hospital [68]. Patients undergoing resection for ulcerative colitis are at highest risk of venous thromboembolism if they require emergency surgery and are at high or moderate risk of venous thromboembolism when undergoing elective surgery, are on steroids or have hypoalbuminaemia [69]. While these are observational data, they are also typical of many patients who require colectomy.

Several authors have noted the high rates of postoperative venous thromboembolism in IBD patients and have suggested the extended use of venous thromboembolism prophylaxis [64–66,69] along the same lines as in current standard practice for patients undergoing colorectal cancer resection.

Statement 1.10

Venous thromboembolic prophylaxis should be optimized in all patients requiring abdominal surgery for IBD. Extended prophylaxis with 28 days of low-molecular-weight heparin may be advisable.

Level of evidence: II

Grade of recommendation: B

Consensus: 93.9% (SA 60.6%, A 33.3%)

Audit of surgical outcomes and key performance indicators

The auditing of outcomes following surgical intervention is essential to ensure high-quality care for patients. The ACPGBI has financed and supported the only international surgical IBD database in the form of the

Ileoanal Pouch Registry, although there are undoubtedly limitations to voluntary data submission, inherent selection bias, poor reporting of complications and lack of long-term functional outcomes [70]. The ACPGBI has also commissioned a web-based pouch surgery reporting platform available to consultant members to allow comparisons of volume and outcomes in pouch surgery in England based on near real-time administrative data sets [37,38] with plans to expand to surgical procedures for Crohn's disease.

Audit of surgical outcomes in IBD is particularly important within the context of multimodal treatment, especially where outcomes from medical treatments may also be associated with significant complications, and both medical and surgical options will need to be considered by the multidisciplinary team [71,72]. Ideally, surgical outcomes should be embedded in combined national databases; the UK IBD Audit was responsible for auditing all outcomes for IBD patients from 2006 until 2016 [73] and its function has now been taken over by the IBD Registry, a joint venture between Crohn's and Colitis UK, the Royal College of Physicians and the British Society of Gastroenterology, with representation from the ACPGBI.

Snapshot audits also have their role in answering specific questions: the European Society of Coloproctology (ESCP) snapshot audit in right hemicolectomy included a significant subset of patients with IBD [74]. A further combined snapshot audit of patients with colitis will be the next combined project between ESCP and the European Crohn's and Colitis Organisation (ECCO).

Good audit allows measurement of agreed key performance indicators to monitor outcomes, reduce variation, drive up standards across IBD services [75] and give opportunities to implement quality improvement initiatives [76]. Reporting of patient-reported outcomes [77] and especially patient submission of their own outcomes are key areas for future development [78]. The ideal scenario would be composite databases with dual data entry interfaces for both clinician and individual patient to contribute.

Statement 1.11

Standard of care for IBD patients undergoing surgery should include registration in prospectively managed and adequately resourced national databases with inclusion of short- and long-term outcome data to allow comparative audit of agreed key performance indicators.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 88.6% (SA 57.1%, A 31.4%)

Research in IBD surgery

The James Lind Alliance conducted a priority-setting partnership for key topics in IBD research [79] and, in similar fashion, the ACPGBI published its own consensus-driven prioritization of research topics in colorectal surgery [80]. Both prioritize research to optimize outcomes for patients with perianal Crohn's disease and to assess the role and timing of surgical resection as an alternative to medical therapy in ileocaecal Crohn's disease. Both subjects have been the subject of recent commissioned calls from the National Institute of Health Research Health Technology Assessment, although there are no nationally funded studies yet.

The ECCO ran a workshop in unmet research needs in perianal Crohn's disease and identified the natural history of perianal Crohn's disease, classification of fistula tracks, clinical, patient-reported and MRI outcome measures and lack of randomized controlled trials as major research gaps [81]. The latter concern is partly met by the ongoing PISA trial in fistulating perianal Crohn's disease that offers randomization among three arms of (i) standard care with long-term seton placement and oral immunosuppression, (ii) biological therapy with timed seton removal and (iii) seton drainage with limited biological therapy and then advancement flap [82]. A recent randomized trial has been published examining stem cell therapy in fistulizing perianal Crohn's disease, with some promise from a novel intervention [83].

There is continued enthusiasm among clinicians and patients for simple surgical solutions that may carry minimal risk while still offering remission from IBD. With the publication of a systematic review suggesting that appendicectomy alters the activity of colitis in patients with acute ulcerative colitis [84], a multicentre study is now under way to assess the safety and efficacy of appendicectomy in ulcerative colitis [85].

With recognized variation in national trends at reconstructive surgery after colectomy with either pouch surgery or ileoanal anastomosis, research is now in progress to examine the relative merits of both options [86]. Technical aspects of surgery continue to evolve, with studies to examine transanal resection to assist rectal dissection [87], anastomotic techniques aimed at minimizing anastomotic leak [88], new methods of undertaking ileocaecal anastomosis to reduce recurrence rates [89] and innovative ways to prevent the formation of parastomal hernia [90]. Reducing recognized consequences of surgery that affect quality of life, such as pouchitis, is a key research area, with faecal microbial transplantation currently under evaluation as a potential intervention for pouchitis [91].

Patients with IBD have demonstrated significant engagement with research processes that prioritize patient-centred outcomes [92,93], and a willingness to be involved in research [16,94].

Statement 1.12

All patients undergoing surgery for IBD should have the opportunity to participate in well-designed clinical trials. IBD service provision should ensure support for patient recruitment to multidisciplinary trials and cohort studies.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 88.6% (SA 62.9%, A 25.7%)

Small bowel surgery in Crohn's disease

The small bowel, and especially the terminal ileum, is commonly affected in about 80% of Crohn's cases with one-third of patients having isolated ileitis. Crohn's disease is a complex disorder with no surgical cure and the primary treatment is medical. However, about half of patients will need surgery within 5 years of diagnosis, rising to 70% after 15 years of onset of the disease [95]. The aim of surgery is to improve quality of life in situations where medical management is less effective. To achieve this aim, the decision to recommend surgery should be made through close interdisciplinary discussion between gastroenterologists and surgeons, and in consultation with the patient and his/her wishes. If surgery is indicated, the underlying principle has to be bowel sparing [96]. Unfortunately, there are few high-quality randomized controlled trials to assess different surgical techniques for surgery in small bowel Crohn's disease and much of the evidence is from small studies and historic data [97].

Indications for surgery

Failure of medical treatment

Crohn's disease is a lifelong chronic inflammatory disease which is mainly treated medically. Biological therapies, including anti-tumour necrosis factor α (TNF α) agents, are very effective in treating cases that are refractory to first-line agents [e.g. glucocorticoids, 5-aminosalicylates (5-ASAs), antibiotics] [98]. The failure of medical treatment can be either primary nonresponsive or secondary (subsequent loss of response). The primary response is usually evaluated after 8–12 weeks from the start of treatment [99]. Surgery is recommended for such patients and for those who are noncompliant with medical treatment or develop severe complications from its continuation [100,101].

Statement 2.1.

Surgery is recommended in patients with localized small bowel disease who experience failure, noncompliance with or complications of medical treatment.

Level of evidence: III

Grade of recommendation: B

Consensus: 88.2% (SA 52.9%, A 35.3%)

Growth retardation

Growth failure is the most common extraintestinal manifestation in children and adolescents with Crohn's disease (see Section 15). It can be attributed to a variety of factors including the inflammatory process itself, malnutrition, hypogonadism and treatment with glucocorticoids. The management includes nutritional support, immunomodulators and surgery [102]. Catch-up growth is usually manifested in children within 6 months after surgery [103]. Thus, surgery is an attractive option for treatment of children with localized disease after failure of noninvasive methods that enables relief from acute complications, maintaining remission and nutritional recovery [104].

Statement 2.2.

Surgery is indicated in children/adolescents with significant growth retardation due to localized Crohn's disease despite medical treatment

Level of evidence: II

Grade of recommendation: B

Consensus: 90.9% (SA 51.5%, A 39.4%)

Ileocecal stricture

The behaviour of Crohn's disease may be nonstricturing, nonpenetrating (B1), stricturing (B2) or penetrating (B3) [105]. About one-third of patients with Crohn's disease will develop stricturing disease. Strictures may be single or multiple, short or long and may occur anywhere in the gastrointestinal track. The most common sites are the small bowel, especially terminal ileum, and at surgical anastomoses.

Assessment will generally require ileo-colonoscopy and cross-sectional imaging by CT or MR enterography, or transabdominal ultrasound. CT or MR enterography are considered the gold standard techniques for assessment of small bowel disease. Both techniques, in addition to inflammatory markers, are useful in distinguishing inflammatory from fibrostenotic disease which is important as inflammatory strictures are more likely to respond to medical therapy whereas fibrotic disease is likely to require mechanical treatment [106,107].

The decision to recommend surgery is ultimately a balance between potential benefits (relief of symptoms, improved nutrition and possible reduction of medications) and the morbidity of surgery (i.e. anastomotic leakage, stoma, altered symptoms, changed body image, later recurrence and short bowel syndrome). The surgical options include endoscopic balloon dilatation, strictureplasty and resection.

Endoscopic balloon dilatation

Endoscopic balloon dilatation has become increasingly popular for the treatment of selected symptomatic Crohn's strictures which are short, not associated with markers of inflammation or fistulas and within the reach of a standard colonoscope [108]. Thienpont *et al.* reported their experience of 237 dilatations in 138 patients. All strictures treated were < 5 cm and were predominantly at ileocolic anastomoses (see Section 3). Immediate success, judged by the ability to pass an adult colonoscope through the stricture, was achieved in 97%. Six perforations occurred (2.5% risk per procedure, 4.3% risk per patient). At median follow-up of 5 years, 24% of patients required surgery and 46% repeat dilatation. After the first dilation, 44% of patients remained dilatation- and surgery-free [109]. The incidence of complications was low, reaching 2%, with perforation being the most common [110]. Also, a long-term prospective study of 55 patients found that balloon dilatation helped to avoid surgery in 70% of patients. Some researchers suggested that the presence of ulcers, stricture site and length are the determinants of the success of the procedure. However, a systematic review of 353 strictures stated that the only predictor of a surgery-free outcome was a short stricture [111]. The same findings were supported by another review that included 3252 strictures in 1500 patients; those authors noted that steroid injection and increased length of stricture made earlier surgical re-intervention more likely [112].

Statement 2.3

Endoscopic balloon dilatation is a therapeutic option for small bowel Crohn's and anastomotic strictures of < 5 cm that are endoscopically accessible with no associated abscess or fistula, provided immediate surgical support is available.

Level of evidence: II

Grade of recommendation: B

Consensus: 96.9% (SA 40.6%, A 56.3%)

Strictureplasty

Strictureplasty, like endoscopic balloon dilatation, is an alternative to resection which fits with the principle of bowel preservation. A systematic review assessed 1112 patients who underwent 3259 strictureplasties, 94% of them being in the jejunum and/or ileum. The 5-year surgical recurrence rate was 28%. Recurrence occurred at nonstrictureplasty sites in 90% of patients with site-specific recurrence rate detected in only 3%. Strictureplasty was therefore very safe and effective in the treatment of short recurrent strictures [113]. Another review concluded that a lower postoperative complication rate was observed with strictureplasty compared with resection. However, the results were not statistically significant ($P = 0.09$). In addition, significantly longer recurrence-free survival was noted in the resection arm [114].

Contraindications to strictureplasty include bowel wall phlegmon, carcinoma or active bleeding with mucosal ulceration [115]. The most common clinical dilemma is whether to resect a segment of multiple strictures that are close together or to undertake one or more strictureplasties. Although the principle of bowel preservation is well established, in practice resection is much more common than strictureplasty. If the stricture(s) is limited to a short segment of small bowel and the remainder of the bowel is normal and not short (over 200 cm), then limited resection is favoured. Strictureplasty should be considered when multiple strictures are present, when stricture(s) are associated with diffuse involvement of the small bowel, when < 200 cm of normal bowel remains or if disease has recurred rapidly after previous resection.

Statement 2.4

Strictureplasty should be considered as the surgical technique of choice when multiple strictures are present and there is concern about preservation of bowel length.

Level of evidence: III

Grade of recommendation: GP

Consensus: 100.0% (SA 51.5%, A 48.5%)

Resection

Resection is the most commonly performed type of surgery for small bowel disease. It is considered as an early treatment for localized ileal disease after taking into consideration the risks and benefits of both medical and surgical treatment, the risk of recurrence after surgery and patient choice [116]. Surgery is likely to

be more successful than medical therapy if there is fibrotic disease with a minimal inflammatory component. This is particularly the case if there are obstructive symptoms.

The reoperation rate in this selected group is high, reaching 50% after many years. However, there are no available comparative data about the long-term rates after medical therapy. Also, there are no studies to evaluate the quality of life after both lines of treatment [115]. Therefore, resection is still considered to be a reasonable option for treatment of symptomatic localized disease, either from diagnosis or after failure of medical treatment.

Statement 2.5

Early resection is the preferred surgical option for localized small bowel Crohn's disease where there are obstructive symptoms due to mainly fibrotic disease not amenable to endoscopic balloon dilatation.

Level of evidence: III

Grade of recommendation: C

Consensus: 96.9% (SA 71.9%, A 25.0%)

Abscess

Smaller abscesses < 4 cm can be treated by parenteral antibiotics while larger ones usually require image-guided drainage as recommended by the American College of Radiology [116,117]. Percutaneous drainage has gained popularity over the last few years; according to a nationwide report usage in the USA has risen from 7% 20 years ago to 29% [118]. Current evidence would suggest that, in the presence of an abscess, surgery should be avoided as first-line treatment to avoid unnecessary bowel resection [119]. If surgery is indicated due to concomitant fistula or stricture, delaying intervention until percutaneous drainage has been carried out and the patient optimized from a nutritional and inflammatory perspective will lead to reduced overall length of bowel resection, incidence of complications and likelihood of stoma formation [119–121] (see Section 3).

Perforation

The incidence of free perforation in small bowel Crohn's disease varies from 1 to 16% [122–124]. It is usually an indication for immediate surgery due to associated peritonitis. Bowel resection with stoma formation is the preferred intervention. However, primary anastomosis can be an option for haemodynamically stable patients with good general condition and localized contamination [101].

Statement 2.6.

Surgery is usually required for acute free small bowel perforation in a patient with Crohn's disease.

Level of evidence: II

Grade of recommendation: B

Consensus: 93.8% (SA 68.8%, A 25.0%)

Fistula

Primary management of fistula includes delineation of its anatomy, drainage of sepsis, nutritional support and determining the underlying cause, whether inflammation or stenosis. For primary enterocutaneous fistula, resectional surgery is generally necessary, although medical treatment may be attempted [125,126]. The evidence for medical therapy is minimal and of low quality. Entero-enteric fistulas are usually asymptomatic and require surgery only if they cause malabsorption or diarrhoea [2]. For entero-urogenital fistula, surgery is still superior to medical therapy, but again medical therapy may be attempted [127,128] (see Sections 3 and 12).

Statement 2.7.

Surgery is usually required for symptomatic small bowel fistulas after preoperative optimization.

Level of evidence: II

Grade of recommendation: B

Consensus: 93.5% (SA 54.8%, A 38.7%)

Intestinal neoplasia

The risk for small bowel adenocarcinoma in Crohn's disease is low, being approximately 2.2% at 25 years [129]. However, there is a paucity of clinical research in this area. Risk factors include duration of the disease, young age at diagnosis, male gender, site of the Crohn's, inflammation and strictures [130]. Any suspicious lesion identified by imaging or during stricture-plasty or endoscopic examination should be biopsied. If that is not possible, surgical resection is required to rule out malignancy [101].

Statement 2.8.

Biopsy is indicated for any suspicious mass or ulcer in the small bowel; surgical resection should be considered if this is not feasible.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 94.1% (SA 58.8%, A 35.3%)

Surgical technique

The surgical approach

Laparoscopy has advantages over open surgery in terms of quicker recovery, less pain, early mobilization, lower incidence of adhesions, incisional hernia and wound infection, in addition to better cosmesis and body image. A Cochrane Review and two randomized controlled trials (RCTs) with long follow up reaching 10 years provide the evidence [131–133]. Minimally invasive surgery has been employed successfully in complex cases associated with fistula, previous surgery or abscess, with morbidity and hospital stay equivalent to those of initial resection or uncomplicated disease [134–136] (see Sections 3 and 12).

Statement 2.9.

Laparoscopy is the preferred surgical approach for small bowel Crohn's disease, particularly for primary procedures, but may not always be possible in patients with recurrent or complex disease.

Level of evidence: I

Grade of recommendation: A

Consensus: 94.1% (SA 50.0%, A 44.1%)

Resection margins

In Crohn's disease, the involved bowel can be differentiated from the normal one by palpating the mesenteric border of the bowel wall, where it is usually thickened with fat wrapped on the sides of the wall [99]. Some older studies were in favour of extended resection for the involved bowel [137,138]. However, a RCT of 152 patients comparing a macroscopically limited resection margin of 2 cm with an extended resection margin of 12 cm, found that the width of the excised margin did not affect recurrence. More significantly, recurrence rates did not increase with the presence of microscopic disease at the specimen's margins [139]. There is, however, some emerging evidence that the extent of mesenteric resection, rather than bowel length, may have an impact on disease recurrence [140]. For further discussion see Section 3.

Statement 2.10.

Minimal length rather than radical extended resection is currently recommended for excision of small bowel disease.

Level of evidence: I

Grade of recommendation: A

Consensus: 93.8% (SA 46.9%, A 46.9%)

Type of anastomosis

An intriguing aspect of postoperative recurrent Crohn's disease is that in about 90% of cases recurrence occurs just proximal to the anastomosis. The significance of the technique of anastomosis in this pattern of recurrence is uncertain. Anastomoses may be constructed in a variety of configurations (end-to-end, end-to-side, side-to-end and side-to-side) using either stapled devices (linear or circular) or sutures (one or two layers and various materials). A variety of trials and one meta-analysis have addressed the significance of the anastomotic technique in terms of leakage rates and subsequent recurrence [141–145]. All reports have tended to focus on ileocolic anastomosis and are therefore discussed in more detail in Section 3. It is impossible to analyse the data for small bowel anastomoses alone. However, if the results for ileocolic anastomosis are extrapolated to small bowel anastomoses alone there is no evidence to suggest that one type of anastomosis is better than another.

Statement 2.11.

There is insufficient evidence to suggest an association between anastomotic technique and incidence of recurrent Crohn's disease after small bowel resection. Small bowel anastomosis may be carried out according to surgeon preference.

Level of evidence: I

Grade of recommendation: A

Consensus: 100.0% (SA 53.1%, A 46.9%)

Type of strictureplasty

The most commonly performed strictureplasty is the Heineke–Mikulicz. This type is most appropriate for isolated short segments, up to 5 cm. Finney's strictureplasty is used for medium-length strictures (5–20 cm) [146]. For longer strictures, some studies recommended nonconventional methods such as modified Finney, combined Heineke–Mikulicz and Finney, modified Heineke–Mikulicz and Michelassi (side-to-side isoperistaltic strictureplasty) [147–150]. An international, multicentre, prospective, observational study of the Michelassi technique in 184 patients from six centres proved its safety, with low morbidity, mortality and recurrence rates [151]. Also, a systematic review of 32 studies including 1616 patients and 4538 strictureplasties showed equivalent efficacy and complication rates between conventional and nonconventional methods [152].

Statement 2.12.

Long strictures (> 20 cm) and multiple strictures within a short segment of small bowel may be amenable to bowel conservation techniques such as Finney or Michelassi strictuoplasty.

Level of evidence: III

Grade of recommendation: C

Consensus: 82.8% (SA 37.9%, A 44.8%)

disease where mucosal healing is not achieved, and after drainage of Crohn's-related abscess.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 96.8% (SA 64.5%, A 32.3%)

Ileocaecal resection in Crohn's disease

Crohn's disease is a severe inflammatory condition of the intestine affecting 322 per 100 000 people in Europe and 319 per 100 000 people in North America [9]. It is associated with periods of debilitating symptoms including tiredness, severe abdominal discomfort, weight loss and chronic diarrhoea, often leading to the need for hospitalization and time off work. The disease can affect any part of the gastrointestinal track from the mouth to the anus, but in one-third of patients it is localized to the ileocaecal region. The IBD surgeon is frequently involved in managing patients with ileocaecal Crohn's disease as medical therapy is currently ineffective in controlling disease for a significant proportion of patients and the ileocaecal segment is readily amenable to surgical resection. This section discusses the important aspects of surgery for ileocaecal Crohn's disease.

Indications for surgery

Patients presenting for the first time with localized ileocaecal Crohn's will usually be treated with systemic steroids to induce remission [153]. Subsequent therapy may be medical or surgical and will be influenced by disease severity and also by patient choice. Mild disease may be best treated with budesonide. Severe disease, especially where complications are present at presentation, may be best treated with surgery. Moderately active disease is the area where there is limited evidence to guide best practice. The European Crohn's and Colitis guidelines note a consensus preference for avoiding early surgery in moderately active ileocaecal disease but also acknowledge the lack of evidence in making this recommendation [153]. Research to resolve this issue remains a major priority [79,94].

Statement 3.1

Ileocaecal Crohn's resection should be considered in patients with fibrotic disease, with symptomatic fistulizing disease, with asymptomatic fistulizing

Timing of surgery

There is a tendency for both patient and physician alike to perceive prolonged medical therapy as the treatment of choice with surgery reserved for failure of medical treatment, but this dogma is questionable given the high rates of resection observed in patients with ileocaecal Crohn's disease [154]. As Crohn's is a lifelong condition, medical therapy is usually protracted. The length of treatment for immunomodulatory therapy (e.g. anti-TNF α) in particular is unknown and open ended. Morbidity is not insignificant, and there are high costs associated with prolonged treatment. Most patients will eventually need surgery [155]. The recently reported LIR!C trial suggests that, even with immunomodulatory therapy, 37% of patients with terminal ileal Crohn's will have surgery within 4 years of initiating treatment [71]. Studies on the effect of long-term medical therapy on quality of life are lacking. In contrast there is evidence that surgery will reduce the need for further surgery in the long term in at least 50% of patients [156–158]. Indeed a survey of patients who had ileocaecal resection after medical therapy suggested that over 75% wished they had undergone surgery earlier [159]. There is therefore an argument for earlier surgical intervention. The argument is perhaps strongest for those with obstructive symptoms and minimal inflammatory activity [160–162]. In this situation, fibrotic stenosis is likely to be prominent and medical therapy probably ineffective. It is possible that, even with an inflammatory component to the disease process, early surgery may result in a better quality of life for patients than immunomodulatory therapy. High-quality evidence is lacking and randomized trials are proposed to investigate this specific hypothesis. There is some corroborative evidence to suggest that patients undergoing early surgery achieve better resolution of the inflammatory response [163].

For those with recurrent disease after initial immunosuppressive medical therapy (steroids and/or azathioprine) there are good-quality RCT data [71]. LIR!C suggests that quality of life and hospital admission 12 months after medical therapy with infliximab or laparoscopic surgical resection is the same. In addition,

important considerations for patients such as body image and cosmesis do not seem to be negatively affected by surgery. Laparoscopic resection for limited nonstricturing ileocaecal Crohn's disease in patients for whom conventional therapy has failed could be considered as a reasonable alternative to infliximab [71].

Statement 3.2

Patients with recently diagnosed moderate ileocaecal Crohn's disease may reasonably be offered surgical resection rather than immunomodulation (eg anti-TNF α) and/or immunosuppression (e.g. thiopurine) after induction of remission.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 90.9% (SA 42.4%, A 48.5%)

Statement 3.3

Recurrence of ileocaecal Crohn's disease after initial treatment with steroids \pm immunosuppression may be treated with either surgical resection or immunomodulating drugs.

Level of evidence: I

Grade of recommendation: A

Consensus: 97.0% (SA 42.4%, A 54.5%)

A further clinical scenario is the 'surprise diagnosis' made at laparotomy in the acutely ill patient. This should be a rare event with the increasing use of preoperative imaging and laparoscopy. However, if a patient is found to have unexpected localized ileitis, resection is not usually advocated as it can be virtually impossible to differentiate Crohn's disease from other causes of enteritis. Interestingly, when asked what they would recommend if faced with this scenario, most surgeons would not do any resection and refer for medical therapy. Conversely most physicians would advocate surgery [164].

Statement 3.4

The unexpected finding of uncomplicated terminal ileitis at surgery should not necessarily lead to immediate resection.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 83.3% (SA 66.7%, A 16.7%)

Surgical approach*Open versus laparoscopic surgery*

The evidence for a laparoscopic approach compared with open surgery for initial ileocaecal Crohn's is strong [133,165,166]. Proven advantages include better

cosmesis, earlier recovery, shorter length of stay and a reduction in both early morbidity, later incisional hernia and adhesion problems. Despite this, nearly 60% of procedures in the UK are carried out via an open approach [167]. The reason for this high rate of open surgery is unclear but may relate at least in part to complex disease or recurrent surgery where the benefit of laparoscopy is not proven. Certainly, laparoscopy is possible and safe in experienced hands, but there must be a low threshold for early conversion to avoid unnecessary iatrogenic complications [134,168] (see also Sections 2 and 12).

Single-incision laparoscopic surgery (SILS)

The use of a SILS approach for ileocaecal Crohn's resection is unproven. Although there are advocates who claim significantly reduced analgesia requirements with other outcome measures comparable to multiport laparoscopic surgery [169–171], the data are retrospective and open to marked selection bias, with the multiport laparoscopic group tending to have had more complex surgery. The SILS procedure is undoubtedly surgically demanding. There may be small advantages in terms of cosmesis and pain reduction in expert hands, but this may be difficult to extrapolate to surgeons with less experience.

Statement 3.5.

Patients undergoing surgery for terminal ileal Crohn's disease should undergo a laparoscopic approach when this can be carried out safely.

Level of evidence: I

Grade of recommendation: A

Consensus: 97.0% (SA 69.7%, A 27.3%)

Statement 3.6.

There is no evidence to justify the widespread use of single-incision laparoscopic surgery (SILS) in ileocaecal Crohn's resection.

Level of evidence: IV

Grade of recommendation: D

Consensus: 89.7% (SA 51.7%, A 37.9%)

Extent of resection

The clinical focus for Crohn's disease has long been on the mucosal disease. Surgeons initially tried to reduce the chance of recurrent mucosal disease by extended surgical resection of all bowel with mucosal disease in the belief that microscopic clearance was key. However, extended surgical resection only predisposed patients

with Crohn's disease to short gut syndrome and so the current vogue for conservative surgery was established.

Recently there has been increasing recognition that Crohn's disease affects not just the bowel lumen but also its mesentery, and that unresected mesentery may contribute to high recurrence rates [172–174]. Hence the mesentery has been suggested as an additional target for resection by the IBD surgeon [175]. Current surgical techniques advise conservation of the mesentery with division close to the bowel wall. It is conceivable that a more oncological-style mesocolic resection may reduce need for surgery for recurrence. Evidence for this hypothesis comes from a study showing that high levels of visceral fat are predictive of recurrence [176]. A radical approach may not be easy; many patients have thickened mesentery with friable vessels that can be difficult to ligate. More radical mesenteric resection may also increase complications. While an initial cohort study has suggested that extended mesenteric resection may reduce recurrence rates [140], a formal trial comparing close *vs* radical mesenteric resection is required prior to any change in the current advice for a conservative approach (see Section 2).

Anastomotic technique

The important outcomes regarding anastomotic technique are anastomotic leakage rate and rate of symptomatic recurrent disease. Recurrent disease after surgery is unfortunately common, with an actuarial risk of about 1.5% per year [177]. Surgeons have for many years explored different anastomotic techniques in the hope of reducing recurrence rates.

Stapled side-to-side versus hand-sewn end-to-end anastomosis

There have been several trials and meta-analyses looking at the two commonest methods of anastomosis: the stapled side-to-side anastomosis and the hand-sewn end-to-end technique. Advocates of the stapled side-to-side anastomosis suggest that recurrence is lower, possibly due to a wider lumen. Results are conflicting, but the most recent meta-analyses concluded that stapled side-to-side anastomosis is the preferred procedure, resulting in reduced overall postoperative complications, especially anastomotic leakage, but also decreased recurrence and reoperation rate [142,144,178]. These data should be treated with caution. The meta-analyses include both randomized and nonrandomized trials. If only data from randomized trials are analysed, the difference disappears. In addition, none of the trials allowed for confounding risk factors for recurrence and follow-up was inadequate in the majority of trials included in analysis.

In light of these limitations, it would be unwise to make a strong association between anastomotic technique and recurrence rates.

Side-to-side isoperistaltic strictureplasty

A bowel-sparing surgical strategy is essential when operating on patients with Crohn's disease. About 40% of patients will go on to have further surgery in their lifetime due to recurrence. About 8% will ultimately develop intestinal failure as a consequence of repeated extensive resection [179,180]. The modified long Michelassi strictureplasty is perhaps the ultimate bowel-sparing procedure for terminal ileal Crohn's disease [181]. With the side-to-side isoperistaltic strictureplasty constructed over the length of the ileocaecal valve, the whole bowel is preserved. Such a procedure has been proven to be feasible and safe provided there is no phlegmon, abscess or fistula originating from the treated segment [182]. Despite macroscopic disease being present in the anastomosed segment, significant mucosal healing has been observed in many reports [183]. The mechanism of healing is unclear but may relate to alleviation of faecal stasis once mechanical obstruction is resolved. Long-term cancer risk may be a concern, but rates appear to be extremely low [184] and the surgical construction does allow for endoscopic surveillance. Certainly, such a technique is warranted in the patient with extensive small bowel disease that includes the terminal ileum.

Kono-S anastomosis

The Kono-S anastomosis has been advocated as a technique that may reduce surgical anastomotic recurrence. The technique involves suturing the stapled ends of the resected bowel to create a supporting column. A hand-sewn anastomosis is then created on the anti-mesenteric border of the bowel at least 1 cm from this supporting column. Theoretically the supporting column maintains the diameter of the anastomosis, preventing distortion and stenosis. The wide anastomosis and anastomosis away from the mesenteric border of the bowel all purportedly contribute to a reduction in postoperative recurrence. An international multicentre cohort study of 187 patients has demonstrated a remarkably low 10-year surgical recurrence-free survival rate of 98.6% [89]. A prospective randomized study is ongoing to corroborate these early encouraging observations.

Statement 3.7.

There is insufficient evidence to suggest an association between anastomotic technique in ileocaecal resection and incidence of recurrence. Promising alternative techniques require further assessment.

Level of evidence: I
 Grade of recommendation: A
 Consensus: 96.8% (SA 58.1%, A 38.7%)

The role of endoscopic balloon dilatation

The ECCO consensus on management of Crohn's disease recommends balloon dilatation for the management of ileocaecal disease as an alternative after initial medical treatment [2]. In clinical practice, this option is determined by the characteristics of the stricture. Strictures should be accessible, as is the case with most ileocaecal strictures, short and single site. Anastomotic strictures are perhaps the most amenable to dilatation. There are risks associated with the technique, including inability to completely dilate, perforation and bleeding in the short term, and recurrence in the long term [110]. A recent meta-analysis suggests that therapeutic response (for ileocaecal as well as more proximal small bowel strictures) is as high as 70% with a 5–8% complication rate [185]. The authors point out that whilst this response rate is appealing, endoscopic dilatation is essentially a short-term solution, with 75% of patients eventually undergoing surgery during 5-year follow-up.

Statement 3.8

Balloon dilatation is an alternative to surgery to alleviate obstructive symptoms in patients with ileocaecal Crohn's disease or recurrent disease at an ileocolic anastomosis, especially where the stricture is < 5 cm, not angulated or inaccessible, not severely inflamed and not fistulizing. Many patients will eventually require surgery.

Level of evidence: II
 Grade of recommendation: B
 Consensus: 86.7% (SA 40.0%, A 46.7%)

Crohn's-related abscess

Crohn's disease results in transmural inflammation with deep fissuring. In more than 20% of patients this can lead to abscess formation [121]. Immediate surgery may be carried out in this situation but surgery may be complex and often results in stoma formation. There is an increasing trend to manage this situation conservatively, initially with percutaneous drainage and antibiotics [118]. This forms part of a surgical strategy to optimize the patient before later definitive surgery [186] (see later). In 30% of patients there is complete resolution of the abscess [121]. The dilemma in these patients is whether to

continue with planned surgery or to institute medical therapy as an alternative. The evidence for which option is best is poor. One retrospective case series of 13 patients with a phlegmon treated with antibiotics and then medical therapy suggested that 90% avoided surgery for a median of 2.3 years [187]. However, the risks of medical therapy, particularly immunosuppressor or immunomodulator treatment, in a patient with the potential for septic sequelae must be high and careful observation would be required. Further proposed trials (LIR!C 2, BIONIC) may answer the question of whether to treat this group surgically or medically. Until then, factors favouring early resectional surgery include short segment disease, development of an abscess while on biological therapy, persistent symptoms after abscess drainage or inability to drain an abscess percutaneously.

Statement 3.9

An abscess in association with active ileocaecal Crohn's disease should be treated with antibiotics and percutaneous drainage where possible, although surgical drainage may be necessary in selected cases.

Level of evidence: III
 Grade of recommendation: B
 Consensus: 93.5% (SA 51.6%, A 41.9%)

Statement 3.10

There is insufficient evidence to suggest whether surgery or medical therapy is better after complete resolution of Crohn's-related abscess. The risks and benefits of each approach should be explained to the patient in a neutral manner to ensure a fully informed choice on further management.

Level of evidence: IV
 Grade of recommendation: GP
 Consensus: 84.4% (SA 25.0%, A 59.4%)

Enteric fistulas

Enteric fistulas connecting diseased segments of terminal ileum or the ileocaecal area to other organs are common and often asymptomatic. Surgical resection of Crohn's enteric fistulas is not indicated in asymptomatic patients with an incidental radiological finding of enteroenteric fistula [188]. However, surgery is indicated for persistent symptoms, most notably of diarrhoea, abdominal pain and weight loss, but also for associated stenotic or septic complications or if mucosal healing of Crohn's disease is not achieved despite optimized medical therapy [2]. As most fistulas in Crohn's disease arise from a segment of

diseased bowel, this is the principal target for resection [189]. The recipient organ, for example small bowel, sigmoid colon or bladder, is usually amenable to surgical repair rather than requiring resection.

Enterocutaneous fistulas may occur as a primary manifestation of ileocaecal Crohn's disease, especially after abscess drainage, but around a quarter arise as a complication of anastomotic failure after resection [189]. Enterocutaneous fistulas require aggressive early treatment with antibiotics, percutaneous drainage of infection, correction of fluid and electrolyte disturbances, initiation of nutritional support and specialist wound management [150] (see Section 14). Multidisciplinary management is essential [150,190], but ultimately delayed surgical resection offers the only potential cure for most patients with Crohn's enterocutaneous fistulas [125], albeit not without potential complications and adverse impact on long-term outcome in some patients.

Statement 3.11

Early ileocaecal resection should be considered in optimized patients with enteric fistulas who are symptomatic from the fistula, experience obstructive symptoms from associated stricturing disease, develop intra-abdominal abscesses, or in whom mucosal healing is not achieved on optimal medical therapy.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 87.5% (SA 56.3%, A 31.3%)

Statement 3.12

When operating on patients with enteric Crohn's fistulas, surgical resection of the primary diseased bowel segment with preservation of the recipient organ is recommended wherever possible.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 90.6% (SA 56.3%, A 34.4%)

Statement 3.13

Enterocutaneous fistulas are best managed with percutaneous drainage of sepsis, correction of electrolyte abnormalities, nutritional support and wound care in the short term, usually followed by delayed surgical resection after optimization.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 93.3% (SA 66.7%, A 26.7%)

Optimization prior to surgery

Optimization of the patient before surgery is a common theme throughout the surgical management of IBD and is touched on earlier in this section and elsewhere. It is a crucial part of improving outcome. Steroid reduction, nutritional assessment and optimization, thrombosis prophylaxis, abscess drainage with antibiotics and smoking cessation are all components to this optimization [54].

Statement 3.14

Patients should be optimized before surgery for ileocaecal Crohn's disease with emphasis on steroid reduction, nutritional status, sepsis control, smoking cessation and prevention of venous thromboembolism.

Levels of evidence: I to III

Grade of recommendation: C

Consensus: 100.0% (SA 79.4%, A 20.6%)

Postoperative management

Many studies have looked at potential predictors of recurrence of Crohn's disease, which may be useful in influencing not only the intensity of surveillance but also the requirement for costly and potentially toxic postoperative immunomodulating drugs or combination therapies. Young age at time of index surgery, prior intestinal surgery, penetrating disease, coexisting perianal disease and, in particular, smoking are established risk factors [2]. Severe myenteric plexitis may be another predictor of recurrence [191,192].

The currently most effective diagnostic tool for detecting recurrence is ileocolonoscopy. Endoscopic recurrence precedes clinical recurrence, allowing for escalation of medical therapy in the hope of reducing the need for re-do surgery [193,194]. Various prophylactic medical therapies have been evaluated over the last 30 years and treatment should be considered in patients who have at least one of the recognized risk factors [2]. Further details of types of therapy and evidence for their use are available in the updated BSG guidance (in preparation). IBD surgeons should ensure prompt follow-up with a gastroenterologist for patients undergoing ileocaecal resection.

Statement 3.15

There are several established risk factors for recurrence after ileocaecal resection, including positive smoking status, young age at first surgery, previous Crohn's surgery and fistulating and perianal

disease. Prophylactic medical therapy should be considered in patients with one or more of these risk factors after ileocaecal resection. Support for smoking cessation is recommended for persistent smokers.

Level of evidence: I

Grade of recommendation: C

Consensus: 97.0% (SA 54.5%, A 42.4%)

Colectomy for IBD

Despite the increased prevalence of IBD there is evidence that the number of colectomies performed is decreasing. Previous studies assessing the likelihood of requiring colectomy in ulcerative colitis have reported rates as high as 65% at 25 years [50]. However, many of the data on the long-term risk of colectomy emerged from cohorts who were diagnosed and followed up in the 1970s and 1980s. A subsequent report based on a study period from 1989–2009 reported a colectomy rate for ulcerative colitis of 10% at 10 years [195]. Prospective population cohort studies from Scandinavia for both ulcerative colitis and Crohn's also report a decrease in rate of colectomy [196]. In a systematic review and meta-analysis the progressively decreased risk of surgery for IBD was convincingly demonstrated for both ulcerative colitis and Crohn's disease. The risk of surgery 1, 5 and 10 years after diagnosis of ulcerative colitis was 4.9% (95% CI: 3.8–6.3%), 11.6% (95% CI: 9.3–14.4%) and 15.6% (95% CI: 12.5–19.6%), respectively.

The decreased need for surgery is attributed in part to the adoption of additional medical treatment in patients with severe colitis who fail to respond to high-dose steroids. This second-line intervention has been termed rescue therapy, given the generalized sentiment that surgery equates to failure in acute severe colitis. The two effective options for treating steroid-refractory acute severe ulcerative colitis are ciclosporin and infliximab; both have been examined in RCTs and have equal efficacy in the short and medium term. Colectomy rates were 17% in the ciclosporin group and 21% in the infliximab arm (CYSif) and 41% *vs* 47% (Construct) [197,198]. However, long-term rates of surgery after rescue therapy in acute severe colitis remain high, with 43% of patients requiring colectomy by 12 months in pooled randomized trials [199].

The management of patients with a flare of IBD or ongoing resistance to medical therapy is increasingly complex. Over the past two decades the significant expansion in the number of treatment options available

for Crohn's and ulcerative colitis, initially with monoclonal antibodies against anti-TNF α (infliximab, adalimumab, certolizumab pegol, golimumab) and subsequently anti-integrin (natalizumab, vedolizumab) therapies, in addition to increased understanding of combined therapy with conventional immunosuppressive drugs, has complicated the decision process as to when and how to operate. This fact is highly relevant to the IBD surgeon as colectomy with ileostomy is one of the commonest procedures in IBD, accounting for 33% of surgical procedures in the recent UK IBD audit [200].

Statement 4.1

Colectomy rates for inflammatory bowel disease are decreasing due to improvements in medical rescue therapies. Nevertheless more than a third of patients requiring rescue therapy for acute severe colitis will subsequently undergo colectomy within 12 months.

Level of evidence: I

Grade of recommendation: A

Consensus: 85.3% (SA 38.2%, A 47.1%)

Indications for colectomy

Acute severe colitis

Acute severe colitis occurs in 12–25% of all patients with ulcerative colitis and is the first manifestation of IBD in 20–30% of patients [201–203]. Acute severe colitis is diagnosed according to Truelove and Witts' criteria, namely bloody stool frequency ≥ 6 per day and at least one of the following: pulse rate > 90 b.p.m., temperature $> 37.8^{\circ}\text{C}$, haemoglobin < 10.5 g/dl and erythrocyte sedimentation rate (ESR) > 30 mm/h [204]. More recently, the ECCO and the American College of Gastroenterology have modified the Truelove and Witts criteria, defining acute severe colitis as that characterized by more than six stools per day, accompanied by one of the signs of systemic toxicity, namely tachycardia, fever, anaemia and elevated ESR [205].

Three modes of presentation are recognized in clinical practice: (i) new-onset colitis, representing roughly one-third of the acute severe colitis population; (ii) acute-on-chronic colitis; and (iii) relapsing and remitting patterns of disease. A quarter of all patients with ulcerative colitis experience at least one episode of acute severe colitis; 20% come to colectomy on first admission, rising to 40% after two admissions. The likelihood of colectomy is related to biological severity on admission [201].

All patients with acute severe colitis should be admitted to hospital with access to shared specialist care provided by a gastroenterologist and colorectal surgeon.

Centralized care has been shown to improve outcomes and reduce mortality [33] (see Section 1). Initial treatment is implemented with high-dose intravenous steroids in a dose of 100 mg of hydrocortisone four times a day or as a continuous infusion of the equivalent dose of methylprednisolone (60 mg). Although commonly recommended, these doses are not based on dose-ranging studies performed on this kind of patient but are extrapolated from a single study in patients with mild to moderate ulcerative colitis. Higher doses do not improve the outcome [206].

Given that 60–69% of patients respond to steroids there is a need to develop methods to predict those who will fail to improve, with a view to instigating either rescue therapy or colectomy [207]. In the absence of a widely accepted management and monitoring protocol, one of the major challenges faced by clinicians is the potential to continue medical therapy that is unlikely to change the outcome but will increase the risk of the subsequent surgery. Close monitoring of patients admitted with acute severe colitis is therefore essential and should be in the setting of shared care between physician and colorectal surgeon. In particular, three key stages of assessment in the acute setting have been investigated in the literature: (i) on admission, (ii) after initiation of steroid therapy, and (iii) after initiation of salvage therapy.

Patients admitted with acute severe colitis should have daily monitoring of electrolytes, liver function, full blood count in addition to C-reactive protein (CRP) and regular measurement of serum albumin. Steroid-refractoriness can be predicted with an evaluation of clinical, biochemical, endoscopic and radiological markers. Low potassium should be corrected as it may predispose to toxic dilatation. CRP and albumin are both useful in assessing the potential for steroid resistance. A minimum of three stool cultures upon admission is essential as infectious causes of colitis should be excluded. *Clostridium difficile* infection complicating ulcerative colitis is increasingly recognized as a cause of severe disease and it infers an additional risk of colectomy and mortality [208].

Clinical parameters to be monitored include stool frequency, presence of rectal bleeding and abdominal examination; while steroids may mask clinical signs of peritonitis, subtle signs such as localized tenderness on percussion indicate the presence of microperforations. A limited flexible sigmoidoscopy without bowel preparation and minimal inflation performed by an experienced endoscopist provides additional information on the extent of disease plus severity; endoscopic criteria for severe colitis include extensive mucosal abrasions, deep ulcerations, ulceration edge mucosal detachment and

well-like ulceration [209,210]. The histological changes of IBD are present as early as 7 days from the onset of symptoms [211]. In patients with prior exposure to immunosuppression, endoscopy should also be used to exclude cytomegalovirus (CMV) colitis [212]. Identification of multiple intranuclear inclusion bodies on haematoxylin and eosin staining is a reliable means of identifying CMV colitis, but diagnosis may require immunohistochemistry [213]. Colonoscopy has been evaluated in acute severe colitis but is not recommended because of the risk of perforation or precipitating toxic dilatation [214].

Patients presenting with acute severe colitis should have abdominal radiography (AXR) on admission. AXR is useful, as apart from detecting perforation and dilatation it can also inform about the extent of disease by assessing both mucosal changes and proximal faecal hold-up. The extent of underlying disease has been shown to correlate with increased rates of progression to surgery. In particular, ulcerative colitis extending proximal to the splenic flexure has been associated with poorer prognosis and is predictive of steroid-refractory disease. Colonic dilatation > 5.5 cm is suggestive of megacolon. Severe disease is typified by loss of haustrations, mucosal irregularity and thickening of the bowel wall. The presence of three isolated small bowel loops predicts treatment failure in 73% of patients [215]. Computed tomography scanning has been described to aid in diagnosis of acute toxic colitis but is not useful in assessing patients on admission [216].

Statement 4.2.

Patients admitted with acute severe colitis should have daily monitoring of electrolytes, liver function and full blood count in addition to regular measurement of C-reactive protein and serum albumin. Stool cultures upon admission are essential to exclude infectious causes of colitis. Limited flexible sigmoidoscopy without bowel preparation and minimal insufflation should be performed by an experienced endoscopist. Abdominal radiography may be useful in assessing the extent of disease.

Level of evidence: III

Grade of recommendation: C

Consensus: 81.8% (SA 57.6%, A 24.2%)

Greater biological severity of colitis on admission has been correlated with increased rates of surgery (based on Truelove and Witts criteria): a retrospective study demonstrated that resection rates increase in proportion to the number of criteria present. Patients with one criterion and six or more bloody stools had a colectomy rate of 8.5%. With the presence of two criteria this rate

increased to 30% and with three or more the rate of colectomy rose to 48% [201].

A reduction in stool frequency of < 40% after 5 days of IV steroid predicts treatment failure. By contrast, stopping rectal bleeding is predictive of steroid responsiveness. Assessment of response following 3 days of steroid therapy should be used to guide further management and a shared decision made with regard to surgery or rescue therapy. In a study by Travis *et al.*, 51 cases of acute severe colitis were treated with intensively scheduled 6-hourly 100-mg doses of intravenous hydrocortisone and rectal steroid enemas. Low stool frequency and CRP on day three following steroid initiation were predictive of treatment response, with clinical remission defined as three or fewer stools a day with the absence of visible blood after 7 days. Conversely, patients with more than eight stools a day, or three to eight stools a day with CRP > 45 mg/l had an 85% risk of steroid failure and progression to surgery [217].

After failing to respond to 3–5 days of intravenous corticosteroids, patients should be considered for intravenous ciclosporine (2 mg/kg/day) or infliximab (5 mg/kg IV) or for colectomy. Close integration of the surgical and stoma therapy teams in the multidisciplinary management team should continue and patients counselled about colectomy as the best alternative treatment for their colitis. In view of the significant numbers of patients with acute severe colitis who ultimately require colectomy [199], surgery should not be viewed as treatment failure but rather as a reasonable treatment option with potential advantages in terms of quality of life, symptom relief and avoidance of ongoing need for medication.

There have been many additional predictive factors described in an effort to identify which patients are likely to progress to colectomy at this stage. Care must be taken to distinguish predictive factors for acute severe colitis from lesser degrees of activity:

- Age over 40 years, presence of body temperature > 37.5°C and ongoing active disease despite treatment with a thiopurine have all been associated with failure of rescue therapy;
- High faecal calprotectin on admission was seen in cases that failed both steroid and infliximab therapy and progressed to colectomy within 1–8 days after initiation of rescue therapy [218].

Several clinical predictive indices have been proven to perform well in identifying those who require salvage therapy within only 3–5 days of admission; patients experiencing more than eight bloody stools per day or three to eight stools per day plus a CRP > 45 mg/l were both associated with a colectomy rate of 85% [217]. Lindgren *et al.* [219] developed the fulminant colitis

index based on the same variables as the Oxford index (stool frequency/day + 0.14 × CRP mg/l). Ho *et al.* [220] based the Scottish index on stool frequency, the presence of colonic dilatation and hypo-albuminaemia. Of these the Scottish index and the Travis score have been assessed using data from the National IBD audit. Both predicted treatment failure with steroids. In addition, the Travis score identified those patients who were likely to fail rescue therapy [220,221].

In a recently published study [222], an ulcerative colitis endoscopic index of severity (UCEIS) score of more than six on admission and faecal calprotectin > 1000 µg/g on day three were found to be early predictors of failure of intravenous corticosteroid therapy and the need for rescue therapy or colectomy.

Statement 4.3.

Colectomy provides a viable treatment option in the proportion of patients with acute severe colitis who fail to respond to medical therapy with potential advantages in terms of quality of life, symptom relief and avoidance of ongoing need for medication.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.1% (SA 65.7%, A 31.4%)

Statement 4.4

Predicting the need for, and timing of, colectomy requires careful continuous monitoring and good clinical judgement.

Level of evidence: III

Grade of recommendation: C

Consensus: 97.1% (SA 77.1%, A 20.0%)

Toxic colitis

In a longitudinal study over four decades Clemente *et al.* observed that although overall colectomy rates had reduced in the last four decades the rate for patients with complicated disease on admission, or who developed local or systemic complications during the admission, remained unchanged. The early colectomy rate was similar across the four cohorts: 84.6% (11/13), 71.4% (5/7), 87.5% (7/8) and 50% (4/8) in cohorts 1, 2, 3 and 4, respectively ($P = 0.2$) [223].

Approximately 5% of patients with acute severe colitis will progress to a severe toxic colitis, defined as more than 10 stools per day, daily continuous bleeding, requirement for blood transfusion, elevated CRP (> 30 mg/l), fever (> 37.6°C), tachycardia (90 b.p.m.), abdominal tenderness and distension, and colonic dilation on AXR [202].

The majority of patients with toxic megacolon are diagnosed on admission. Many patients with IBD who develop toxic megacolon will have underlying secondary gastrointestinal infection [213,224]. Management is the same as for acute severe colitis with the addition of intravenous antibiotics to cover microbial translocation and emergency colectomy in selected cases. Careful clinical monitoring includes reassessment throughout the initial 24 h of intensive medical management, which should include repeat AXR. Provided there is evidence of decreasing distension and associated improvement in the patient's clinical condition then medical management may be continued. Failure to progress or increasing distension, deteriorating physiological state and increasing CRP mandates immediate surgery [202,224,225]. Steroids may attenuate physical signs, and if there is uncertainty a CT scan may help with decision-making [216]. However, even subtle localized peritonism implies potential microperforation. Given the high potential mortality management decisions are best made by senior surgeons and physicians.

Approximately 50% of cases will respond to medical therapy [226]. Perforation in the presence of toxic colitis has a high mortality rate [226,227] that increases with increasing time interval between perforation and surgery. Symptoms and signs may be masked by ongoing medical therapy. Perforation is unusual in the absence of severe toxic colitis and those patients may not have signs of classic peritonitis. In cases where the patient has taken high doses of corticosteroids for a long time or when salvage therapy has been prolonged beyond 7 days, the morbidity rate is greatly increased [227]. Prolonged observation (over 3 days with steroid therapy and over 7 days with biological therapy) is counterproductive, as over time the risk of toxic colitis and perforation increases and mortality rates remains as high as 50% [228].

Although in the past toxic colitis was thought to be a rare complication of Crohn's disease compared with ulcerative colitis, recent studies have shown that Crohn's colitis is the underlying diagnosis in as many as 50% of cases [228].

Statement 4.5.

Patients with severe acute colitis and signs of colonic distension should be closely monitored with regular clinical review and daily abdominal radiographs to monitor for increasing dilatation until there is definite clinical and radiological improvement. Colectomy is the preferred treatment choice if there are clinical signs of toxic megacolon or worsening dilatation on abdominal radiography.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 93.8% (SA 53.1%, A 40.6%)

Severe bleeding in IBD

In patients with ulcerative colitis, those with severe haemorrhage have extensive colitis and almost all have pan-colitis. Severe bleeding in this context is an indication for urgent colectomy. Given the relative infrequency of severe bleeding in Crohn's disease, available medical literature on this topic is mostly in the form of retrospective case series, with reported incidence ranging from 0.6% to 4% [229]. In contrast to ulcerative colitis where the bleeding is usually diffuse, in Crohn's disease the bleeding is often from a localized ulcer which is not always in the colon. In a large single centre, 15% of cases were from bleeding in the small bowel [230].

Despite the relative rarity of severe bleeding in IBD, it accounts for approximately 5% of all urgent colectomies. Bleeding can occur at any age or disease duration, but most studies suggest that the bleeding occurs in a younger patient population [229,230]. Initial management should always include primary resuscitation with intravenous fluids and blood transfusion as in any patient with a significant gastrointestinal bleed. If the patient continues to be haemodynamically unstable the surgical team should be involved early in the course while continuing resuscitation.

Papi *et al.* [231] summarized five series of haemorrhage in Crohn's disease published between 1991 and 2001. Of the 101 patients included in this study, 37 (36.6%) underwent surgery during the first episode of bleeding and 64 (63.4%) underwent nonoperative management. These figures include some cases with small bowel disease.

In a retrospective case-controlled study of 70 patients with acute severe lower gastrointestinal bleeding the cumulative probability of bleeding after diagnosis of Crohn's disease was 1.7%, 3.6%, 6.5% and 10.3% after 1, 5, 10 and 20 years, respectively. Bleeding recurred in 29 patients (41.4%) after a median time of 3.2 months. The cumulative probability of re-bleeding tended to be lower in patients treated with infliximab than in those receiving other treatments ($P = 0.076$). Both azathioprine and infliximab reduce the risk of re-bleeding [232]. Similarly, in a study population of 1374 cases of Crohn's disease with a prevalence of acute lower gastrointestinal bleeding of 5.3% multivariate analysis identified left colon disease, azathioprine use > 1 year and previous bleeding as risk factors for bleeding. Older age, surgical treatment and a previous history of bleeding were risk factors for re-bleeding. Overall mortality was 8.2% (six of seven were postoperative and related to co-morbidity) [233].

Statement 4.6.

Severe lower gastrointestinal haemorrhage due to inflammatory bowel disease is rare. After adequate resuscitation and exclusion of other sources, severe haemorrhage due to ulcerative colitis is usually related to disease severity and likely to require urgent colectomy. In Crohn's colitis, bleeding is often localized and may be managed using endoscopic or interventional radiological techniques, although colectomy will be required in many cases.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100.0% (SA 37.5%, A 62.5%)

Perforation

Free perforation occurs in approximately 2% of patients with ulcerative colitis and is usually associated with toxic colitis or megacolon. Occurrence without megacolon is rare and should raise the suspicion of Crohn's disease. In Crohn's disease, free perforation is also a rare but severe complication occurring in 1–3% of all patients. Perforations in Crohn's disease may occur anywhere in the gastrointestinal track including the ileum, jejunum and gastro-duodenum. Colonic perforations account for 20–50% of all cases of perforation in Crohn's disease [234,235]. Colonic perforation often occurs during a bout of toxic colitis, or acute exacerbation of chronic disease, especially in the presence of distal obstruction. All reported cases have been managed by colectomy [123,234,235].

Statement 4.7.

Colonic perforation is rare in ulcerative colitis and is usually associated with an acute flare. Colonic perforation in Crohn's is also rare but frequently presents in apparently quiescent disease. Colectomy is the treatment of choice for colonic perforation in inflammatory bowel disease.

Level of evidence: III

Grade of recommendation: C

Consensus: 90.6% (SA 56.3%, A 34.4%)

Surgical technique

Abdominal colectomy with ileostomy is the mainstay of the management of patients with severe colitis [236]. More and more frequently this is being attempted laparoscopically as there is a reduction or indeed absence of adhesions compared with open colectomy. This is particularly pertinent to facilitating subsequent restorative surgery. Another perceived advantage is a

reduction of incisional hernias [237]. In a systematic review and meta-analysis of nine nonrandomized studies, six cohort studies and three case-matched series comprising 966 patients in total, the pooled risk ratio of wound infection was 0.60 (95% CI: 0.38–0.95; $P = 0.03$) and that of intra-abdominal abscess was 0.27 (0.08–0.91; $P = 0.04$), both in favour of laparoscopic surgery. Pooled risk ratios for other complications showed no significant differences. The combined conversion rate was 5.5% with a significant reduction in postoperative stay, again favouring laparoscopic colectomy [238]. This study comprised a heterogeneous mix of hand-assisted and total laparoscopic colectomies, which were analysed together. There has been, to date, no systematic review of solely laparoscopic colectomy and there are no randomized trials of open *vs* laparoscopic colectomy. Laparotomy is still recommended in cases with toxic dilatation, perforation and severe haemorrhage [202,238–240]. SILS has also been described for subtotal colectomy in IBD. Given the small numbers of highly selected cases and limited evidence of superiority over conventional laparoscopic approaches, it has not been widely adopted [241].

Whether surgical access is open or laparoscopic the subsequent colectomy shares common specific principles:

- The colon may be mobilized sequentially, initiated at the caecum or sigmoid according to surgeon preference. Mobilization starting from the right colon, with preservation of the ileo-colic supply to distal small bowel if a subsequent pouch is planned, is often more common in open surgery. In laparoscopic surgery, transection of the rectosigmoid with subsequent left initial colon mobilization may be preferred. Neither approach is associated with particular benefit. Where omentum is adherent to the colon it should be resected *en bloc* to avoid soiling from underlying sealed perforations (commonly encountered at the splenic flexure).
- If the colon is extremely friable then an open procedure is indicated. The resection technique should be modified to initial early division of the bowel and sequential division of the mesentery with packing of the bowel into a bowel bag to avoid excessive soiling [202].
- In cases with severe dysplasia, cancer or a mass lesion then colectomy is performed with high ligation of the lymphovascular pedicles.
- The inferior mesenteric artery is preserved if a restorative procedure is planned for a later date.

There are several options for handling of the rectal stump, and this continues to be a subject of debate. Intra-peritoneal stump closure with division of the rectosigmoid at the pelvic brim with rectal drainage has a low complication rate and is thought to facilitate

subsequent restorative surgery [242,243]. Closure with subcutaneous placement of the stump necessitates leaving a longer length of sigmoid and rectum with a subsequent high incidence of wound breakdown. Proponents of this technique argue that wound breakdown is a less morbid complication than intra-peritoneal stump breakdown [244], that the rectal stump is easily located at the time of restorative surgery and that subcutaneous stump placement is more acceptable to patients than the other alternative of exteriorizing the distal bowel as a mucous fistula. In reality many surgeons advocate selective use of either exterior intra-abdominal closure depending on the severity of disease at time of surgery [245]. In a retrospective series that compared both intra- and extraperitoneal closure there was no difference in morbidity; neither technique could offset the risk of pelvic sepsis. Subcutaneous placement of colorectal stump was associated with more frequent but less morbid complications. [246].

It should be noted that, in the laparoscopic era, the intraperitoneal technique has a distinct advantage when it comes to restorative surgery. A completion proctectomy can begin laparoscopically using the same port sites previously selected for the colectomy. In those cases where the rectosigmoid stump is brought to the subcutaneous tissue, it is necessary to begin a completion proctectomy with mobilization of the colorectal segment using the existing extraction site incision. The majority of laparoscopic series favour intraperitoneal closure even if the authors previously favoured subcutaneous closure [247]. The current rectal stump leak rate in large series ranges from 0 to 5% [246].

Statement 4.8

There are short-term advantages in a laparoscopic approach to colectomy where feasible. An initial laparoscopic approach may also facilitate subsequent planned restorative procedures. Laparotomy is recommended in emergency cases with toxic dilatation, perforation and severe haemorrhage. If indicated, colectomy should not be delayed due to lack of laparoscopic expertise.

Level of evidence: II

Grade of recommendation: A

Consensus: 87.5% (SA 53.1%, A 34.4%)

Statement 4.9

Management of the rectal stump remains controversial and will mostly be determined by personal surgical preference. Although pelvic sepsis after

colectomy is relatively low, proactive management is advisable to minimize morbidity.

Level of evidence: IV

Grade of recommendation: D

Consensus: 81.8% (SA 48.5%, A 33.3%)

Perioperative management

Nutrition

Inflammatory Bowel Disease patients undergoing total colectomy will frequently be malnourished. Patients with weight loss >10%, body mass index (BMI) <18.5 kg/m² or albumin <30 g/l have been shown to be at significantly increased risk of postoperative complications [237,241]. Nutritional guidelines for IBD were published by the European Society for Clinical Nutrition and Metabolism (ESPEN) in 2017 [248]. Most recommendations are based on consensus among experts or extrapolated from the general surgical population. Specific recommendations in the perioperative period are avoidance of long periods of preoperative fasting, re-establishment of oral feeding as early as possible after surgery, integration of nutrition into the overall management of the patient, metabolic control (e.g. of blood glucose) and early mobilization.

Patients with acute colitis can usually be managed both pre- and postoperatively with oral nutritional supplements. In a randomized trial of 42 patients with moderate to severe flares of ulcerative colitis, enteral nutrition increased median serum albumin by 16.7% (0.5–30.4%) whereas parenteral nutrition was associated with only a 4.6% gain (12.0–13.7%) ($P = 0.019$). Enteral feeding was also associated with a much lower complication rate [249].

The benefits of early feeding have been evaluated by a Cochrane Review. Fourteen RCTs representing a total of 1224 patients all undergoing gastrointestinal surgery were assessed. Individual clinical complications failed to reach statistical significance, but the direction of effect suggests that earlier feeding may reduce the risk of postsurgical complications. Mortality was the only outcome to show a significant benefit, but was not necessarily associated with early commencement of feeding, as the reported causes of death were anastomotic leakage, reoperation and acute myocardial infarction [250].

In patients undergoing emergency surgery, artificial nutrition should be initiated if the patient is malnourished at the time of surgery or if oral diet cannot be recommenced within 7 days after surgery. Patients with acute toxic colitis are most likely to need parenteral nutrition.

Statement 4.10.

Patients with severe malnutrition (defined by weight loss > 10% within the last 3–6 months, body mass index < 18.5 kg/m² and/or albumin levels < 30 g/l), are at an increased risk of postoperative complications. Preoperative and postoperative nutritional therapies should be considered.

Level of evidence: IV

Grade of recommendation: D

Consensus: 88.6% (SA 57.1%, A 31.4%)

Prevention of venous thromboembolism

There is extensive data that patients with active IBD have an increased risk of both venous and arterial thrombosis due to a hyper-coagulable state [251] (see Section 1). Thrombo-prophylaxis does not appear to precipitate excessive bleeding during flares of IBD, even in patients experiencing bloody diarrhoea, and is recommended in all patients with acute severe colitis [252]. Despite this evidence and extensive recommendations in guidelines the uptake of the routine use of venous thromboembolism prophylaxis by physicians is still low [253]. Results from the UK national IBD audit are more reassuring with incremental increases demonstrated for venous thromboembolism prophylaxis from 2008 to 2012 and use in 94% of inpatients reported in the 2014 audit report [200].

Involvement of a stoma therapist

Approximately one-fifth of stomas have to be sited in an emergency; 15% of patients undergo surgery without the stoma site having been marked in advance [254]. The difficulties of stoma siting by the operating surgeon have been studied prospectively against the gold standard of a qualified stoma therapist and found to be inadequate [255].

Preoperative stoma site marking and counselling aim to improve patient rehabilitation and adaptation to a new medical condition. In a prospective study to evaluate the impact of preoperative siting on quality of life, independence and complications were evaluated utilizing a validated assessment tool. A total of 52 patients were marked and 53 not marked. There was a significant difference in favour of the premarked group in 18/20 items assessed [256]. Bass *et al.* compared the outcomes of 292 patients whose stoma sites were marked compared with 301 patients whose stomas were not marked. The authors reported that the overall complication rates in the marked and the unmarked groups were 32.5% and 43.5%, respectively, with significantly

more early postoperative complications occurring in the unmarked patients ($P < 0.0075$) [257].

Statement 4.11.

Patients being considered for colectomy should have timely access to a stoma therapist for counselling and stoma siting.

Level of evidence: III

Grade of recommendation: B

Consensus: 97.1% (SA 82.9%, A 14.3%)

Steroid therapy

Most patients having a colectomy will be either refractory to medical therapy or have acute severe colitis. Almost invariably patients will have been on corticosteroids for some time or be on supra-physiological doses of steroid (> 10 mg prednisolone). It is well recognized that patients who have used corticosteroids within the past year are at greater risk for adrenal insufficiency, especially following surgery, and may need stress-dose corticosteroids perioperatively. In a survey of practice published in 1996, 84% of 348 colorectal surgeons would administer 100 mg of hydrocortisone phosphate intravenously before surgery. Sixty-two per cent would give 100 mg of hydrocortisone phosphate intravenously every 8 h postoperatively, tapering the dose to 50 mg intravenously every 8–12 h. Most patients (49%) received 20 mg of prednisone per day when their oral intake was resumed with a slow taper over several weeks [258].

The frequent use of such large (stress) doses was stimulated by reports of mortality from adrenal failure. However, the dose of cortisone required to cause adrenal insufficiency is unknown, as is the duration of treatment that can accurately predict its development, although it is commonly believed that several weeks of systemic corticosteroid supplementation are required before adrenal gland function is suppressed. What is known is that subjects on corticosteroids may be able to respond to surgical stress by increasing endogenous corticosteroids and do not necessarily require large doses of steroid [259]. Friedman performed 35 major orthopaedic surgeries among 28 patients receiving chronic steroids (mean daily dose of prednisone 10 mg) without administration of stress-dosed corticosteroids and noted no clinical evidence of adrenal insufficiency [260]. Zaghyan *et al.* [261] reported no significant improvement in postoperative haemodynamic stability with the use of high-dose perioperative corticosteroids compared with a low dose or none.

A subsequent randomized trial in patients taking prednisone > 7.5 mg daily for several months and with documented secondary adrenal insufficiency showed no increased episodes of haemodynamic instability after saline *vs* intravenous cortisol, in addition to their usual daily dose of prednisone during major surgery [262].

Statement 4.12.

Steroid use should be gradually reduced after colectomy for acute severe colitis. Clinicians need to be aware of the potential for prolonged adrenal suppression in some patients.

Level of evidence: III

Grade of recommendation: GP

Consensus: 94.1% (SA 70.6%, A 23.5%)

Outcomes

Postoperative mortality

In-hospital mortality after emergency colectomy is higher than after elective surgery [263]. Current rates vary from 5–6% in population-based studies for emergency colectomy and 0–1.5% for elective surgery [35,40,244,264–266]. Factors contributing to mortality include low hospital total colectomy volume, comorbidity and greater age. Rates of morbidity and mortality after colectomy for ulcerative colitis are associated with hospital volume [33].

Subsequent restorative surgery

Having a colectomy in a low-volume hospital also decreases the odds of subsequent reconstruction. Reconstruction after colectomy is variable depending on country and whether IBD surgery is centralized. In a Swedish population-based cohort study over 10 years, 2017 colectomies were performed from a total of 2818 IBD operations. In patients initially treated with a subtotal colectomy with an ileostomy, only one-third (680/2017) had their intestinal continuity restored [40]. Previous hospital-based studies have shown that 42–70% of patients undergo reconstructive surgery after colectomy [247,267] (49, 50, 54, 86). Of those who do not undergo reconstruction the rate of subsequent proctectomy varies from 86% in older series to 18% in the era of pouch surgery. Of the 20% who choose to keep the rectum many will default surveillance endoscopy [268].

Statement 4.13.

Given the high mortality rates associated with urgent colectomy in low-volume units, consideration should

be given to early transfer of patients with acute severe colitis to high-volume units.

Level of evidence: IIA

Grade of recommendation: B

Consensus: 88.2% (SA 50.0%, A 38.2%)

Cancer in retained rectum

Although there are evidence-based guidelines for cancer surveillance in IBD no evidence-based recommendations have been made for postoperative surveillance. Rates of cancer in the retained rectum after colectomy for IBD are variable. In a meta-analysis of published studies the prevalence and incidence of cancer after colectomy were < 3%. Risk factors include a previous history of colorectal cancer and duration of disease prior to colectomy [269].

Statement 4.14.

Patients with retained rectum should have regular surveillance of the rectal stump. The frequency of surveillance should be based on duration of disease and any history of colorectal cancer or dysplasia.

Level of evidence: III

Grade of recommendation: B

Consensus: 97.1% (SA 65.7%, A 31.4%)

Appendicectomy and ulcerative colitis

There is substantial epidemiological, experimental and clinical evidence that the appendix plays a role in the development and course of ulcerative colitis [270–272]. A systematic review has shown that appendicectomy might influence the disease course in ulcerative colitis patients, with possible reduction in relapse rates and reduction in the need for immunosuppression and for more extensive surgery [84]. The benefit appears most pronounced for those with proctitis and distal colitis [84]. As the quality of evidence is poor and there may be an increased risk of dysplasia after appendicectomy [273] high-quality research is required before appendicectomy can be definitively recommended as therapy for patients with ulcerative colitis. One such study is currently recruiting [85].

Proctectomy and proctocolectomy

Many guidelines for the care of patients with ulcerative colitis describe the ileoanal pouch as the standard of care in the surgical treatment of the disease [1]. However, it is important to remember that (pan)

proctocolectomy remains the only treatment (surgical or medical) to eradicate and ‘cure’ ulcerative colitis. It retains an important place amongst the available treatments despite committing patients to a permanent end ileostomy, and all other procedures should be evaluated in comparison with it [274,275].

Crohn’s disease remains an unwise indication for the ileoanal pouch procedure (sometimes called restorative proctocolectomy) and so (pan)proctocolectomy in the case of Crohn’s colitis or less frequently proctocolectomy alone remain important treatment choices [276].

In this section, the term proctocolectomy will be used in preference to panproctocolectomy to describe complete removal of the colon, rectum and anus. Surgical removal of the rectum alone with sparing of the colon is described as proctectomy, with the term completion proctectomy used when the colon has already been removed. This guideline does not discuss the Kock pouch as an alternative to end ileostomy as this is covered in Section 8.

Indications for proctocolectomy and proctectomy

Ulcerative colitis

Proctocolectomy is an operation that is rarely indicated in an emergency setting. In theory, a proctocolectomy may be indicated in an emergency situation if there is massive haemorrhage from the rectum or perforation of the rectum, although both are extremely rare occurrences. Most surgeons would consider subtotal colectomy and ileostomy most appropriate for fulminant or perforated colitis. This can be performed successfully either laparoscopically or by open surgery [277]. The procedure requires the formation of an ileostomy, with either exteriorization of the rectosigmoid stump as a mucous fistula or subcutaneous burial beneath the lower end of the wound to mitigate the consequences of stump leak [278] or with internal rectal closure at the pelvic brim.

The more common indications for proctocolectomy in ulcerative colitis can be categorized as either urgent or elective. Broadly speaking, urgent indications result from a failure to control disease with medical management and the elective indications are for reducing the risk of, or treating, neoplasia. In both situations, the option of ileoanal pouch formation and the likely functional outcomes should be discussed as appropriate with the individual patient. Predictors of poor pouch function, such as poor continence, mobility or other anorectal disease, may lead some patients to choose proctocolectomy over ileoanal pouch and avoid a reduced quality of life and the need for further

interventions. A diagnosis of rectal cancer may lead to a preference of proctocolectomy over ileoanal pouch formation, although it is not an absolute contraindication. The effect of preoperative radiotherapy for a rectal cancer on subsequent pouch function is not well documented, but as might be expected postoperative radiotherapy of a pouch increases complications and failure rates [279]. Clearly if locally advanced rectal cancer is identified before surgery, careful planning to avoid pouch radiation is required.

It is important when counselling the patient to make it clear that quality of life may be very good after a proctocolectomy and ileostomy. Although limited by small sample size, significant heterogeneity and limited follow-up, a meta-analysis has suggested equivalent overall health-related quality of life between total proctocolectomy with ileostomy and ileoanal pouch anastomosis [280].

Statement 5.1.

Proctocolectomy with end ileostomy offers equivalent health-related quality of life to ileoanal pouch surgery in selected patients with ulcerative colitis.

Level of evidence: I

Grade of recommendation: B

Consensus: 85.7% (SA 40.0%, A 45.7%)

Crohn’s disease

The indications for proctocolectomy in Crohn’s colitis are more complex. This is because the pattern of disease may allow less extensive alternatives to removal of the colon, rectum and anus. Clearly if there is uncontrolled pan-colorectal disease a proctocolectomy is the only option. Similarly, more radical surgery is required when the indication for surgery is cancer or high-grade dysplasia, because metachronous disease is common [281,282]. Although the evidence is less strong, several studies have demonstrated that perianal Crohn’s disease is associated with increased risk of recurrence which may be complex [283,284], suggesting that more radical excision and stoma formation in this situation may give the optimal long-term outcome. In cases with isolated segmental colonic disease, a segmental colectomy or subtotal colectomy and ileorectal anastomosis are bowel-preserving options. Indeed, in disease isolated to the anorectum, a proctectomy only may occasionally be carried out [99,276].

All these circumstances require a balance in judgement and decision-making, and careful counselling of the patient. Proctocolectomy results in lower rates of

recurrent Crohn's disease but the risks of perineal wound and stoma complications are higher. The effects of a stoma on quality of life must also be considered. Less radical options potentially reduce complications and may avoid a stoma but at the expense of higher recurrence [285,286] and the potential for further surgery. A recent meta-analysis [287] concluded that segmental, subtotal and proctocolectomy were equally effective treatment options for patients with colonic Crohn's disease and the choice of operation remains fundamentally dependent on the extent of colonic disease. A lower recurrence rate with panproctocolectomy was confirmed and segmental colectomy had the highest risk of postoperative complications. If the extent of disease allows for more than one of these options, then these data should be taken into account when counselling patients.

Statement 5.2

In Crohn's colitis, segmental colectomy, subtotal colectomy and proctocolectomy are equally effective treatment options with the choice of operation dependent on the extent of colonic disease. Proctocolectomy will reduce risks of recurrence of colorectal disease at the expense of a higher complication rate than subtotal colectomy and a permanent stoma.

Level of evidence: I

Grade of recommendation: B

Consensus: 90.6% (SA 28.1%, A 62.5%)

Indication for completion proctectomy

Completion proctectomy with removal of the rectum and anus is undertaken following a previous subtotal colectomy and is a procedure which commits the patient to a permanent end stoma. The indications for this procedure may be slightly different between ulcerative colitis and Crohn's disease.

Ulcerative colitis

The rate of proctectomy is relatively higher in patients with ulcerative colitis compared with Crohn's disease. The pattern of disease in ulcerative colitis is such that it almost always involves the rectum and progresses proximally to produce a pan-colitis in some patients. Following subtotal colectomy, the rectal stump may produce significant symptoms in terms of discharge and discomfort. Severe symptoms, dysplasia and the risk of malignancy are all indications for proctectomy. Recent population data from Sweden suggest that although the risk of malignancy in a defunctioned rectum or after

ileorectal anastomosis is low, it remains higher than in the general population. This study of 5886 patients demonstrated an increased risk in the presence of sclerosing cholangitis or if there was preexisting dysplasia in the rectum or colon [288]. The decision should be considered in the context of a choice of possible restorative procedures, either the ileoanal pouch (see Section 6) or less commonly ileorectal anastomosis (see Section 7).

Statement 5.3.

Indications for completion proctectomy in ulcerative colitis include ongoing symptoms from the rectal stump and avoidance of future malignancy. Dysplasia in the rectal stump in IBD is a strong indication for early completion proctectomy. Patients with sclerosing cholangitis or dysplasia present in the initial colectomy specimen are at high risk of malignancy in the retained rectum.

Level of evidence: II

Grade of recommendation: B

Consensus: 97.0% (SA 63.6%, A 33.3%)

Crohn's disease

Preservation of the rectum in patients with Crohn's colitis is more likely than in ulcerative colitis due to the possibility of disease sparing the rectum. Medical therapy may be used to reduce rectal disease activity and allow restoration of continuity with formation of an ileorectal anastomosis.

Indications for completion proctectomy in Crohn's disease include significant perianal fistulating disease, anal stricture or active proctitis, leading to poor bowel function if ileorectal anastomosis is undertaken. As mentioned above in regard to proctocolectomy, colonic or rectal malignancy is a strong indication for proctectomy since there is a significant incidence of metachronous colorectal cancers [281,282,289,290]. Although endoscopic surveillance can be considered many would also view colonic or rectal dysplasia as an indication for proctectomy. In the absence of dysplasia in the rectal remnant the risk of malignancy in the retained rectum is lower, so some may chose the option of surveillance to allow rectal preservation and restoration of continuity following a subtotal colectomy [291,292].

Surveillance of a retained rectum in IBD

If preservation of the rectal remnant is selected for ulcerative colitis or Crohn's disease, then surveillance should be carried out in accordance with BSG guidance. Essentially screening should start at around 10 years after onset of symptoms. This should be continued 5-yearly if

the patient is considered low risk or yearly if high risk [previous dysplasia in the colon, presence of primary sclerosing cholangitis or persistent atrophy and inflammation of the rectal mucosa (BSG guidelines)] (see Section 6).

Timing of surgery

In an ideal situation, preoperative steroids should be reduced and stopped, and immunosuppression halted; however, this is often not practical. If the patient is unable to reduce a high dose of steroids then consideration should be given to subtotal colectomy and ileostomy at this point with more definitive surgery later when the medication can be reduced or stopped (see Sections 5 and 13).

Physical and mental recovery from the initial surgery is important prior to definitive surgery being undertaken. Withdrawal of corticosteroids and immunosuppressive therapeutic agents may reduce the risk of postoperative complications, especially sepsis, although the evidence for the role of the latter is not as strong [293–295]. Restoration of nutritional status is also key to quick recovery from surgery and the promotion of perineal wound healing. These factors are important in the decision regarding timing of proctocolectomy or completion proctectomy.

A delay in proctocolectomy, completion proctectomy or a restorative procedure may be considered in a woman until after completion of her family to avoid the risk of tubal adhesions secondary to pelvic surgery with its impact on fertility and fecundity [296,297]. More recent evidence suggests that a laparoscopic approach may reduce this risk [294,298].

As in all patients undergoing major colorectal procedures a thorough preassessment and consent process is important which may include cardiopulmonary exercise testing in patients with significant comorbidity.

Statement 5.4

Proctocolectomy and completion proctectomy are ideally performed when oral steroid therapy is reduced to a minimum or stopped.

Level of evidence: II

Grade of recommendation: B

Consensus: 93.5% (SA 67.7%, A 25.8%)

Technical aspects of surgery

Perioperative care

There is no requirement for mechanical bowel preparation before proctocolectomy or completion

proctectomy. There will be no anastomosis and the dehydration caused by purgative laxatives is not justified. Prophylactic antibiotic use is recommended and there is no strong evidence to suggest that there is a benefit to extended use of prophylaxis in this group of patients.

Laparoscopic versus open surgery

The advantages of laparoscopic surgery in terms of patient recovery and fewer long-term adhesion-related problems are well described and detailed in other sections. There are no RCTs that compare the two methods in proctocolectomy alone. Open surgery remains a pragmatic approach where laparoscopy is not available, although if available it should be preferred.

High versus low vessel ligation

In the absence of dysplasia and with an indication for surgery of poorly controlled medical treatment it seems reasonable to forego high ligation of vessels. However, in the presence of malignancy or high-grade dysplasia, normal oncological principles and planes should be observed.

Preservation of omentum

There is no evidence to support the excision of the omentum *en bloc* with the transverse colon or its careful preservation in surgery for ulcerative colitis or Crohn's disease. The omentum may be important in moderating the immune response following surgery and be useful in filling the pelvis after the rectum is removed. However the omentum, if poorly preserved, may be a source of internal herniation and adhesion formation.

Rectal excision

The two major discussion points relating to rectal excision, either as part of a proctocolectomy or as completion proctectomy, are the preferred planes for rectal dissection (close rectal dissection *vs* total mesorectal excision, TME) and perineal excision (intersphincteric dissection *vs* an extrasphincteric approach). If there is malignancy or high-grade dysplasia, the approach should be one of TME from above and intersphincteric dissection from below only if the tumour is high enough in the rectum to allow this safely. The advantages of close rectal dissection are that by preserving the mesorectum, the risk of nerve damage is minimized and in addition there remains a smaller 'dead space' in the pelvis which may decrease the rate of pelvic sepsis and perineal hernia. This is offset by being more technically difficult to many surgeons who are much more familiar with the TME plane of dissection, and there is a potentially increased risk of bleeding. The use of energy devices potentially decreases the bleeding risk.

Similarly, the advantage of performing the perineal part of the procedure in the intersphincteric plane is that by minimizing the size of the skin incision, wound healing is improved [299,300]. Severe perianal disease in Crohn's disease may alter the approach on the perineal part of the dissection in order to minimize poor healing and sinus formation. This may even necessitate the involvement of plastic surgeons and the placement of a myocutaneous flap at the time of primary surgery where there is extensive perianal disease and significant tissue loss, including where rectovaginal fistulation necessitates excision of part of the vaginal wall [301,302].

Statement 5.5.

Total mesorectal excision with high ligation is recommended for rectal dissection when there is established dysplasia or rectal cancer on a background of colitis. Selection of plane of rectal dissection may otherwise be determined by surgeon preference.

Level of evidence: IV
Grade of recommendation: GP
Consensus: 96.6% (SA 65.5%, A 31.0%)

Stoma formation

The patient should be seen by a colorectal specialist stoma care nurse for counselling and preoperative marking of the eventual end ileostomy.

Statement 5.6.

Close rectal dissection, intersphincteric perineal dissection and omental interposition may help minimize pelvic sepsis, perineal wound complications and sexual dysfunction. Careful attention to the choice and execution of all surgical techniques is essential.

Level of evidence: IV
Grade of recommendation: GP
Consensus: 83.3% (SA 53.3%, A 30.0%)

Sound stoma formation may be the most important factor in determining long-term quality of life for a patient. If a patient has elected to have a nonreversible permanent ileostomy after proctocolectomy then every effort should be made to ensure perfect siting and minimize the complications of retraction, prolapse, stenosis and hernia formation. For further information on reducing complications after stoma formation see the ACPGBI Position Statement on parastomal hernia [303].

Statement 5.7

Careful focus on stoma preparation, siting and construction may reduce the incidence of common stoma problems following proctocolectomy.

Level of evidence: IV
Grade of recommendation: GP
Consensus: 94.3% (SA 62.9%, A 31.4%)

New techniques

Other recent developments in rectal surgery may have an impact in the future but have yet to find their place in IBD surgery. Proponents of robotic surgery argue that a reduced risk of urinary and sexual dysfunction may be one of the great advantages, and we await trial data [304,305].

Although a proctectomy often involves an abdominal and a perineal approach, it is possible to carry out completion proctectomy exclusively via a transperineal approach [306]. Using ultrasound dissection and with the patient prone, a close rectal dissection can be carried out to remove up to 25 cm of rectal stump.

Transanal TME (TaTME) has been described in small series for completion proctectomy but its use is now being explored more widely in rectal cancer [307]. It is possible to extrapolate this technique to incorporate a close rectal dissection plane. TaTME may have advantages in terms of nerve sparing, single stapled anastomosis, distal margin selection and potentially better function but it also has disadvantages in terms of technical challenge and the potential to cause damage to surrounding structures if done incorrectly. Further studies are needed to confirm whether this technique has merit.

Outcomes

Proctocolectomy is associated with fewer postoperative complications than ileoanal pouch formation. One often quoted series states the difference as 26% vs 52% [308]. After stomal problems, perineal wound healing is one of the most significant complications after proctocolectomy or completion proctectomy and is not necessarily reduced in the latter [309]. The risk may be ameliorated by intersphincteric dissection where possible [300]. Failed primary perineal wound healing is more common in patients treated for Crohn's disease (reported in up to 50%) than ulcerative colitis [310–312]. If it is possible to preserve the omentum and mobilize it sufficiently to reach the pelvis, particularly if there has been a TME approach, this may improve primary wound healing and reduce infection [313].

The formation of a chronic sinus or recurrent perianal sepsis due to presacral abscess are well recognized long-term consequences and are difficult to treat [314,315]. The use of a vacuum-assisted drainage techniques, such as Endo-SPONGE[®], may help with closure [316]. The sub-atmospheric pressure drains the excessive fluid from the extravascular space resulting in improved blood supply and oxygenation. After shrinkage of the cavity and removal of sepsis, the cavity can often be closed by suturing the external sphincter. In extreme and recalcitrant cases omental transposition (if not already done) [317], myocutaneous flap interposition [318] and even hyperbaric oxygen therapy have been described [319].

Statement 5.8

A chronic perineal sinus may be treated with negative pressure drainage, but may occasionally require further intervention with omental interposition, myocutaneous flaps and/or hyperbaric oxygen.

Level of evidence: IV

Grade of recommendation: D

Consensus: 93.5% (SA 38.7%, A 54.8%)

There is an increasing focus of research on the role of the mesentery and its role in the recurrence of Crohn's disease. This has been extrapolated to the mesorectum, and there is a suggestion that whilst close rectal dissection may be useful in ulcerative colitis, leaving the mesorectum in Crohn's disease may be deleterious and a TME may be better, although more evidence is awaited [175, 320].

Urinary and sexual dysfunction can occur with any pelvic dissection. In men this may result in impotence or retrograde ejaculation. It is difficult to be clear of the absolute risk, early commentators noting 3% [321]. Laparoscopic surgery may decrease rates, perhaps by better visualization [322]. The removal of the rectum can lead to a change in the axis of the vagina in women and create problems. This might be prevented by placing the omentum in the pelvis to fill the space left after proctectomy. Nevertheless women should be counselled about potential problems postoperatively [323].

Finally, there are a number of individual case reports of cancer of the ileostomy in patients with proctocolectomy performed for ulcerative colitis, underlining the need to maintain links with stoma care and patient education [324].

Statement 5.9

Both male and female patients having proctocolectomy or completion proctectomy should be

counselled carefully about the risks of urinary and sexual dysfunction.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.1% (SA 80.0%, A 17.1%)

Summary

Proctocolectomy and completion proctectomy remain important procedures in the surgical management of IBD. In general, these are usually planned procedures with close rectal dissection and intersphincteric dissection often employed to try to minimize the complication of poor perineal wound healing. Careful consideration should be given to modifying the approach in Crohn's with severe rectal (and mesorectal) disease or extensive perianal disease. Careful consenting and meticulous attention to stoma formation are critical in ensuring a good outcome for the patient.

Ileoanal pouch surgery

The ileoanal pouch procedure, or restorative proctocolectomy as it was originally described [325], has revolutionized the treatment of patients with ulcerative colitis who require surgery. It offers a potential cure for the disease whilst allowing restoration of bowel continuity. With nearly 40 years of experience there is a wealth of evidence to guide surgeons on the nuances of surgical technique and help them explain expected outcomes to patients considering pouch surgery.

Patient selection

Patients with ulcerative colitis who may be considered for pouch surgery essentially fall into three groups: severe acute colitis, chronic colitis refractory to medical therapy or those with dysplastic or neoplastic changes. However, the decision to undergo an ileoanal pouch is complex. Alternative surgical procedures exist and consist of colectomy/proctocolectomy and a permanent stoma, ileorectal anastomosis or Koch pouch. These alternative procedures are discussed in Sections 5, 7 and 8, respectively. There are clear advantages of a pouch procedure compared with these alternatives: avoidance of a permanent stoma, resection of all disease and potential cure. These need to be weighed against the potential disadvantages of an ileoanal pouch: the procedure may be challenging with a relatively high incidence of short- and long-term complications and an ultimate failure rate of over 6% [326]. In addition, functional

outcomes are seldom perfect and there are circumstances where pouch surgery may be inadvisable [327]. Most specialists would advise that a multidisciplinary team (including surgeon, gastroenterologist and pouch nurse specialist) should be involved in any decision regarding recommendation of a pouch procedure and there should be a rigorous counselling process to advise the patient of potential outcomes of surgery as well as alternatives.

Statement 6.1

Pouch surgery offers improved quality of life for patients with ulcerative colitis who need colectomy and wish to avoid a permanent stoma. Careful counselling of the patient as to the advantages and disadvantages of, and potential alternatives to, ileoanal pouch surgery is essential.

Level of evidence: II–IV

Grade of recommendation: B

Consensus: 97.1% (SA 61.8%, A 35.3%)

Intervention

Types of pouches

Parks' S pouch was the original ileoanal reservoir described in 1978 [328]. In 1980, Parks *et al.* reported outcomes in 21 patients [329]. Although all were continent during the day, 11 patients had to use a catheter to evacuate the pouch due to difficulty related to the length of the efferent spout. The W pouch was proposed by Nicholls and Pezim in 1984 [330], the potential advantages being a lower frequency of defaecation and no requirement for pouch intubation. Technically, the W pouch was not more difficult to construct, although it was more time-consuming. The bulkier configuration of the pouch may also result in difficulties in a patient with a narrow pelvis. Fifty centimetres of ileum is required for W pouch construction compared with 30–40 cm for a J pouch. The J pouch is the most widely performed modern pouch configuration because it is technically easy to construct and results in good function without the need for pouch intubation due to direct anastomosis of the pouch to the anal canal. Both pouch construction and pouch–anal anastomosis may be undertaken with hand-sewn or stapling techniques, although the latter now predominate.

Three randomized trials comparing J and W pouches have been published [331–333]. Two trials showed no difference in function between J and W pouches at 12 months of follow-up [331,332]. A further trial of 24 patients showed a mean daily defaecation frequency

of three for W pouches and five for J pouches at 12 months [333]. In this study, the W pouch was also associated with significantly less night-time defaecation and significantly less usage of antidiarrhoeals. A subsequent meta-analysis of 18 studies comprising 1519 patients concluded that all three reservoirs had similar complication rates. The S pouch was associated with the need for anal intubation. There was less frequency and less need for antidiarrhoeal agents with the W pouch compared with the J pouch [334]. However, long-term outcome data are not available and frequent reports of massive distension of W pouches over decades of follow-up may represent a real issue within clinical practice.

Statement 6.2.

Despite the W pouch being possibly associated with lower defaecatory frequency and less need for antidiarrhoeal agents at 12 months' follow-up, the J pouch remains the pouch construction of choice mainly due to technical simplicity but may also promise better long-term function.

Level of evidence: I

Grade of recommendation: B

Consensus 96.9% (SA 62.5%, A 34.4%)

Construction of the ileal pouch and pouch–anal anastomosis

The pouch and pouch–anal anastomosis may be constructed using various techniques.

In hand-sewn pouch–anal anastomosis with mucosectomy the mucosectomy of the anorectal canal is performed by sharp dissection through a trans-anal approach. The pouch is then brought through the anal canal and a sutured pouch–anal anastomosis performed. This allows precise determination of the level of pouch–anal anastomosis and avoids the possibility of leaving rectal mucosa behind.

In stapled pouch–anal anastomosis a transverse stapling device is applied at the level of the anorectal junction and the bowel is then divided. The anvil of a circular stapling device is held within the pouch with a purse-string suture. The circular stapling device is then inserted transanally and the pin deployed through the transversely stapled distal anorectum to connect and close the anvil and finally create the pouch–anal anastomosis by firing the instrument. A stapled anastomosis is easier and quicker to perform and may cause less trauma to the anal sphincter. However, the technique will leave rectal mucosa behind. Subsequent inflammation of this mucosa (cuffitis) can cause functional problems (see

below). In addition, there is a theoretical risk of dysplasia in this cuff.

A meta-analysis of 21 studies including 4183 patients concluded that both anastomotic techniques had similar postoperative outcomes; however, a stapled procedure resulted in improvement in nocturnal incontinence. Data on dysplasia were inconclusive [335]. A large prospective study of 3109 patients suggested superior function and better quality of life in the stapled group [336]. A subsequent meta-analysis of RCTs only suggested no functional difference between techniques [337]. Ten-year follow-up of the double-stapled technique has shown the incidence of cuff dysplasia to be 4.5% [338]. While there have been reports of cancer developing following an ileoanal pouch, this has occurred after mucosectomy as well as after the double-stapled technique [339]. Indeed, residual islands of rectal mucosa may remain at the ileoanal anastomosis in up to 7% of patients after mucosectomy [340].

Statement 6.3.

Stapled primary pouch–anal anastomosis appears superior to hand-sewn anastomosis in technical ease and postoperative pouch function.

Level of evidence: I

Grade of recommendation: B

Consensus: 90.0% (SA 53.3%, A 36.7%)

Role of pouch diversion

Pelvic sepsis occurs in about 5% of patients undergoing ileal pouch–anal anastomosis (IPAA) [341]. The presence of sepsis increases the pouch failure rate substantially (26%, compared with 5.9% in patients without this complication) and results in poorer function for those who retain the pouch [341]. Apart from the longer-term poorer functional outcomes, sepsis may also be life threatening.

The use of a defunctioning ileostomy may help to reduce the incidence or impact of pelvic sepsis. However, mechanical and functional complications may follow ileostomy creation. Readmission rates of up to 15% for dehydration have been reported [342]. Subsequent reversal also carries risks. One large series of 1504 patients reported a morbidity rate of 11.4% (mainly small bowel obstruction) and a mortality rate of 0.06% [343].

Omitting a loop ileostomy has the attractive advantages of requiring only one hospital admission and avoiding these potential complications. A review of 17 studies comprising 1486 patients reported no difference in functional outcome [39]. However, the development of a pouch-related leak was significantly more common in the

no-ileostomy group and the rate of pelvic sepsis was significantly lower in patients with a temporary ileostomy. Despite this review, the current data lack the power to robustly determine whether a pouch should be routinely defunctioned or not. It appears justified to omit diversion in selected optimized patients, provided leaks are identified early and salvaged. Nevertheless, three-quarters of pouch procedures in the UK are currently combined with a defunctioning stoma [38,344].

Statement 6.4.

Most surgeons currently use a diverting ileostomy when undertaking pouch surgery, although the diverting ileostomy may be reasonably omitted in well-selected and optimized patients. Early diagnosis with prompt treatment of pelvic sepsis is essential in all patients, especially those who are not diverted, in order to avoid long-term pouch dysfunction.

Level of evidence: III

Grade of recommendation: C

Consensus: 97.0% (SA 51.5%, A 45.5%)

Laparoscopic pouch formation, robotics, SILS and natural orifice specimen extraction techniques

Laparoscopic pouch surgery is technically feasible and safe, and is performed using the same principles as the open procedure. Relative contraindications are multiple intra-abdominal adhesions and obesity. A theoretical advantage of a laparoscopic approach is the reduction in adhesions. Following open ileoanal pouch surgery, small bowel obstruction occurs in up to 25% [345,346] with one-quarter of these patients requiring reoperation. Despite this a Cochrane Review concluded that short-term advantages of the laparoscopic approach seem to be limited and their clinical significance arguable [347]. A more recent meta-analysis suggests equivalent adverse event rates and long-term functional results to open surgery but acknowledges that current evidence is underpowered to detect true differences [348]. Both meta-analyses include studies that were published many years ago during the learning curve phase for laparoscopic surgery. Nevertheless, the lack of subsequent high-quality trials means that there is still no clear evidence that a laparoscopic approach offers significant advantages over open pouch surgery [349]. Regarding colectomy only, the evidence for a laparoscopic approach is slightly stronger (see Section 4).

Robot-assisted pouch procedures appear to offer acceptable short-term outcomes but there is no high-quality evidence to suggest superior outcomes compared with existing techniques [350]. Similarly, SILS

[351] and natural orifice specimen extraction techniques [352] have been described but require further investigation before recommendation.

Statement 6.5.

There is currently no clear evidence attesting to the overall benefits of laparoscopic pouch surgery. However, this approach may be employed by appropriately trained individuals.

Level of evidence: I

Grade of recommendation: C

Consensus: 90.9% (SA 33.3%, A 57.6%)

Intra-operative complications

Failure of the pouch to reach: the inability to achieve adequate mobility of the small bowel in order to anastomose the ileal pouch to the anal canal may be reduced by adequate patient selection. Certainly, a high BMI may predispose to lack of reach, and such patients should be encouraged to lose weight if circumstances permit. Adequate mobility and length should be confirmed prior to pouch construction. There is adequate mobility if the apex of the pouch lies 6 cm below the pubic symphysis [353]. If this is not the case, several steps can be taken to improve mobility:

- Scoring ('laddering') of the peritoneum of the small bowel mesentery
- Further mobilization of the small bowel to expose the third part of the duodenum and pancreas
- Construction of mesenteric windows [354]
- Division of the ileocaecal artery [355]
- Use of an S pouch [356]
- Use of an interposition vein graft to the superior mesenteric artery [357].

Transverse or circular stapler failure: failure of firing of either the transverse or circular stapler often requires mucosectomy and transanal hand-sewn technique to complete the anastomosis. J-shaped needles may allow more manoeuvrability and bite within the narrow confines of the anal canal [358].

Laparoscopic complications: current laparoscopic instrumentation makes cross-stapling of the anal stump challenging. Multiple firings of a laparoscopic stapler may result in a jagged transverse staple line. Alternatively, the distal rectum may be stapled too proximally. A utility Pfannenstiel incision to both remove the specimen and allow introduction of a transverse stapler may be employed. Transanal techniques have also been employed [359]. A totally intracorporeal laparoscopic approach has two particular risks. A 180° twist in the pouch may be easily overlooked and risks loss of the pouch. Extra

caution must also be exercised to not incorporate the vaginal wall in the anastomosis [358,360].

Immediate postoperative complications: haemorrhage from staple line bleeding may be controlled with examination under anaesthetic, Foley catheter insertion and irrigation. Adrenaline solution or even cautious diathermy/suture ligation of a bleeding vessel may be possible. Failure to control may require laparotomy.

Sepsis is common, occurring in up to 25% of patients [358], and is the commonest cause of pouch failure. Intra-abdominal abscesses require percutaneous drainage and antibiotic therapy. Pelvic abscesses that cannot be drained percutaneously require examination under anaesthesia and drainage through the anastomosis if possible. The use of endoscopically placed suction devices is beneficial [361]. Prompt treatment may salvage the pouch whereas delay results in a stiff noncompliant pouch and pouch excision in 40% [362].

An abscess may result in a persistent anastomotic sinus [363]. Perhaps 50% may heal with prolonged defunctioning; for those that do not, curettage and deroofting may help [364]. Gluing of the sinus track has been described [365] but is of uncertain benefit.

Statement 6.6.

Awareness and prompt treatment of common postoperative problems after pouch surgery is essential to avoid unnecessary morbidity and preserve long-term pouch function.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.1% (SA 62.9%, A 34.3%)

Postoperative pouch function

Most studies on pouch function are now quite dated. Generally, function is influenced by the length of follow-up [366], although it appears to remain remarkably stable after the first 1–2 years following construction [367]. Children adapt more quickly than adults and there is a lower frequency of defaecation in adolescents 6 months after ileostomy closure than in adults [368]. Assessment of functional outcome is complicated by the lack of uniformity in defining continence, urgency and soiling [369] and is modified by the presence of co-existing irritable bowel syndrome, which may in part explain the enormous variation in defaecation frequency in patients followed up for 2 years or more [370].

The incidence of complete continence varies widely, because of the lack of uniformity in both definition and patient perception. With these caveats, complete continence in pouch patients occurs in over 80% in most

carefully audited series. In addition, most series suggest that 15–30% of patients need to use pads and that up to 16% of patients may be incontinent [371,372]. However, over 30% of patients may be incontinent of flatus [373].

Soiling is a common complication [374], occurring in up to 20% of patients during the day but over 50% at night [375], and is responsible for perianal excoriation, seen in up to 40% of patients at 1 year. Soiling is generally more common in patients who have had a mucosectomy [376]. Soiling does seem to improve with time: Wexner *et al.* [371] found that in 63% of patients soiling became less troublesome up to 5 years after operation.

Ability to distinguish between gas, liquid and solids appears to be preserved in around 90% of patients [377]. Discrimination is preserved even with loss of the anal transition zone and an anastomosis at the dentate line [378]. Urgency is the one symptom that is almost universally improved after a pouch procedure, provided there is no pouchitis. In one large study deferment of defaecation for longer than 1 h was a feature of all patients, and 84% said that they could defer defaecation for more than 2 h [379].

As mentioned earlier, there is an enormous variation in stool frequency, determined largely by diet. Nevertheless it is clear that frequency of defaecation improves with duration of follow-up, being recorded as eight stools in 24 h at 1 month, six stools at 6 months and five after 9 months [380]. Although it seems logical that frequency would be directly related to gut transit, Goldberg *et al.* [381] found no correlation. Instead, frequency was directly related to pouch capacity. This would be consistent with the finding that a W pouch appears to reduce frequency compared with a J pouch [334].

Statement 6.7.

Well-selected patients have good continence after pouch surgery; urgency and frequency improve with time, but soiling may persist, especially at night.

Level of evidence: III

Grade of recommendation: GP

Consensus: 94.1% (SA 50.0%, A 44.1%)

Quality of life

Pouch surgery is essentially carried out to improve quality of life, but measuring quality of life in pouch patients is difficult. Factors that impact on quality of life include body image, especially scars and a stoma in particular, resulting in potential isolation and social compromise; fear of an operation and its potential

complications, recurrence and malignancy; general ill health from anaemia, malnutrition and lack of energy and disturbed bowel function, especially incontinence, which is usually worse with diarrhoea. Other factors include sexual function, pain, mental health and the complications of medication, especially steroids. Perhaps a stoma and incontinence are the most feared complications of surgery for colitis.

Although there are numerous studies on quality of life in patients with colitis undergoing ileoanal pouch surgery, most are of moderate or low methodological quality. A detailed systematic review suggested that only 3 of 33 studies identified could be considered high quality [382]. Despite this, all studies supported the observation that health-related quality of life and health status improved in patients after pouch surgery and that the levels reached those comparable with a healthy population. The authors point out several caveats which mean that these results should be treated with caution over and above the methodological weaknesses of the meta-analysis. These include the fact that quality of life may change with time.

Late postoperative complications

Small bowel obstruction. Small bowel obstruction is the most common complication after an ileoanal pouch with an incidence of up to 25% [342,343], with one-quarter of these patients requiring reoperation. In most cases the cause is adhesional [342,383] although rarer causes related to pouch construction have been described [358].

Stricture. Strictures at the pouch–anal anastomosis are not uncommon, causing symptoms in 16% of patients [358]. Symptoms include straining and incomplete evacuation as well as watery stools and urgency. Often the stricture is the consequence of previous anastomotic complication (abscess or partial dehiscence) but Crohn's disease should be considered, particularly if the stricture is proximal to the anastomosis. Soft and short strictures may respond to simple dilatation, but more refractory strictures require more complex procedures, ranging from advancement flaps to pouch advancement (see Section 13).

Fistula formation. This usually results from inadvertent enterotomy during the pouch procedure but may also arise from the pouch. Management is covered in Section 13. Pouch–vaginal fistula is covered in Section 10.

Portal vein thrombosis. Patients undergoing a pouch procedure are three times more likely than the general

population to develop venous thrombosis and acquired portal vein thrombosis is surprisingly common. Symptomatic thrombosis occurs in about 6% of patients but asymptomatic thrombosis may be as high as 40% [384–387]. Symptoms range from nonspecific abdominal pain to features of an acute abdomen. A high index of suspicion should be maintained in those who fail to thrive after discharge. CT is diagnostic and anticoagulation for 3–6 months usually resolves symptoms with no apparent sequelae [384,387].

Pouch prolapse. Although rare, 83 cases of pouch prolapse have been described [388]. Minor mucosal prolapse can be treated conservatively with stool bulking agents or local procedures [389]. Full-thickness prolapse requires more invasive surgery and various pouchopexy procedures may be considered.

Cuffitis. Inflammation in the rectal cuff in the area between the anastomosis and the dentate line is a common cause of pouch dysfunction that may mimic pouchitis. There are few published data on the diagnosis, management and prognosis of cuffitis, but it has a similar presentation to colitis with bloody diarrhoea and urgency. Biopsies from the cuff at endoscopy usually help to clinch the diagnosis. Cuffitis is a particular risk with use of stapling techniques, and ECCO guidelines suggest that the maximum length of anorectal mucosa between the dentate line and the anastomosis should not exceed 2 cm [214]. Many of those in whom the diagnosis is confirmed will respond to topical 5-ASA or corticosteroids [390]. In those with refractory cuffitis resulting in pouch failure many have been found to have Crohn's disease of the pouch or surgical complications such as sinuses, fistulas or strictures [390,391].

Pouch cancer. Pouch cancer has been described mainly in case reports. A recent review of the literature [392] identified 20 publications containing 26 cases in addition to their own. Almost all cancers were very early stage and the mean time from pouch creation to adenocarcinoma was 8.9 years (see later for surveillance).

Pouch failure. Pouch failure is discussed in Section 13.

Pouchitis. Pouchitis can be defined as nonspecific inflammation in a nondiverted pouch in the absence of local complications such as sepsis or anastomotic dehiscence. It is one of the commonest and more debilitating complications of an ileoanal pouch. The cause remains elusive. Originally reported in continent ileostomies [393,394] the incidence in ileoanal pouch

patients is reported to be between 7% and 42%, but recent work assessing pouch patients up to 30 years after the original procedure suggest the cumulative probability may be as high as 80% [395].

The clinical symptoms of pouchitis include malaise, rectal bleeding, diarrhoea and abdominal pain [396]. Added to this are the endoscopic findings of oedema, contact bleeding/mucosal haemorrhage, granularity and ulceration [397,398]. Biopsies are characterized by neutrophil infiltration and ulceration. Debate existed as to what the best way of diagnosing pouchitis was, and a number of systems have been proposed [397]. In 1994 the Pouch Disease Activity Index (PDAI) was developed, allowing quantification of the degree of pouchitis [399]. It considers clinical, endoscopic and histological parameters, and a diagnosis of pouchitis is made in anyone with a score ≥ 7 . This now allows various treatment approaches to be more accurately compared. Despite its widespread use, it may have limitations in some cases, for example where there are focal areas of pouchitis, found in 64% of patients [400,401].

Treatment options for pouchitis include antibiotic therapy, anti-inflammatory/immunosuppressive agents, novel therapies and, in a small proportion of patients, excision of the pouch. The mainstay of antibiotic treatment is metronidazole [402]. Most patients will have a response within 24–48 h following administration of 750–1500 mg/day for 7–10 days. Those who develop relapsing/remitting disease may require long-term treatment with doses between 250 mg every third day to 250 mg three times a day [400]. Metronidazole has been shown to be effective in active chronic pouchitis in a randomized, double-blind placebo-controlled crossover trial [403]. Alternatives to metronidazole include ciprofloxacin, augmentin, erythromycin, tetracycline and various combinations of the above, most commonly metronidazole and ciprofloxacin [402,404].

In addition to antibiotics, anti-inflammatory and immunosuppressive agents may be effective. Medications include steroid and mesalamine enemas, and oral steroids, sulfasalazine and mesalamine [398]. Other options include various forms of nutritional therapy such as short-chain fatty acid enemas and oxygen free radical scavengers such as allopurinol [404]. Pouchitis has been shown to be associated with reduced counts of both bifidobacteria and lactobacilli [405] and thus attempts have been made to alter the balance between anaerobic and aerobic bacteria within the pouch. The polybiotic formula VSL#3 has been shown to be effective at maintaining remission from pouchitis in a randomized double-blind, placebo-controlled trial [406]. The PDAI was significantly improved after antibiotic and polybiotic supplementation.

Other more recent therapies include the biologicals infliximab [407] vedolizumab [408] and ustekinumab [409] and granulocyte and monocyte apheresis [410]. There is also a multinational Phase III trial using the ICAM-1 anti-sense oligonucleotide alicaforsen in pouchitis [411]. Other trials are under way to examine interventions to prevent pouchitis.

Fertility/pregnancy and delivery in pouches

Ulcerative colitis is often associated with poor sexual function. Several studies have demonstrated a postoperative improvement in sexual function 1 year after IPAA [412,413]. Conversely other studies have shown that fecundity is significantly reduced when compared with patients with ulcerative colitis managed medically or with the normal population [414,415]. One study from Finland showed that the probability of women with an IPAA conceiving was reduced to 80% [416]. Others have reported fecundity rates after IPAA as low as 20% [414]. In view of these risks, alternative surgical options such as subtotal colectomy and end ileostomy or ileo-rectal anastomosis, if appropriate, should be discussed with female patients (see Section 7).

Treatment of infertility may be successful in over 50% of patients [416]. Tubal adhesions are largely felt to be the cause of the infertility postpouch surgery. A laparoscopic approach is associated with fewer adhesions and may result in better preservation of female fertility and should be discussed [298,417]. Oocyte preservation and assisted conception are also modern options available to patients after pouch surgery.

The question of whether a Caesarean section should be recommended for all pouch patients is discussed in Section 17.

Statement 6.8.

Patients should be counselled that they may experience difficulties conceiving following pouch surgery.

Level of evidence: III

Grade of recommendation: B

Consensus: 97.1% (SA 70.6%, A 26.5%)

Statement 6.9

As laparoscopic surgery reduces adhesions and may reduce infertility in women, this approach should be discussed, where appropriate, prior to ileoanal pouch surgery.

Level of evidence: III

Grade of recommendation: C

Consensus: 90.9% (SA 42.4%, A 48.5%)

In male patients, retrograde ejaculation and erectile dysfunction are rare but may occur after IPAA. However, resecting the inflamed colon with surgery often leads to an overall unchanged or even improved sexual function. Sexual dysfunction may be avoided if an ileo-rectal anastomosis is chosen, and this option should be considered if appropriate.

Role of pouchoscopy

Pouchoscopy is perhaps the most important investigation in patients with pouch dysfunction, helping to differentiate between pouchitis, cuffitis and irritable pouch. It also has a high diagnostic yield for other conditions such as prepouch ileitis, Crohn's disease or strictures [418].

Regarding pouch surveillance for cancer there is little consensus as to frequency or indeed need. The risk is low and the ability to detect dysplasia during surveillance is also low [419,420]. Surveillance pouchoscopy with multiple biopsies from the pouch body and anal transitional zone should be considered for those high-risk patients who are most likely to develop dysplasia/cancer, i.e. those with familial adenomatous polyposis (FAP), primary sclerosing cholangitis, a previous history of dysplasia or cancer in the original colectomy specimen, type C histological changes or a long retained rectal stump. Annual surveillance in these groups is generally felt optimal but many experts no longer perform surveillance in other low-risk pouches [419].

Statement 6.10.

Pouchoscopy with a flexible endoscope is a useful investigation in patients with pouch dysfunction. It is also important as part of annual surveillance in selected high-risk patients with ulcerative colitis.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 90.6% (SA 40.6%, A 50.0%)

Volume of pouch surgery and competence

Since Birkmeyer *et al.* [421] published a study demonstrating the association between surgical caseload and improved outcome, findings have been reproduced in many specialties including the provision of pouch surgery [36] and management of pouch-related complications [422]. Although the ECCO guidelines go so far as to recommend that pouch surgery should be performed in high-volume specialist institutions [214], such a statement may be too simplistic. Not all provi-

ders get better results with additional caseload and some 'low-volume' providers achieve excellent results. Repatriating their cases to a high-volume centre with mediocre results would clearly not be desirable [423]. In addition, it is not clear what constitutes a high-volume centre. However, what is clear is that there are several very low-volume centres in the UK doing < 1 pouch per year over the last 5 years [344]. These centres should be encouraged to transfer patients to the nearest high-volume unit.

Statement 6.11.

There is an association between higher surgical caseload and improved outcomes for pouch surgery.

Level of evidence: II

Grade of recommendation: B

Consensus: 97.1% (SA 52.9%, A 44.1%)

Ileorectal anastomosis

The main aims of surgical treatment of ulcerative colitis are to alleviate symptoms, minimize the risk of cancer and avoid the need for immunosuppressive medication. In addition, surgical treatment aims to achieve good functional outcome and to be associated with a good quality of life. Historically, the only option for patients with ulcerative colitis who have failed medical treatment was an ano-proctocolectomy with end ileostomy. In the late 1970s, surgeons described the procedure of restorative proctocolectomy with an IPAA [328]. Such was the research and development directed at this procedure that by the late 1980s it had become the procedure of choice for patients with ulcerative colitis with good long-term functional results. Whilst this procedure may be the current gold standard, it remains an operation of some magnitude and carries risks, including anastomotic failure and pelvic sepsis, the *bête noire* of the pouch procedure. In addition, up to 50% of patients will experience at least one attack of pouchitis in the first 10 years postoperation [395].

During the 1950s subtotal colectomy with ileorectal anastomosis was considered to be an alternative to ano-proctocolectomy for patients with colitis, and a number of proponents of this procedure promoted it as a way to avoid the only option of a permanent stoma [424]. Recently surgeons from several countries have favoured the procedure for carefully selected ulcerative colitis patients claiming several advantages over IPAA [425–429]. Indeed, in Sweden during the period 2000–2010 ileorectal anastomosis for ulcerative colitis has become just as common an operation as IPAA [430].

The procedure is less invasive, may result in satisfactory function and avoids the need for pelvic dissection with the associated risk of sexual dysfunction. Selection of appropriate patients, both with ulcerative colitis and Crohn's disease, is crucial. This selection, as well as description of technique and outcomes are discussed below.

Indications for ileorectal anastomosis in ulcerative colitis

Ulcerative colitis originates in the rectum and extends proximally in a variable but continuous fashion. It begins at the anorectal junction and the severity of disease appears to be higher distally, unless a fulminant pan-colitis is present [431]. Rectal disease alone is sometimes alleviated by topical medication and topical medication will often improve rectal involvement to render such rectal changes and symptoms minimal. Patients with minimal rectal inflammation and those in whom any inflammation is responsive to medical therapy are candidates for an ileorectal anastomosis. They should have no dysplastic change in the rectum or risk factors for dysplasia (sclerosing cholangitis, previous or family history of colorectal cancer). Due to this potential risk for dysplasia in a retained rectum, it is also essential that patients are motivated enough to attend for follow-up surveillance over many years [430]. An exception to the dysplasia rule may be the patient with colitis-associated colorectal cancer, with or without metastatic disease, who is considered to have a short life expectancy and may wish to avoid a stoma.

Good rectal compliance and capacity and normal anal sphincter function are critical for good long-term outcome. Anal function can be assessed by digital rectal examination, but any concerns about the strength of the anal sphincter are more accurately assessed by means of anal manometry. Ileorectal anastomosis is contraindicated in patients with a poorly distensible rectum, severe rectal disease and poor anal sphincter function.

Another group that may benefit from an ileorectal anastomosis are young patients who want to postpone pelvic surgery. Ileorectal anastomosis avoids pelvic dissection and thereby significantly reduces the risk of sexual and urinary dysfunction associated with a panproctocolectomy or IPAA [432–434]. In addition, there is substantial evidence to suggest that fecundity is reduced after IPAA [435,436]. Conversely, in FAP patients, fecundity is unchanged after an ileorectal anastomosis compared with the general population [435]. The mechanism of this reduced fertility is probably related to occlusion of the fallopian tubes by scarring and adhesions [296]. It may be that, with laparoscopic approaches to IPAA, this effect is reduced [298,417]. Nonetheless, current advice would be to consider ileorectal

anastomosis, noting the above caveats, when treating women of reproductive age who have not yet completed their families.

Statement 7.1

Careful patient selection is essential if an ileorectal anastomosis is to be considered for patients with ulcerative colitis. Patients with minimal or controlled rectal disease and reasonable rectal and anal sphincter function may be considered for ileorectal anastomosis provided that there is low risk of dysplasia in the retained rectum and that they are willing to comply with postoperative surveillance.

Level of evidence: IV

Grade: GP

Consensus: 97.0% (SA 48.5%, A 48.5%)

Intervention

Many studies have demonstrated ileorectal anastomosis for ulcerative colitis to be a safe procedure with low morbidity and mortality. The literature would suggest overall morbidity is in the range of 8–28% and mortality between 0% and 4% [437]. Principal complications include small bowel obstruction, anastomotic leak and peritonitis. No data are available that would suggest sutured anastomosis is superior to stapled anastomosis, or vice versa. As long as an appropriate technique is used the choice of method does not appear to matter.

Regarding an open or laparoscopic approach for the ileorectal anastomosis technique, available data are based principally on cohort studies for the colectomy part of the procedure, reporting many outcomes in favour of a laparoscopic approach [238]. The usual benefits to laparoscopic over open surgery apply, i.e. shorter in-hospital stay, shorter convalescence and less postoperative pain. Whilst operating times are typically slightly longer with laparoscopic procedures, the difference these days is minimal and is unlikely to influence the choice of approach. The choice of laparoscopic vs open is a decision for patient and surgeon and depends on the experience of the surgeon and the operating team as well as individual patient factors, including body habitus, previous incisions and operative procedures, and general fitness.

Outcomes in patients with ulcerative colitis

Function

Most published series report frequency of bowel movement between two and six times per day with an

instance of nocturnal seepage of around 5% and an instance of urgency of defaecation of 20–25% [438]. About 25% of patients are on antidiarrhoeal medication after follow-up of 10 years and the functional result usually remains static from 1 year postprocedure [439]. Patients typically report improvement in quality of life once they have recovered from the operative procedure.

Medication

Patients with ulcerative colitis who have undergone ileorectal anastomosis have a high chance of requiring medication to control rectal inflammation. Up to 90% will require treatment, but this is often in the form of topical 5-ASAs [425,428,429,440,441].

Failure

There is an estimated cumulative failure rate of around 10% at 5 years and 20% at 10 years [429]. Failure is usually due to poor functional results with frequent bowel movements, nocturnal seepage, day time urgency and incontinence is often due to flare up of the proctitis which fails to respond to medication. An advantage of ileorectal anastomosis is the possibility of future conversion to an IPAA if failure occurs. Studies suggest this occurs in up to 70% of patients with an ileorectal anastomosis [429,438]. Little is known about subsequent function in these ulcerative colitis patients, but in FAP the function was no worse after a secondary procedure compared with the primary operation [442]. Of course, these data from FAP patients cannot be completely extrapolated to patients with ulcerative colitis as the risk of pouchitis will be higher in this group.

Quality of life

Some data exist regarding quality of life after IPAA compared with ileorectal anastomosis in patients with FAP [443]. Despite better function after an ileorectal anastomosis, quality of life was equal. In ulcerative colitis one study suggests that quality of life is the same after both procedures [438].

Statement 7.2.

Function after ileorectal anastomosis in selected patients with ulcerative colitis may be comparable to that after pouch surgery. Further data are required concerning impact on quality of life.

Level of evidence: III

Grade: B

Consensus: 93.8% (SA 31.3%, A 62.5%)

Risk of dysplasia and cancer

Another reason for failure of ileorectal anastomosis is the development of high-grade dysplasia or rectal cancer in the retained rectum. Indeed the risk of cancer was one of the reasons why ileorectal anastomosis was abandoned after colectomy for ulcerative colitis [444]. Dysplasia of the colorectal mucosa is associated with long-standing ulcerative colitis. Whilst dysplasia in general is considered to be an indication for surgery, it is important to grade the dysplasia and to have the diagnosis confirmed by more than one pathologist. The dysplastic changes are often patchy, in which case the highest degree of dysplasia should be considered. The rate of dysplasia associated with the development of cancer in patients with ulcerative colitis increases with time. The literature can be difficult to interpret, but as a rough rule of thumb, the overall cumulative probability of rectal dysplasia and cancer in a retained rectum increases from 9 and 2%, respectively, at 10 years to 25 and 14% at 20 years [438].

Despite these data, several series have reported that no patients have developed rectal cancer within 10 years of diagnosis [426,427,429,438,444]. A possible explanation for this finding relates to appropriate patient selection. As mentioned above, ileorectal anastomosis should not be carried out on those with risk factors for dysplasia or who are unwilling to undergo surveillance.

In terms of surveillance, it is advised that rectal biopsies should be taken from multiple sites on an annual basis from 8–10 years postoperation; if dysplasia is identified, particularly high-grade dysplasia, completion proctectomy is indicated [445].

Statement 7.3.

With appropriate patient selection and careful surveillance, the risk of cancer in the rectum after ileorectal anastomosis is around 2% at 10 years and 14% at 20 years.

Level of evidence: III

Grade: B

Consensus: 80.0% (SA 26.7%, A 53.3%)

Ileorectal anastomosis in Crohn's disease

Traditional surgical management for refractory Crohn's colitis typically involves the creation of a temporary or permanent stoma, and classically the procedure of choice has been ano-proctocolectomy with permanent ileostomy. However, restorative procedures, which avoid the use of a permanent stoma, are increasingly being used.

Whilst localized Crohn's disease affecting the distal ileum and right colon would be well served by a limited ileocolic resection, in cases of colonic Crohn's disease with patchy involvement of the right colon and further involvement of the transverse or left colon, but rectal sparing, a subtotal colectomy with ileorectal anastomosis is typically performed. The colectomy eliminates the risk of recurrence of colonic disease and the ileorectal anastomosis permits good function and quality of life. Around 80% will have a functioning ileorectal anastomosis 5 years after surgery with an improved quality of life [427]. In contrast, the recurrence of disease in the rectum at 10 years has been quoted at about 80% [292]. The presence of perianal sepsis and co-morbid pathologies is associated with a reduced stoma-free survival [446].

As with subtotal colectomy and ileorectal anastomosis for ulcerative colitis, it is important to assess anal function preoperatively. Digital rectal examination with careful inspection of the perineum and digital assessment of the anal sphincter should be performed, and anal manometry should be carried out if there are any concerns about the strength of the anal sphincter. The compliance and capacity of the rectum can be gauged by insufflation of air via an anoscope, but ideally, direct physiological measurement of rectal compliance and capacity will reassure the surgeon and patient as to the suitability of the rectum to maintain subsequent continence in the presence of a good anal sphincter. A diseased anorectum will compromise the chance of success following ileorectal anastomosis and probably result in a poor outcome and the likely conversion to ileostomy. In such cases, ileorectal anastomosis should be avoided and a permanent ileostomy should be considered [292,447]. A defunctioning loop ileostomy should be considered in patients who are undernourished or immunosuppressed due to their Crohn's medication to avoid potentially catastrophic recurrence of anastomotic leak and subsequent sepsis.

Statement 7.4

Subtotal colectomy and ileorectal anastomosis is a reasonable option for patients with Crohn's colitis with rectal sparing and reasonable sphincter function as it offers improved quality of life in the medium term.

Level of evidence: III

Grade: B

Consensus: 100.0% (SA 48.5%, A 51.5%)

Summary

Subtotal colectomy with ileorectal anastomosis is a reasonable option to consider for patients with ulcerative colitis or Crohn's disease. For patients with ulcerative colitis, it is a potential alternative for those who have minimal disease in the rectum, no dysplasia or cancer, women of reproductive age and in patients with good anal sphincter function and rectal compliance. In patients with Crohn's colitis, this operation offers a good surgical option for those with multiple areas of colonic disease with rectal sparing and again good anal sphincter function. Long-term management requires medical input with regard to prophylactic medication to minimize the risk of recurrence.

Finally, in both ulcerative colitis and Crohn's disease, care must be taken to ensure adequate surveillance of the residual large bowel mucosa with flexible sigmoidoscopy and biopsies from multiple sites.

Continent ileostomy – the Kock pouch

The gold standard restorative procedure for ulcerative colitis is construction of an ileal pouch with IPAA, first described by Parks and Nicholls [328] and subsequently popular with colorectal surgeons. Success with the IPAA procedure is considerable and well established in expert hands, with many patients enjoying good function and quality of life with a relatively low reoperation rate [345,448,449]. Nevertheless, the failure rate increases with time and is around 10–15% at 10–15 years, septic complications and poor function being the most common causes of failure [449–455].

In the event of failure, salvage pouch surgery with re-do IPAA may be possible in a proportion of patients with reasonable outcome, but many patients end up as definitive failures with permanent diversion or pouchectomy and end ileostomy [455–459]. Whilst permanent diversion avoids the risks associated with potentially difficult pouch excision, including bladder or sexual dysfunction and a nonhealing perineal wound [454,460], the morbidity of a loop ileostomy coupled with the risk of diversion pouchitis and mucus accumulation or retention may be considerable, or at least inconvenient. In addition, diversion upstream of a pelvic pouch (sometimes a significant distance proximally owing to mesenteric shortening) may lead to considerable fluid, electrolyte and nutritional deficiency.

Continent ileostomy was first reported by Nils Kock in the 1960s in five patients [461]; it was adapted from the technique for reservoirs constructed for bladder substitution following cystectomy, and its

sustained success then built upon with certain modifications in 20 subsequent cases [462]. At a time when end ileostomies had a poor reputation owing to high complication rates, and before the advent of the ileoanal pouch, the continent ileostomy gave patients control of stoma emptying, and was particularly popular in Scandinavia, where it has remained so despite simultaneous widespread use of IPAA. Currently, continent ileostomy is rarely undertaken in the UK due to the success and popularity of IPAA, which rapidly displaced the Kock pouch in the 1970s and 1980s, coupled with the perceived difficulties and high complication rates associated with continent ileostomy. There is renewed interest in the UK for continent ileostomy as an alternative to an IPAA, or as a salvage option following IPAA failure.

Specialization

It is recommended that continent ileostomy surgery should only be undertaken in specialist centres by surgeons specializing in IBD surgery and trained specifically in continent ileostomy surgery. Designated centres should have stoma therapists trained in the management of continent ileostomy.

Indications for continent ileostomy

Continent ileostomy may be undertaken for FAP or, more unusually, following panproctocolectomy for cancer. Crohn's patients with exclusively colonic or rectal disease may also be considered, but must have demonstrated a complete absence of small bowel disease at follow-up. Ulcerative colitis remains the main pathology for which continent ileostomy is undertaken, and the main indications are:

- When IPAA is not an option
 - Poor sphincters and incontinence
 - Perianal sepsis and fistula
 - Low rectal cancer when panproctocolectomy is undertaken
- Salvage after failed IPAA
- Malfunction of conventional end ileostomy or psychosocial maladjustment [463,464]
- Patient preference.

The starting point for the majority of patients when considering continent ileostomy is likely to be an end ileostomy, following subtotal colectomy with subsequent completion proctectomy, panproctocolectomy or pouchectomy. In 423 continent ileostomy patients from the Cleveland Clinic [465] the indications were:

- Conversion of end ileostomy to continent ileostomy (59%)

- Total proctocolectomy (20%)
- Conversion of failed IPAA to continent ileostomy (16%)
- Completion proctectomy (5%).

Some series have reported an inferior outcome for continent ileostomy patients who have an end ileostomy for a period prior to continent ileostomy, compared with those who go straight to continent ileostomy after proctocolectomy, possibly owing to thickening of the intestinal wall at the site which is to be used for the nipple valve [466–468].

Contraindications to continent ileostomy

The only absolute contraindication to continent ileostomy in IBD is small bowel Crohn's disease [469–471], and patients with small bowel-sparing Crohn's disease must only be considered for continent ileostomy after sufficiently long disease follow-up (at least 5 years) and careful counselling. Kock reported a 27% complication rate in Crohn's patients having continent ileostomy (twice that of patients with ulcerative colitis), and a higher continent reservoir excision rate (16%) compared with ulcerative colitis (2%) [472]. Whilst continent ileostomy may be undertaken for FAP, desmoid disease constitutes a relative contraindication to continent ileostomy in view of the tendency for desmoids to follow surgical intervention.

For ulcerative colitis patients the following relative contraindications should be considered:

- Obesity
 - Technical difficulties of valve construction with higher risk of valve slippage when there is excess visceral fat
 - Advancement of the efferent limb of the continent ileostomy through the abdominal wall may be a problem with visceral and subcutaneous obesity, potentially creating intubation problems
- Perceived inability to intubate
 - Insufficient dexterity, poor eyesight, mentally unprepared
- Marginal small bowel length
 - Particularly following excision of an unsalvageable pelvic pouch (when around 50 cm is likely to be resected)
 - Around one-third of functional small bowel length may be lost converting a J pouch to continent ileostomy
 - Around 50–70 cm of small bowel is required for a Kock pouch and absorptive capacity is unknown
- Inability to accept the risk of complications and revision surgery [472].

Statement 8.1

For patients with inflammatory bowel disease, the use of a Kock pouch is usually reserved for those with ulcerative colitis, although it may be an option in selected patients with isolated colorectal Crohn's disease.

Level of evidence: IV

Grade of recommendation: D

Consensus: 81.3% (SA 15.6%, A 65.6%)

Statement 8.2

Careful selection of patients for Kock pouch surgery is essential and a period of thorough preoperative counselling should be undertaken.

Level of evidence: IV

Grade of recommendation: D

Consensus: 91.2% (SA 55.9%, A 35.3%)

Technical considerations

Around 50–70 cm of small intestine is required for the construction of a low-pressure compliant Kock pouch, and the technique has evolved and undergone a few modifications since its first description [473]. Kock's original continent ileostomy did not have an intussuscepted valve; instead the efferent limb of the pouch was relatively long as it passed through the abdominal wall, the intention being for the rectus abdominus muscle to act like a valve as it contracted [462,474,475]. Interestingly, of Kock's 29 patients without a nipple valve, 25 never required an ileostomy appliance [472]. The intussuscepted nipple valve was later added, although initially fixed by suturing rather than stapling [462,475,476]. Various techniques have been described to improve overall function, to halve valve slippage and revision rates from around 40–50% and pouch excision rates from around 10%, and to halve fistula rates from 16% to 8% [477,478]. Most subsequent modifications have been developed in an attempt to prevent valve slippage, which remains the most troublesome complication.

Failure to fix the pouch adequately to the abdominal wall may result in detachment and the start of pouch problems [479,480]. There may be difficulty with intubation, relative valve incompetence and a risk of pouch torsion; detachment has been reported following blunt abdominal trauma and adhesional traction from an involuting postpartum uterus [479]. Detachment of the continent ileostomy from the abdominal wall may be partial or complete and may affect valve function; whilst

radiological contrast examinations alone may overlook reservoir detachment, such examinations can accurately depict valve dysfunction under these circumstances [481]. Complete detachment may result in sliding herniation of the pouch and ultimately prolapse [39]. Pouch volvulus has also been reported [482].

Statement 8.3

Kock pouch surgery is technically demanding and should only be undertaken by surgeons with appropriate training and experience.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100.0% (SA 73.5%, A 26.5%)

Special considerations when converting a J pouch to Kock pouch

Use of the original pelvic J pouch to construct a continent ileostomy may be possible in 10–25% of patients with J-pouch failure [454,466,483–486]. This is likely to be dependent upon the cause of pouch failure – significant fistulating disease, pelvic sepsis or refractory pouchitis are less likely to result in a successful continent ileostomy, and patients with an anatomically sound pouch with unacceptable function may be the most suitable. Wasmuth [486] reported more complications in patients retaining the original pouch than in those having a new continent ileostomy. In that series of 317 IPAAAs over a 23-year period (1984–2007), pelvic pouch failure occurred in 25 patients (7.8%). Seven underwent continent ileostomy formation along with four tertiary referrals. In all, seven had a continent ileostomy constructed from the J pouch and four had the original pouch excised, with a Kock continent ileostomy in three and a T pouch (see below) in one. In total, eight of the eleven had fully continent pouches.

Lian *et al.* [485] presented a series from the Cleveland Clinic of 64 continent ileostomies after a failed pelvic pouch, in 16 of these the original pelvic pouch was used for the continent ileostomy. The overall continent ileostomy complication rate was 57.8% and the revision rate 43.8%. Borjesson *et al.* [487] reported good results using the pelvic pouch in all patients converted to a Kock pouch; 8 of 13 patients with continent ileostomy needed revisional surgery during a mean 6-year follow-up period.

The surgical burden on patients with continent ileostomy formed after failed IPAA seems no higher than expected for continent ileostomy generally, and the reported success rate is high [484–488].

For the technique of construction of a continent ileostomy from an original pelvic pouch, the latter must be extracted carefully from the pelvis [489], which can be difficult in a hostile fibrosed pelvis, and damage to the pouch may be unavoidable, in which case it should be removed and a continent ileostomy constructed from the remaining terminal ileum.

If the J pouch is to be retained, the afferent ileum is divided 15 cm proximal to the pouch and the 15 cm prepouch length used to construct the intussuscepting valve and stoma, as described above, gaining access to the inside of the pouch through the anal (outlet) end of the pouch. This anal end of the pouch is then anastomosed to the divided prepouch ileum [490]. The continent ileostomy is then dealt with as described with pouch fixation to the abdominal wall, and maturation of the efferent limb and stoma.

Statement 8.4

In the event of pelvic pouch failure, conversion to a Kock pouch may be considered after thorough counselling.

Level of evidence: IV

Grade of recommendation: D

Consensus: 87.9% (SA 42.4%, A 45.5%)

Use of proximal loop ileostomy

A proximal diverting loop ileostomy above a Kock pouch is usually considered unnecessary, running the risk of a high output and the attendant potential complications of closure (Par Myreliid, personal communication). Besides, for the patient who has opted for a continent stoma it would be a little unexpected. Nevertheless, perhaps in the case of difficult continent ileostomy revision, especially in the presence of fistulas or sepsis, or simply as a wise precaution during initial adoption of continent ileostomy surgery, a protecting loop ileostomy 15–20 cm upstream of the pouch may be worth considering, with the option of catheter placement into the pouch through the efferent limb of the stoma for the purposes of irrigation [491,492]. Use of a loop ileostomy has been reported to reduce the overall complication rate and valve slippage but this was a nonrandomized study and should be interpreted with caution [493].

Postoperative care

Scrupulous and detailed postoperative care, in particular care of the Medena catheter, should take place under the supervision of a specialist stoma therapist

experienced in dealing with Kock pouch patients [490,494]. Patients should be warned that handling and caring for the pouch may at first be more demanding than having an ileostomy. Prolonged drainage of the pouch in the early postoperative period seems to be important in ensuring success [478,495].

The catheter should remain in place on free drainage for 14 days, 24 h per day. This is to prevent obstruction and to avoid pouch distension. The catheter should be flushed using the following regime (Eva Carlsson, personal communication):

- First 24 h – flush every 4 h with 20–30 ml sterile saline
- After 24 h – flush every 6 h, and when needed, for 14 days
- After 3 days tap water may be used for flushing
- Check the catheter frequently once the patient starts eating to ensure that it does not block
- If the catheter blocks, gently flush the catheter and, if necessary, rotate or milk the catheter until it runs freely.

Certain dietary restrictions should be followed. For the first 14 days whilst the Medena catheter is in place on free drainage a strict pureed ileum reservoir diet should be consumed. Subsequently, whilst food need not be pureed, care must be taken, patients must be instructed to chew food well, and no raw food is allowed.

After 14 days the patient is instructed in catheter changes with the stoma care nurse and the following regime is undertaken:

- Days 14–20 – the catheter is plugged during the day and the plug removed every hour for flushing; during the night it is connected to a drainage bag
- Days 21–27 – the plug is removed every 2 h and at night is connected to a drainage bag
- Day 28, the catheter is removed completely
- During the fifth week the pouch is emptied every 3 h and once at night, and should be flushed three to four times a day depending on consistency of output.

Once the patient is confident in the use of the Medena catheter he/she is discharged to outpatient follow-up under close supervision of the stoma therapist, and early review within 1 month with the surgeon is arranged. It should be possible to place a simple swab and adherent dressing over the stoma site between catheterizations [494].

Statement 8.5

Careful postoperative care of a Kock pouch is essential and must be undertaken under the supervision

of an appropriately trained stoma therapist familiar with Kock pouch management.

Level of evidence: IV

Grade of recommendation: D

Consensus: 93.9% (SA 63.6%, A 30.3%)

Alternative continent ileostomy constructions

Two main alternatives to the Kock pouch exist: the Barnett continent ileal reservoir (BCIR) and the T pouch. Neither of these pouches is commonly used but both will be briefly described.

The unique feature of the BCIR is an isoperistaltic valve, an intestinal collar and a lateral pouch design [496–498]. Unfortunately, valve slippage still occurs with the BCIR and, whilst good overall outcomes can be achieved [499], the technique has not gained wide popularity.

The T pouch, adapted from the technique of orthotopic ileal neobladder reconstruction, is valveless, thereby completely eliminating this complicated aspect [490,500–502]. Re-operation rates are still in excess of 50% and these pouches are not commonly used.

Complications of continent ileostomy

In the short term surgical reservoir leakage occurs in around 8%, from suture line dehiscence or potentially from abdominal wall anchoring sutures [503], and the most vulnerable site for leakage is probably the area between the anterior suture line and valve.

Revisional surgery for longer-term complications is common and occurs in up to 50% of continent ileostomy patients [455,465–468,477,485]. The major problems with Kock pouches are technical, especially related to the nipple valve, particularly slippage, which is largely responsible for the high reoperation rates. Despite the high revisional rate, continent ileostomy pouch excision rates at 10 years are reported to be < 10% [455,468], similar or better than that reported for IPAA.

Management of complications

Valve dysfunction

The majority of problems with valve dysfunction are seen in the first year postoperatively and patients generally do well after revision, with overall success rates of 50–70% [468,486].

Patients with poor continent ileostomy function or symptoms of valve displacement should undergo

endoscopic and/or radiological assessment. Where catheterization of the valve is difficult or impossible, general anaesthesia with insertion of a Medena catheter to permit drainage may be necessary in the first instance, and an indwelling catheter may stabilize a faulty valve in the short term. In the longer term surgical revision is required but overall salvage success is usually high [504].

Fistula

A fistula affecting a continent ileostomy may arise from the pouch itself, usually from a leak at the suture line, or from the region of the valve. Fistulas arising from pouch leaks will usually present early and may be manageable by catheter drainage alone [495,505], although temporary upstream loop ileostomy may need to be considered. Crohn's disease should be excluded as this may be a cause of fistula formation [506], as may use of mesh for valve reinforcement [506–508]. Rarely, perforation of the pouch and fistula formation may occur as a result of catheter trauma. Investigation should include pouchoscopy and cross-sectional imaging, including CT and/or MRI. Fistulas arising from the valve are likely to require revision surgery.

Stricture

Strictureing may occur at stoma level or at valve level, most likely from ischaemia. Both problems are likely to require revision surgery, although endoscopic stricturotomy has been reported [509]. Prepouch stricture may also occur, in a similar way to prepouch IPAA stricture, and may respond to repeated balloon dilatation [253], although revision surgery is ultimately likely.

Statement 8.6.

Revisory surgery for continent ileostomy is frequently required, mainly for nipple valve problems, and must be undertaken in specialist centres by surgeons familiar with these problems.

Level of evidence: IV

Grade of recommendation: D

Consensus: 96.9% (SA 75.0%, A 21.9%)

Pouchitis

Pouchitis ('mucosal enteritis') occurs in continent ileostomy patients in a similar way to pouchitis in IPAA and it is likely that a degree of stasis and bacterial overgrowth are also responsible [510]. The overall risk of pouchitis in continent ileostomy is 13–43% [511,512]. Bacteriological studies of continent ileostomy have

demonstrated significant bacterial overgrowth with Gram-negative and anaerobic flora [511,513–515]. Multiple enteroliths in Kock pouches have also been reported, probably resulting from the same mechanisms and causing abdominal pain and altered pouch function, but usually extractable by endoscopic means [516–518], although laser lithotripsy has also been reported [519].

Symptoms of continent ileostomy pouchitis include crampy abdominal pain, increased output, bloody discharge and general malaise [510], with severe cases sometimes being associated with weight loss, fever and arthralgia. A firm diagnosis of pouchitis should include endoscopic and histological evidence of inflammation. Treatment of continent ileostomy pouchitis is with antibiotics, usually ciprofloxacin or metronidazole [520], sometimes in rotation in persistent cases. Excision of continent ileostomy for refractory pouchitis is unusual [510].

Metabolic and nutritional factors

Whilst preservation of bowel length is important, and must be considered particularly when converting a pelvic pouch to a continent ileostomy, intestinal failure and malabsorption through short bowel syndrome are unlikely to occur in continent ileostomy patients unless significant complications with fistulas ensue or the need for further resections arises [521,522].

Some continent ileostomy patients may have high-output stomas (> 1000 ml/24 h) with accompanying loss of electrolytes, nitrogen and fat and lower uptake of vitamin B₁₂ [477]. Whilst this may also be seen in some patients with end ileostomies, it is possible that stasis with bacterial overgrowth may be contributory, as well as reduction in bowel length through repeated surgery. Treatment is with oral electrolyte and glucose solutions, antidiarrhoeals such as loperamide, and proton pump inhibitors, with antibiotics if bacterial overgrowth is suspected. Significant metabolic disturbances do not seem to occur with any greater frequency in continent ileostomy patients compared with the normal population, including biliary and urinary stones [523].

Imaging of complications and dysfunction

Acute complications, such as sepsis, anastomotic or suture-line leaks, stomal ischaemia and intubation difficulty, are likely to require a combination of imaging modalities depending upon priorities, clinical suspicion and imaging availability. Cross-sectional (CT or MRI) imaging, for example, supplemented by water-soluble contrast instillation of the pouch, is likely to be most sensitive for the diagnosis of leaks, early fistulas and peri-pouch collections. Early endoscopic examination of the stoma and pouch may be indicated in the case of stomal

ischaemia or infarction, but this should proceed with caution using a gastroscope and minimal insufflation (with carbon dioxide) for fear of perforation. Careful endoscopic examination may need to be undertaken under general anaesthesia in the event of early difficulties with intubation.

For later pouch dysfunction occurring months or years after construction, such as valve complications and pouchitis, a combination of imaging modalities will often be indicated and usually complementary. Endoscopic assessment allows direct visualization of the valve for intubation ease and presence of stricture, evidence of pouchitis and the ability to take biopsies. Endoscopic access to the afferent ileal limb may be difficult and a contrast radiological pouchogram may be more useful, but radiology may over-diagnose inflammation [524]. Carefully performed and interpreted contrast radiology examinations are capable of correctly diagnosing the nature of valve malfunction in up to 96% of cases [525].

Whilst double-contrast barium examinations have generally been superseded by cross-sectional imaging and water-soluble contrast studies, large historical barium radiological studies provide a useful reference for the understanding of Kock pouch anatomy and dysfunction [481,525]. These studies highlight the importance of dynamic studies to diagnose valve eversion and slippage, for example use of the Valsalva manoeuvre and removal of the catheter, whose presence may be artificially stabilizing a faulty valve [525]. In the future, dynamic MRI may prove useful in this regard.

Long-term durability of continent ileostomy

Long-term durability and retention rates of 60–80% over 10–25 years are recognized [455,466,467,478,499,512,526,527]. In Kock's series of 280 patients, of 228 patients with a nipple valve, 221 (97%) were continent [478]. Nessar *et al.* [467] reported 10- and 20-year pouch survival rates of 87 and 77%, respectively, in a series of 330 patients over a 27-year period. Such figures compare very favourably with the best IPAA results. Successful retention of a continent ileostomy depends upon the willingness of the patient and surgeon to embark on revision surgery, possibly many times. Jarvinen *et al.* [512] reported an early series of 76 patients with a mean follow-up of 9 years; revisional surgery was required in 49 patients (66%), mainly for nipple valve failure, and good functional results were ultimately attained in 62 (83%) patients. Litle *et al.* [526] reported on the long-term follow-up (median 11.4 years) of 85 patients, of whom 60% retained a functional pouch and had undergone up to four revisions. Some 41% underwent valve revisions within

6 months of pouch creation and 59% after 6 months. Similarly, Lepisto and Jarvinen [466], during long-term follow-up (mean 18 years) of 96 patients, reported cumulative success rates of 96% at 1 year, 86% at 10 years, 77% at 15 years and 71% at 29 years. Some 85 re-reconstructions were performed among 57 patients (59%), and of these patients 14 had pouch excision. The commonest reasons for pouch excision in these series were recurrent valve dysfunction, fistulas, Crohn's disease and refractory pouchitis.

Quality of life with continent ileostomy

Good quality of life with a continent ileostomy is reported in many series [466,499,512,526]. Patients tend to be highly motivated to retain their continent ileostomy and with it a satisfactory quality of life, even if multiple revisions are necessary to achieve this. Specific quality of life questionnaire assessment, comparing 68 continent ileostomy patients (median age 60 years at follow-up) with a median follow-up of 31 years with a randomly selected age-matched and gender-match sample from the Swedish population, showed health-related quality of life to be similar in the two groups [527], with 78% of continent ileostomy patients rating their overall health as 'good, very good or excellent'. The Cleveland Clinic evaluated quality of life in 216 of 330 continent ileostomy patients (in whom there was a mean number of complications and pouch revisions of 3.7 and 2.9, respectively) during a median follow-up of 11 years, using a continent ileostomy surgery follow-up questionnaire and the Cleveland Global Quality of Life scale [467]. Quality of life measurements for patients with a retained continent ileostomy were higher on all scales in comparison with patients who reverted to a Brooke ileostomy after continent ileostomy excision. Working capacity and leisure activities do not seem to be overtly affected by having a continent ileostomy [499,523].

Statement 8.7

Good long-term Kock pouch function and quality of life may be maintained but multiple interventions are often required.

Level of evidence: III

Grade of recommendation: B

Consensus: 90.0% (SA 53.3%, A 36.7%)

Long-term surveillance of continent ileostomy

There is no absolute clinical need for continent ileostomy patients to be followed up long term, although

surgeons and institutions would be advised to maintain a database of patients to assess outcomes. As these patients are generally well-informed motivated individuals, functional pouch problems in continent ileostomy patients are likely to be reported promptly and the means to enable this should be made available at specialist centres. In the absence of functional problems or suspected pouchitis, endoscopic surveillance and mucosal biopsy are probably unnecessary, as the risk of dysplasia or cancer seems to be extremely low [466,521,528].

Summary

Continent ileostomy (Kock pouch) appears to be an entirely valid option for patients with ulcerative colitis and a small proportion of patients with colonic-only Crohn's disease. Overall success may be better in continent ileostomy performed as a primary construction from an end ileostomy after proctocolectomy compared with those undergoing conversion from an ileoanal pouch after failure. There are unique technical considerations which surgeons must master before undertaking continent ileostomy formation, and surgeons and patients must be prepared to undergo continent ileostomy revision in order to deal with complications, in particular to maintain integrity of the nipple valve. For this reason, such surgery should only be undertaken in specialist centres with sufficient support from appropriately trained specialist nurses. Long-term pouch durability rates and quality of life seem to be high.

Surgery for perianal Crohn's disease

Perianal manifestations of Crohn's disease are common. Up to one-third of patients will develop perianal pathology including fistulas, fissures, anal skin tags and anorectal stricture, ulceration or stenosis. In some cases, perianal disease is the initial presenting problem [529,530].

Surgical therapy essentially has dual roles. The primary role is treating sepsis whilst preventing tissue destruction. This approach alleviates symptoms or at least provides symptom control through drainage with a view to long-term palliation. Alternatively, surgical drainage may act as a bridge to further intervention with medical or multimodal therapy. The second role of the colorectal surgeon (which may be within the context of multimodal therapy) is in offering interventions aimed at definitive repair or fistula healing. While the need for sepsis control with minimization of tissue damage and consequent functional disturbance is absolutely essential, the chronic relapsing pattern of Crohn's disease dictates that any subsequent surgery should be tailored to the needs and goals of each

patient. Some patients may prefer symptom palliation while others may desire definitive management with attempt(s) at healing. It is paramount that the surgeon focuses on an approach to management that is patient-centred and directed [49].

Perianal fistula disease

Fistulating perianal Crohn's disease may present with perianal abscess, purulent or faecal discharge or incontinence. The disease represents a significant challenge for patients, physicians and surgeons. Despite perceived advances in medical treatment, long-term disease control is achieved in about two-thirds of patients with simple fistulas and only one-third of patients with complex disease [531]. There is little high-quality evidence for the surgical interventions commonly used in this condition. The available 'expert evidence' suggests there are no universally accepted treatment pathways/ algorithms [532,533]. The resulting variable practice coupled with the lack of high-quality evidence to guide best practice probably contributes to the wide variation in rates of disease control. The current trend for multimodal surgical and long-term, expensive medical therapy drives up healthcare costs [534].

Management of perianal Crohn's infection

The first surgical intervention for patients with perianal Crohn's fistulas is most commonly for drainage of an acute abscess to provide control of sepsis. If fistulas are readily identifiable, a 'loose' draining seton may be placed. Fistula tracks should not be sought by an inexperienced or nonspecialist surgeon to avoid iatrogenic secondary tracks; definitive procedures may be safely deferred in favour of abscess drainage using small stab wounds in the emergency setting.

Surgical treatment in this patient group is associated with poor and delayed wound healing. The chronic nature of the disease coupled with a potential for loose stool consistency and frequent bowel function if there is associated luminal disease means that sphincter preservation is paramount. A conservative approach is therefore advocated. A small proportion of fistulas may also heal spontaneously [535]. Certainly, with the above caveats there should be no attempt to lay open the fistula. Although some argue that a very low fistula, involving minimal or no muscle tissue, could be laid open with minimal risk, others exercise caution, particularly in the presence of proctitis where incontinence can occur even after simple incision and drainage [536]. A recent consensus statement on management of perianal Crohn's disease rejected the

use of any form of fistulotomy [49] or cutting setons due to potential sphincter damage.

Statement 9.1

Management of acute infection in perianal Crohn's disease has two fundamental principles: adequate drainage of sepsis and minimization of tissue disruption.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 96.9% (SA 68.8%, A 28.1%)

Subsequent management

Initial elective management

The goal of conservative management is effective symptom control with insertion of draining setons at the first elective procedure after abscess drainage [537,538]. There is no evidence to guide which seton material is optimal. The material used should be robust, nonallergenic and, above all, comfortable to the patient, but otherwise may be at the discretion of the operating surgeon.

Many surgeons would selectively utilize MRI in the management of patients with perianal Crohn's fistula at this stage. Some prefer to obtain imaging to aid localization of fistula openings and any residual sepsis before undertaking an elective examination under anaesthetic. Other surgeons use MRI postoperatively to assess resolution of fistula-related sepsis after placement of setons [30]. Exclusion of residual sepsis is important if subsequent medical therapy is to be initiated and confidence that drainage is adequate must be obtained clinically and/or radiologically before therapy is started.

Statement 9.2.

The principle of initial elective management of fistulating perianal Crohn's disease is stabilizing the disease process with effective seton drainage.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 61.3%, A 38.7%)

Medical management

Current best practice in management of perianal fistulating disease uses both medical therapy and surgical interventions to achieve fistula healing or alleviation of symptoms [539–541]. There is increasing evidence that this multimodal approach using draining setons

followed by anti-TNF α and/or immunomodulators has additional beneficial effects on symptoms (and possibly healing) of perianal fistulas compared with surgery or medical therapy alone (at least in the medium term). For more details about medical treatment see the forthcoming BSG guidelines.

When medical therapy is being considered, the surgeon's role is to ensure satisfactory resolution of sepsis and advise on the timing of seton removal. Fistulas will not heal unless setons are removed, but optimal timing of seton removal has not yet been established. Whether this should occur before initiation of medical therapy or after the first or second dose is not clear, although the PISA ('Multimodal treatment of perianal fistulas in Crohn's disease: seton *vs* anti-TNF *vs* advancement plasty') trial may provide better evidence on timing [82]. Most clinicians would remove just before or soon after the second dose of infliximab at around 2–6 weeks after initiation of treatment [542,543]. There may be variations to this management dependent on circumstances, none of which is evidence based.

For instance, in the situation where multiple fistulas are present, a programmed plan of seton removal may be considered. In some patients, where palliation of fistula symptoms is prioritized over healing, setons may be left *in situ* in the long term. A multidisciplinary approach to these decisions involving surgeon, physician, IBD specialist nurse and gastrointestinal radiologist and, most importantly, the patient is essential.

Statement 9.3.

Depending upon patient choice and expectations, multimodal therapy using adequate surgical drainage followed by immunosuppressive therapy should be the initial management. Biological therapy is advisable for complex fistulas and proctitis.

Level of evidence: II

Grade of recommendation: B

Consensus: 97.0% (SA 54.5%, A 42.4%)

Definitive surgical management

If medical management is contraindicated or fails and the patient prioritizes 'healing' as a treatment objective, then definitive surgical management may be considered. The decision-making process must be patient-centred with the surgeon offering options for treatment, counselling on success rates and the consequences of failure and being realistic about expectations. None of the available surgical options for perianal fistulous disease

are perfect. Indeed, overall results may be considered at best moderate. Outcome will depend upon various factors including complexity, severity and duration of disease, prior procedures, scarring, functional status of the anorectum, smoking status and particularly whether proctitis is present [49,544,545].

Whilst there are trials reporting outcomes of medical therapy for this condition, there are no large RCTs reporting on surgical therapies. This may be due to the high degree of heterogeneity inherent in the disease. This includes factors relating to disease course (phenotype of Crohn's disease, mild or fulminant disease, duration of disease), prior treatment factors (antibodies to anti-TNF drugs, loss of response to treatment) and fistula anatomy (simple *vs* complex, number of fistula tracks, primary and secondary track behaviour). As all these factors influence clinical decision-making; a well-designed surgical trial would either need to stratify recruitment across these factors or limit recruitment to specific characteristics.

Whichever surgical option is selected, the underlying basic dictum must be preservation of tissue, particularly sphincter muscle. Crohn's patients have impaired healing. Excision of perianal skin tags is largely contraindicated as it may lead to rapid deterioration in symptoms (2) in the same way as radical lay-open techniques may accentuate the disease process. If present, a stricture may be gently dilated. Patients with Crohn's disease tend to have looser stool if luminal disease is present or as a consequence of previous intestinal resection. Even minor compromise in sphincter function may unmask symptoms of faecal incontinence or urgency, making most specialist surgeons reluctant to recommend any form of fistulotomy or indeed cutting seton [546,547].

Statement 9.4

The main role of the surgeon in the multimodal setting is to advise on the timing and order of seton removal, together with options for definitive healing in some circumstances. Surgical procedures are often most appropriate for simple fistulas.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 93.3% (SA 40.0%, A 53.3%)

Statement 9.5

Definitive surgical management of perianal Crohn's fistulas should prioritize tissue preservation, particularly sphincter muscle, and minimize functional disturbance, especially where attempts at healing fail.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.1% (SA 58.8%, A 38.2%)

Surgical options

Seton drainage alone

Well-placed draining seton(s) often control disease and are tolerated well by many patients. There is no ongoing risk to continence if sepsis is controlled and potentially no need for further surgery in nearly 90% of patients in whom setons are the planned definitive strategy [548]. The surgeon may recommend this as the only option, but it is essentially palliation only and residual discharge, seton discomfort and sexual embarrassment may prompt some patients into considering treatment aimed at trying to heal the fistula(s).

A systematic review on the topic assessed outcomes of studies comparing surgical monotherapy *vs* combined surgical and medical therapy. This descriptive analysis found that healing rates were approximately double in the multimodal group (55% *vs* 25%) (15). Details about optimization of medical management of perianal Crohn's disease fistulas within the context of multimodal therapy are detailed in the forthcoming BSG guidelines.

Statement 9.6.

Seton drainage offers reasonable symptom control and may be the optimal definitive choice in selected patients.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 64.5%, A 35.5%)

Fistula plug

The anal fistula plug has the advantage of minimal tissue disruption, avoiding potential wound-healing issues and theoretically continence issues. The most commonly used plugs are Surgisis[®] (Cook Surgical Inc., Bloomington, Indiana, USA), a bioabsorbable material made from porcine intestine, and the GORE[®] BIO-A plug (WL Gore & Associates, Inc., Flagstaff, Arizona, USA), comprising absorbable synthetic material. A recent meta-analysis summarized the available data from 16 studies including 84 patients [549]. The total success rate, defined as closure of the fistula track, was 58% (95% CI: 47–69%). Although the authors of the meta-analysis reported a reduced success rate with patients who had failed previous surgical (3/22, 14%) and immuno-suppressive

treatment (3/11, 27%), the numbers of these patients are simply too small to come to any meaningful conclusion. Indeed the quality of the data is so poor, due to lack of standardization and heterogeneity, missing data regarding prognostic indicators (e.g. proctitis, severe complex disease), small numbers in individual studies, variable but often short follow-up and lack of data on reason for failure (whether technical or disease related), that it is very difficult to recommend the plug based upon reported success. The meta-analysis did not include the results of a multicentre open-label RCT where some attempt was made to stratify patients [550]. In this study 54 Crohn's patients had an anal fistula plug; fistula closure at 12 weeks was achieved in 31.5%. The closure rate was similar to that achieved with seton removal alone (relative risk 1.31, 95% CI: 0.59–4.02, $P = 0.19$). The complexity of the track did not seem to influence success. It is disappointing that this trial was carried out without the use of biological therapy, as multimodal therapy would be considered the current best practice standard.

Statement 9.7.

There is weak evidence to support anal fistula plug as a low-risk option in simple perianal Crohn's fistulas where successful healing may be achieved in a small proportion of fistulas. There is a risk of post-procedure sepsis, but long-term functional consequences are unlikely.

Level of evidence: II

Grade of recommendation: C

Consensus: 87.5% (SA 25.0%, A 62.5%)

Despite poor data quality and the negative result of a RCT, there appear to be some successes with the fistula plug and the minimally invasive nature of the intervention make it a viable part of the surgical armamentarium [30,49].

Ligation of the intersphincteric track (LIFT) procedure

Although the LIFT procedure purportedly preserves the anal sphincters it does involve a significant amount of tissue division and a degree of sphincter retraction, firstly to gain access to the fistula in the intersphincteric space and subsequently in coring out the component of the track external to the external sphincter.

There are few data specifically on use of LIFT in Crohn's disease. One prospective study published in 2014 reported outcomes of 15 LIFT procedures for Crohn's fistulas [551]. The procedure was successful in nine cases at very short-term (2-month) follow-up. At 12-month follow-up, one repair had failed and three patients had developed a new fistula, meaning that just

one-third of patients remained healed. Four patients with trans-sphincteric perianal Crohn's fistulas were reportedly successfully treated in the short term with LIFT procedures reinforced with bioprosthetic mesh in the intersphincteric space [552].

Clearly there are only a small number of patients described in the literature and the long-term results are unknown. There are currently insufficient data to recommend or dismiss this technique.

Statement 9.8.

At present there is insufficient evidence for the use of the LIFT procedure in the treatment of perianal Crohn's fistula.

Level of evidence: IV

Grade of recommendation: D

Consensus: 90.0% (SA 30.0%, A 60.0%)

Advancement flap

Endoanal advancement flaps in perianal Crohn's disease have been described in several studies. The literature was summarized in a review published in 2010 [553]. Although the weighted success of 64% seems very promising, the authors point out the limited quality of the reports with numerous structural and design flaws. In addition, they report an incontinence rate of 9.4%. Nevertheless, the advancement flap was chosen as the most appropriate surgical comparator in an ongoing trial of multimodal treatment of perianal Crohn's disease [82].

Scarring, fibrosis and guttering deformities from previous surgery may all predicate against the use of advancement flaps in many patients with chronic perianal Crohn's fistulas. It should be noted that the endoanal advancement flap is relatively contraindicated in patients with proctitis due to poor wound healing and high recurrence [554,555]. Ano-cutaneous flaps may be an alternative in this situation but have not been assessed.

Statement 9.9.

Although there is some evidence for use of an advancement flap as a means of closure for perianal Crohn's fistula in the absence of stricture or proctitis, there is a high failure rate and associated risk to continence.

Level of evidence: III

Grade of recommendation: C

Consensus: 93.9% (SA 36.4%, A 57.6%)

Fibrin glue

Fibrin glue is applied into the fistula track as a paste and activates the thrombin system, causing mechanical

obstruction of the fistula track. One randomized trial initially reported favourable results with the technique over observation in perianal Crohn's fistulas [556]. At 8 weeks, the primary end-point of fistula closure was seen in 38% of the fibrin group compared with 16% of the observation group (OR 3.2, 95% CI: 1.1–98, $P = 0.04$). The same group reported on 14 patients with refractory fistulating Crohn's disease undergoing fibrin glue treatment. This study found clinical improvement in 75% of patients at 3 months' follow-up and complete healing in 57% of patients at 2 years [557]. Subsequent trials of fibrin glue in the cryptoglandular setting have suggested poor results, and the technique has largely fallen out of favour [558,559].

The limited data from a single centre do not justify its use in perianal Crohn's fistulas although combination with other biomaterials, such as adipose-derived stem cells, allograft acellular dermal matrix and xenograft collagen, requires further investigation (see below).

Statement 9.10.

There is insufficient evidence to recommend fibrin glue alone as a treatment for fistulating perianal Crohn's disease.

Level of evidence: II

Grade of recommendation: C

Consensus: 100.0% (SA 32.3%, A 67.7%)

Novel therapies

Hybrid techniques

The bioLIFT technique combines the LIFT procedure with insertion of a bioprosthesis graft in the intersphincteric plane, but only a very small case series has been reported (36). The LIFT-plug technique has also been described but not reported in patients with perianal Crohn's fistulas [552].

Permacol™ paste injection has been combined with advancement flap in seven patients with IBD-related fistulas [560]. Healing rates were 57% (4/7) after a median of 14 months' follow-up.

Biomaterials

Biomaterials include autografts (adipose-derived stem cells, platelet-rich plasma), allografts (acellular dermal matrix) and xenografts (Permacol injection) [561]. These techniques may be promising in that they cause minimal tissue disruption. Most have not been tested in the field of perianal Crohn's disease. However, there is recent randomized trial evidence for autologous stem cells which is particularly promising. The surgical

procedure involves curettage of the track, correct location of the injection and sutured closure of the internal opening of the fistula(s). A large multicentre trial suggested that a greater proportion of patients treated with allogenic adipose-derived mesenchymal stem cells (Cx601) attained combined remission compared with placebo injection [intention to treat 53/107 (51%) vs 36/105 (34%), 97.5% CI for difference 0.2–30.3; $P = 0.024$] [83]. However, the high remission rates following placebo injection could perhaps reflect the surgical technique incorporating sutured closure of internal openings of fistulas.

Other techniques

The over the scope clip (OTSC®, Ovesco™) refers to application of a metal alloy clip to a fistula opening. The technology has been used in flexible endoscopy and has recently been adapted for application with perianal fistula via a specific delivery mechanism. There is a single report on the use of this technique in ten anal fistula patients, six of whom had Crohn's disease. Treatment was successful in five patients with a follow-up period ranging from 157 to 523 days [562].

Fistula track laser closure (FiLAC) is a sphincter-preserving technique that uses a diode laser source and radial emitting laser probe (FiLAC™, Biolitec, Vienna, Germany) that works by destroying the lining of the track and shrinking the tissue around the probe [563]. No data exist for use of the treatment in perianal Crohn's disease.

Video-assisted anal fistula treatment (VAAFT) utilizes a fistuloscope, unipolar electrode and endobrush and glue to fulgurate, curette and seal the track [564]. The internal opening must be closed. Again, no data currently exist for the treatment of perianal Crohn's fistulas.

While these advanced technologies have a sound theoretical basis all are in an early stage of evolution, and although some early results are promising they are difficult to reproduce. Longer follow-up and further evidence is required before any of these techniques can be recommended.

Statement 9.11.

Allogenic adipose-derived mesenchymal stem cells may offer improved healing in perianal Crohn's disease. Hybrid techniques and alternative therapies have therapeutic potential but at present remain unproven.

Level of evidence: I–III

Grade of recommendation: A

Consensus: 90.3% (SA 12.9%, A 77.4%)

Statement 9.12.

The chances of success and consequences of failure of any proposed surgical intervention should be discussed in detail with the patient to ensure acceptability of the intervention.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 71.4%, A 28.6%)

Statement 9.13

Faecal diversion may be considered for symptom control in patients with perianal Crohn's fistulas or if proctitis cannot be controlled medically.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.0% (SA 63.6%, A 33.3%)

Management of the failed perineum

Pain, pads and incontinence define the failing bottom with significant negative impact on quality of life. There may be a point when the patient reaches the decision that medical or surgical therapy is not going to help. The surgeon can only guide the patient to this conclusion by being realistic in terms of what can be offered [94]. A temporizing intervention is to defunction the bowel. Diversion in a patient with severe symptomatic perianal Crohn's is often associated with a significant improvement in quality of life [565]. The choice of stoma type should be individualized based upon the pattern of disease and patient preference. Whilst a loop ileostomy is more commonly utilized [566], isolated proctitis or perianal disease may be more effectively defunctioned with a colostomy. This may make a subsequent proctectomy technically easier.

It is important for the patient to realize that a diverting stoma in this situation is highly likely to be permanent, with just 10% of patients returning to long-term intestinal continuity. As such, for most patients, diversion may simply be a stepping stone to subsequent proctectomy [567].

Diversion does not always provide adequate symptom control or improvement in quality of life in severe perianal Crohn's disease, and proctectomy or proctocolectomy should be considered (see Section 5), with patients expressing the desire to see clinicians raise this option earlier in their treatment pathway [94].

Proctectomy in the setting of perianal Crohn's disease is associated with poor healing in up to 40% of patients [568]. This may result in a simple chronic perianal sinus with occasional discharge with a spectrum of outcomes to the other extreme of severe non-healing perineum with persistent discharge rivaling that experienced before proctectomy. Reconstruction with myocutaneous flaps should be considered in particularly bad cases of disease. Vertical and transverse rectus abdominis [569], gluteal [570] or gracilis [571] myocutaneous flaps have been described in this setting.

Statement 9.14

Proctectomy provides improved symptom control and quality of life in selected patients.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 60.6%, A 39.4%)

Other manifestations of perianal Crohn's disease*Skin tags*

Profuse and atypical skin tags can be pathognomic of perianal Crohn's disease. They are associated with perianal lymphoedema [572] or fibrosis. Patients may request excision due to symptoms of swelling, induration, irritation or difficulty in perineal hygiene. However, conservative management is key as excision frequently leads to deterioration in symptoms from poor healing and may precipitate need for more aggressive surgery [529].

Fissures

A Crohn's fissure, unlike idiopathic fissures that tend to lie in the posterior or occasionally anterior midline, may occur at any position on the anal circumference. Sometimes the atypical location of a fissure in itself raises the suspicion of the underlying diagnosis of Crohn's disease. Crohn's fissures tend to be painless and may occur in combination with other perianal manifestations of Crohn's disease. It may be difficult to differentiate a true high-pressure fissure from an anal ulcer.

As with all perianal Crohn's disease, treatment of a true high-pressure fissure should be conservative with topical therapies (GTN, diltiazem gel or ointment) and botulinum toxin injection being used in preference to surgical sphincterotomy [529].

Anal stricture

Anal and low rectal strictures are not uncommon in Crohn's disease, occurring in about 10% of patients with perianal disease [573], especially in patients with proctitis or chronic perianal sepsis relating to fistulating disease. Diagnosis is readily made on digital rectal or proctoscopic examination and often treatment is not

required as the stricture is asymptomatic. It is quite surprising how patients may tolerate severe stenosis. If symptoms develop in the form of obstructed defaecation, then simple dilatation is often effective but may occasionally be accompanied by poor wound healing [574]. Refractory cases usually require proctectomy as a stoma often exacerbates symptoms of stenosis [575].

Haemorrhoids

As haemorrhoids occur commonly in the general population it is no surprise that they also occur in patients with perianal Crohn's. Indeed, symptoms from haemorrhoids may be exacerbated by frequent call to stool. Treatment is conservative due to poor healing. Haemorrhoidectomy should be avoided unless absolutely necessary and only ever offered in the absence of proctitis [575]. Rubber band ligation is recommended as a treatment by the American Gastroenterology Association [576] and Doppler-guided haemorrhoidal artery ligation may be successful without compromising wound healing [577].

Anal ulceration

This is an unusual but dramatic presentation. An abscess should be excluded. Treatment is then medical, with the primary objective of symptom relief, and steroid injection or topical tacrolimus may help [578]. Occasionally, especially in children, a severe variant of anal ulceration 'highly destructive perianal Crohn's' [579] may be observed. Medical management in the form of immunomodulation is the mainstay of treatment. Severe cases may benefit from defunctioning stoma.

Rectovaginal and pouch–vaginal fistula

Perineal involvement in Crohn's disease is relatively common, with rectovaginal fistulata (RVF) occurring in 5–10% [127,580,581]. Indeed after obstetric trauma, Crohn's disease is the commonest cause of vaginal fistulation [582]. The likelihood of developing a fistula is related to the presence and severity of left-sided colorectal Crohn's involvement [583]; only 3.5% of patients with small bowel disease will have fistulation compared with 23% of those with large bowel involvement [582]. The presence of RVF significantly increases the lifetime risk of a stoma or proctectomy [584].

Presentation and assessment

Rectovaginal and pouch–vaginal fistulas usually present with leakage of gas, liquid or faeces through the vagina, as well as pain or discomfort and a purulent discharge. In addition, there may be dyspareunia, perineal pain or

tenderness and avoidance of sexual intercourse [127,581]. Fistulas are classified according to the relationship with the anal sphincter; ano–vaginal fistulas where the intestinal internal opening is in the anus and rectovaginal when it is within the rectum, with the former often having a more benign clinical course [585]. These terms are often used interchangeably in the literature.

Clinical examination may reveal the presence of anal or rectal disease with inflammation or the presence of a stricture. Vaginal examination may show a fistula opening or induration in the posterior vaginal wall. The internal and external openings of any fistula may be difficult to find clinically, and where clinical suspicion is high but initial examination is unhelpful an examination under anaesthetic is advised and usually combined with specialized imaging.

Magnetic resonance imaging can clearly show perianal sepsis but may not be helpful in RVF [529], although the use of endocoil MRI improves accuracy [586]. Abdominal cross-sectional imaging is often helpful in assessing concurrent small bowel disease, and luminal assessment with colonoscopy is vital to assess the total inflammatory burden. Anal ultrasound (with or without hydrogen peroxide enhancement) may also be useful [587,588] and may also provide vital anatomical information regarding integrity of the anal sphincter [589]. Transperineal ultrasound may be a promising alternative [590].

In keeping with the general principles of anal fistula management, treatment should be a staged process with initial steps of drainage of sepsis and control of the primary track [582,583] prior to attempted definitive treatment.

Statement 10.1

A combination of careful examination under anaesthesia by an experienced surgeon and perineal MRI is useful in the diagnosis and assessment of clinically apparent or suspected rectovaginal fistulation.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 93.8% (SA 59.4%, A 34.4%)

Medical management

Whilst the control of any underlying Crohn's disease may be vital to the success of any surgical treatment for fistulas to the vagina, medical management may in itself lead to fistula healing. Many reports have been published suggesting concurrent medical therapy to supplement surgical treatment.

Antibiotics

There are no randomized studies investigating the use of antibiotics in the healing of RVF and so the evidence to date is largely anecdotal and relates to case series [581,591]. There may be some short-term benefit in the reduction of symptoms. Brandt *et al.* [592] treated 26 patients with oral metronidazole, achieving healing in under half at the expense of neurological symptoms with prolonged use. Similarly, the use of ciprofloxacin, in combination with metronidazole or azathioprine, may be beneficial for symptom reduction [582,593,594].

Corticosteroids

There is no evidence on the role of steroids specifically for the treatment of RVF and pouch–vaginal fistulas in Crohn's disease.

Cyclosporine/tacrolimus

Whilst intravenous cyclosporine has been shown to induce healing in Crohn's anal fistulas in one study (88% after a mean of 7.4 days), two RVFs in this study rapidly recurred after conversion to oral medication (19). Similar poor results have been reported by others [127,595].

6-mercaptopurine (6-MP)/azathioprine

The immunosuppressive agent 6-MP and its metabolite azathioprine have been used to attempt healing in anal fistulas including a small RVF subgroup. One-third of this subgroup healed in a randomized controlled study comparing 6-MP with placebo [596]. Healing took a mean of 3.1 months and often longer, with most relapsing after cessation of treatment.

Infliximab

The advent of anti-TNF treatment has markedly changed the treatment of Crohn's disease, particularly in the treatment of fistulas [597]. Whilst most attention has been directed at intestinal and anal fistulas, no studies specifically address RVFs. The best evidence comes from subgroup analysis of the ACCENT II study [598]. Those patients who responded to the three initial induction doses were randomized to continue with treatment or receive placebo. RVF closure was preserved for longer in the treatment group and those who initially responded to induction and received ongoing maintenance treatment thereafter had a 44% chance of maintaining healing. For this reason, many advocate the use of anti-TNF treatment to reduce active anorectal inflammation prior to considering RVF repair [581].

However, evidence that surgical success is increased following biological therapy is lacking [599–601].

Statement 10.2.

Healing of Crohn's rectovaginal fistula may occur in a small proportion of patients on anti-TNF α therapy.

Level of evidence: III

Grade of recommendation: D

Consensus: 87.1% (SA 25.8%, A 61.3%)

Surgical treatment

Initial treatment for RVF should always be drainage of any sepsis and control of the primary track with a seton only if infection is present [602]. Following drainage, attempts should be made to optimize local anal and/or rectal inflammation.

The original standard surgical treatment for difficult, symptomatic RVF traversing a large portion or the entire anterior sphincter complex was always proctectomy or permanent diversion with a stoma. Modern management has led to a more sphincter-preserving approach with the use of trans-vaginal or trans-rectal flaps, advancement rectal sleeves or a trans-perineal approach, as well as the application of techniques used in idiopathic anal fistula treatment, namely fistula plugs and collagen paste or tissue interposition (gracilis and Martius flaps). The ultimate choice of approach depends on the exact location of the fistula and the concurrent condition of the anus, rectum and sphincter complex [603]. Often more than one surgical option may be needed to heal a fistula [604]. Overall for Crohn's RVF healing rates of up to 67% have been reported in experienced specialized units. It may take up to 48 months and a mean of 1.4 operations to achieve success [599,605,606] and is probably dependent on factors such as the concurrent use of immunomodulators with failure associated with the use of steroids and smoking [607].

Statement 10.3

Initial surgical treatment of Crohn's rectovaginal fistula should involve draining sepsis and controlling any primary tracks with a seton. A seton is not required in absence of sepsis.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 86.7% (SA 36.7%, A 50.0%)

Statement 10.4

In patients with Crohn's rectovaginal fistula who prioritize healing over palliation and who have undergone careful counselling, sphincter-saving surgery may be attempted after optimization of any luminal disease. The chances of success, associated risks and consequences of failed treatment should be discussed.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 93.5% (SA 45.2%, A 48.4%)

Statement 10.5

Surgical treatment of rectovaginal fistula often involves a variety of approaches and more than one procedure to achieve healing. Successful healing is often not achieved in a significant proportion of patients, even in specialist units.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 54.8%, A 45.2%)

Rectal advancement flaps

This technique involves the creation of a broad-based flap involving mucosa, submucosa and circular muscle of the rectum. The fistula track is identified, excised or curetted and the internal opening closed with absorbable sutures. The mobilized flap is then secured over the closed opening distal to it to cover the site of the previous fistula. The vaginal opening is usually left open to drain freely to avoid a collection in the rectovaginal space [582]. The attraction of this technique is that the flap is covering the track from a high-pressure area (rectum) to a lower-pressure area (vagina) with the introduction of normal interposing tissue [608]. This approach is contraindicated in cases with active rectal disease, extensive ulceration or strictures.

Vaginal advancement flaps

These have the advantage of using nondiseased pliant vaginal tissue, avoiding excessive handling of the rectal mucosa, which is particularly important if there is any residual inflammation present [609]. Cure rates using this approach have been reported to be as high as 92% [609], especially when levator muscle is interposed between the repaired rectum and the vagina [610]. A more realistic success rate is around 40–60% [603,611–615], with success rates independent of the use of a defunctioning stoma.

A recent systematic review comparing treatment with advancement flaps for Crohn's-related RVF found no

difference in primary closure, overall closure or recurrence rates between either the rectal or vaginal approach [616]. A total of 11 observational studies were assessed giving a pooled rate of closure of 54% with the rectal approach and 69% with a vaginal flap. Irrespective of healing, sexual function and quality of life scores are comparable before and after healing [607], although rates of dyspareunia may be slightly higher in those women who do not heal.

Statement 10.6.

Advancement flaps have a healing rate of 50% in selected patients with Crohn's rectovaginal fistula. Vaginal and rectal approaches appear equivalent in terms of healing.

Level of evidence: III

Grade of recommendation: B

Consensus: 93.1% (SA 37.9%, A 55.2%)

Fistula sealing techniques

The general mantra for modern surgical treatment for anal fistulas is that of sphincter conservation. This is especially true for RVF where sphincterotomy would often necessitate cutting the majority of the length of the anal sphincter leaving a wide wound which may heal badly. Due to these factors, fibrin glue and latterly collagen fistula plugs have been used to try to heal tracks. Most studies combine the results of treatment for cryptogenic fistulas and those related to Crohn's disease, with success rates for fibrin glue ranging from 14% to 69% [550,581]. A systematic review showed a closure rate of 55% using fistula plugs in Crohn's-related anal fistulas, although RVFs were excluded from this analysis [617]. Gajsek *et al.* reviewed the long-term results of the button fistula plug in the treatment of RVF related to Crohn's disease and pouch–vaginal fistulas. They found that at 2 years no pouch–vaginal fistulas and 44% of RVFs had healed [618]. Furthermore, all attempts at repeated plug insertion failed. Other groups have had some success in both RVFs and pouch–vaginal fistulas with the button plug, with 60–66% [619] healing in RVFs and 57% healing in pouch fistulas in the short term (15 weeks) [620]. In a similar way repeat insertion led to only a 12.5% success rate.

Statement 10.7.

Fistula plugs offer a low-risk option in treating narrow-calibre Crohn's rectovaginal and pouch–vaginal fistulas, but healing rates are < 50%.

Level of evidence: IV

Grade of recommendation: D

Consensus: 86.2% (SA 44.8%, A 41.4%)

Gracilis muscle interposition/Martius graft

The interposition of healthy tissue into a fistula track or reinforcing a fistula repair has been employed either with a labial fat pad flap graft (modified Martius) or a muscle flap (gracilis). In a study of gracilis muscle interposition 33% of nine patients with Crohn's vaginal fistulas healed [621], although with a 29–47% complication rate [622]. In a recent systematic review of gracilis graft for complex perineal fistulas the success rate in the Crohn's subgroup was 54% [623], although success rates of up to 92% at 3.4 years have been reported [624]. By contrast Martius graft had a success rate of 50% in the Crohn's subgroup (eight patients, at 35 months) [625] and 70% (five out of seven women at 3 months) [626], but with a lower morbidity rate of 15%.

Statement 10.8.

Tissue interposition with either gracilis muscle flap or modified Martius graft (labial fat pad) may be used in well-counselled patients with Crohn's rectovaginal fistula, but successful healing is achieved in < 50% of cases.

Level of evidence: III

Grade of recommendation: D

Consensus: 100.0% (SA 44.8%, A 55.2%)

Rectal sleeve reconstruction

A sleeve flap may provide a better option in those patients with low-circumferential rectal disease but normal mucosa proximally, and good continence. The procedure involves resection of all diseased mucosa allowing anastomosis with normal rectal mucosa to the 'neo-dentate' line. There are limited reports of this technique (Soave procedure), the largest series being in 13 patients [627], 11 of whom had RVF. Eight patients were healed at 1 year. Other groups have had success in highly selected cases where RVF coexists with a rectal stricture [628]. An alternative to a purely perineal approach is to mobilize the rectum from the abdomen, resecting the diseased segment. After performing an anal mucosectomy from below and closing the fistula, the healthy bowel is advanced to form a colo-anal anastomosis [580]. This anastomosis may be created immediately or with delayed maturation after 5–6 days (Turnbull–Cutait technique) [629].

Stem cells

Abdominal wall fat has been harvested and injected into RVF tracks; this has been successful in a limited number

of patients when the fistula is related to obstetric injury, but when used in Crohn's disease all fistulas recurred [630]. Studies have reported using stem cell injection from autologous fat harvesting with some success [631]. A Phase II study in 10 women has shown that using autologous fat-derived stem cells, 60% of RVFs are healed at 52 weeks [632].

Diversion stoma and proctectomy

Many patients with Crohn's RVF will be diverted during the course of treatment as an adjunct to healing, as a means of alleviating symptoms or to salvage complications of interventions aimed at healing.

The ultimate treatment for recurrent anal fistulation or RVF in Crohn's disease is proctectomy. Up to 20% of patients are ultimately treated this way [633]. The procedure is not without complication, with nonhealing perineal wounds occurring in between 30% and 50% [608,634] (see Section 13).

Statement 10.9.

Many patients with Crohn's rectovaginal fistula will be diverted during treatment as an adjunct to healing, as a means of alleviating symptoms or to salvage complications of interventions aimed at healing. Proctectomy is required to treat up to 20% of patients with rectovaginal fistulas and is associated with a high rate of perineal wound morbidity.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 96.6% (SA 44.8%, A 51.7%)

Pouch–vaginal fistulas

Pouch–vaginal fistulas occur in 2.9–10.6% [635–638] of pouches and become apparent at a mean time of between 8 and 21 months after construction of the pouch (range –132 months) [638]. Local advancement flaps are successful in 44% of cases, with 10% of cases suitable for a re-do pouch with an ultimate success rate of 50%. Results are significantly worse for those patients with ileoanal pouch fistulas who eventually have a diagnosis of Crohn's disease; one-third of this group will eventually lose the pouch [638,639]. Often pouch–vaginal fistulation is preceded by postoperative sepsis [637]. Fistula plugs have been used with limited success in small case series (four out of seven healed, 57%) [620]. Local flap procedures may be used either from the vagina or from the pouch with limited success (30–55% healing) [635,638]. A transvaginal procedure may have the

advantage of preserving sphincter function and with repeated repairs up to 78% will heal [640]. More major surgery has been advocated, including perineal pouch advancement with good results in a few patients [641] or gracilis muscle interposition [635,642]. Overall the success rate of surgery for pouch–vaginal fistula is 50% [643].

Statement 10.10

Pouch–vaginal fistulas occur in up to 10% of female patients with ileoanal pouches and often follow pouch sepsis or anastomotic disruption.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 82.8% (SA 34.5%, A 48.3%)

Statement 10.11

Many techniques are required to treat pouch–vaginal fistula and often more than one is needed for ultimate success, which may be expected in < 50% of cases. Diversion, pouch revision and pouch excision are the best options for technical complications causing pouch–vaginal fistula. Biological therapy and rectovaginal fistula surgical techniques may be used in patients with Crohn's-related pouch–vaginal fistula.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 93.3% (SA 43.3%, A 50.0%)

Summary

Rectovaginal and pouch vaginal fistulas are relatively common complications of Crohn's disease and ileoanal pouch formation (occurring in up to 10% of cases). When present they significantly reduce quality of life. Often a multidisciplinary approach to treatment is needed to optimize any underlying IBD and drain any sepsis. Following this a variety of strategies may be used depending upon the exact presentation. Multiple attempts at surgery are usually required before successful healing, with no surgical approach having superior results.

Duodenal Crohn's disease

Duodenal Crohn's disease is defined using criteria proposed by Nugent and Roy [644]. In the presence of one of the two following criteria the diagnosis of duodenal Crohn's disease can be made: (i) the histological presence of noncaseating granuloma or granulomatous inflammation with or without obvious Crohn's disease elsewhere in the intestinal track, and without evidence of systemic granulomatous disorder; or (ii) documented

Crohn's disease elsewhere in the intestinal track and radiological and/or endoscopic findings of diffuse inflammatory change in the upper gastrointestinal track consistent with Crohn's disease. Duodenal manifestations are not always primary and can be secondary. In situations where surgery is needed for duodenal Crohn's disease the indications are usually related to duodenal involvement from adjacent organs such as the terminal ileum and colon.

Strict adherence to diagnostic criteria as described above gives estimates of the prevalence of duodenal Crohn's disease of between 1.8% and 4.5% [644,645]. This usually relates to symptomatic disease, but the true incidence and prevalence of duodenal Crohn's disease may be underestimated. Many of these data originate from studies on patients with long-standing Crohn's disease who are already on immunosuppression. As the risk of duodenal Crohn's disease is much higher in the paediatric population it is standard practice to perform upper gastrointestinal investigations to assess this part of the gastrointestinal track, but the true incidence of duodenal lesions in adult-onset Crohn's disease is less well known [646]. Horje and colleagues have attempted to identify this risk in a single-centre cohort and estimated that up to 55% of patients with newly diagnosed Crohn's disease have some upper gastrointestinal manifestation but they may not always be symptomatic [647]. Focal duodenal inflammation can be seen in over 50% of patients with Crohn's disease even in the absence of *Helicobacter pylori* [648,649]. It is assumed that the treatments given to suppress the inflammation in the other organs reduce the inflammatory burden in the upper gastrointestinal track, leading to a lower prevalence. It is reasonable to speculate that this may be the reason for the low surgical burden of duodenal Crohn's disease.

There have been isolated reports of primary fistulating disease of the duodenum [650–654]. Fistulating disease involving the duodenum is more commonly associated with disease in the colon or ileum directly invading the duodenum [655]. One of the more common scenarios in which a fistula to the duodenum occurs is in the presence of an ileocolic anastomosis placed adjacent to the duodenum, but ileal or colonic disease can also directly fistulate into the second part of the duodenum. The primary management strategy in this situation is to treat the source of the fistula and will involve resecting the affected segment of the bowel. Repair of the duodenum can be performed primarily if the defect is small. In the event of a large defect the options are an omental patch, a serosal patch involving a segment of jejunum or a duodenojejunostomy. The advantage of a jejunal serosal patch is that in the event of subsequent perforation, the duodenal contents will

most likely drain to the attached jejunum, causing no metabolic consequences to the patient. It is important to ensure that any jejunum used for a serosal patch or duodenojejunosomy is disease free. Preventing duodenal fistulas by avoiding direct placement of any anastomosis over the duodenum or by placing the omentum between the duodenum and anastomosis appears intuitive but is without any supportive evidence.

Statement 11.1

Medical management is the preferred initial approach in primary duodenal Crohn's disease. Surgery is seldom required.

Level of evidence: III

Grade of recommendation: B

Consensus: 93.8% (SA 53.1%, A 40.6%)

The most common symptoms of duodenal Crohn's disease are upper abdominal pain, nausea and vomiting. Weight loss and bleeding can be associated symptoms. Very rarely, pancreatitis can occur after duodenal scarring. The paediatric population tend to suffer less bleeding than the adult population. It is more common for the disease affecting other parts of the gastrointestinal track to manifest symptoms in the vast majority of patients. In most situations the treatment is medical. The EPACT II study group have developed recommendations for medical management of duodenal Crohn's disease and these are available to view at <http://www.epact.ch/> [656]. These recommendations are not based on, but conform to, the ECCO guidelines [153]. Medical treatment for duodenal Crohn's disease does not differ greatly from that for other parts of the gastrointestinal track except for the addition of proton pump inhibitors and *H. pylori* eradication therapy. Surgery, when required, is for complications of the disease.

Statement 11.2

Fistulating disease involving the duodenum is more often secondary to Crohn's disease of an adjacent organ and requires surgery to remove the affected segment with primary or secondary repair of the duodenum.

Level of evidence: III

Grade of recommendation: B

Consensus: 90.3% (SA 48.4%, A 41.9%)

One of the most common indications for surgery in duodenal Crohn's disease is obstruction related to strictures. In most situations, the strictures are short and

occur at the first or second part of the duodenum. They are usually amenable to endoscopic balloon dilatation and in most situations symptomatic relief is obtained. Much of the evidence is from case series, which reflects the uncommon nature of the problem. Most series describe 60–80% success rates, but repeated dilatations are frequently needed. The reported perforation rate of 1–2% makes it a safe procedure even when repeated procedures are needed, and dilatation should be offered as first-line treatment [185,653].

There are many indications for surgery in duodenal Crohn's disease, but the most common is structuring refractory to endoscopic treatment. Other indications include persistent ulcers with pain, upper gastrointestinal bleeding and malignancy.

The most common procedures in the setting of obstruction are bypass procedures (gastrojejunosomy or gastroduodenostomy) or strictureplasty. The choice of procedure should be based on the nature of the stricture and a clinical assessment of the likelihood of success. There are no prospective trials to evaluate these procedures and again most of these recommendations are based on individual case series. In one such series ($n = 10$) from the Cleveland Clinic 70% of patients required reoperation for duodenal Crohn's disease and in this setting marginal ulceration was the most common reason for re-do surgery [657]. On this basis vagotomy is recommended as routine when performing a bypass procedure, but other series have not corroborated these findings. The role of vagotomy is currently unknown, and given that it is a procedure not commonly performed and can be associated with profuse diarrhoea it may be safely omitted in this setting. More recent series have reported similar outcomes by omitting vagotomy and this may be related to the regular use of proton pump inhibitors [658].

Strictureplasty is a safe procedure in this setting and there are no head-to-head to studies comparing strictureplasty with bypass procedures. Recurrence and reoperation rates are reportedly higher after strictureplasty compared with bypass surgery [658–660]. It should be noted, however, that published series are based on very small numbers and that any conclusions are difficult to form.

Primary fistulas are a rare phenomenon in duodenal Crohn's disease [661]. The procedure of choice in this situation is to separate the organ into which the duodenum is fistulating. The duodenal defect can then be repaired primarily in a similar manner to that performed in the presence of a perforated ulcer. In the event of the duodenal defect being large, a duodenojejunosomy is the procedure of choice, but it is essential to ensure that the segment of jejunum used is not affected with Crohn's disease.

Pancreaticoduodenectomy (Whipple's procedure) has been described in extreme situations of duodenal Crohn's disease [662]. While the morbidity reported was low, it is not recommended as a first-line procedure as the other procedures detailed above have good success rates.

Malignancy can occur in long-standing duodenal Crohn's disease and the risk is assumed to be the same as with Crohn's disease in the rest of the small bowel [663]. A high index of suspicion is required to diagnose this pre-operatively as the treatment will need to follow oncological principles and may require extensive surgery.

Statement 11.3

In primary duodenal Crohn's disease obstruction is the most common indication for surgery. Where endoscopic balloon dilatation does not offer symptom control, strictureplasty or gastrointestinal bypass surgery are the recommended surgical options

Level of evidence: IV

Grade of recommendation: B

Consensus: 93.8% (SA 59.4%, A 34.4%)

Summary

Duodenal Crohn's disease is probably more prevalent than has been previously thought. Nonetheless, symptoms requiring surgery are rare and as a result, recommendations for surgery are based on case reports and case series. Surgery, when required, should follow principles to offer symptomatic treatment except in the case of malignancy where oncological treatment principles should be followed.

Surgery for recurrent ileocaecal Crohn's disease

Crohn's disease is not cured by surgery and the mainstay of treatment remains medical therapy. The role of surgery is to address complications (perforation, abscess, strictures, obstruction, fistula, haemorrhage) and symptoms refractory to maximal medical therapy. The need for close cooperation between surgeon, gastroenterologist and the wider IBD multidisciplinary team is essential, not least in patients who have had previous surgery (ileocaectomy unless otherwise stated).

Often quoted data from 1955–1989 indicate that the risk of surgery during the first decade after diagnosis of terminal ileal Crohn's disease is 71%, and 44% of patients who have surgery require a second resection during the next 10 years [664]. Current population-based studies show that the likelihood of having bowel

resection has decreased during the 21st century, with the rate of primary surgery in Crohn's disease now at 47% in the first decade [50,665]. Changes both in the diagnosis and the management of the disease may explain this reduction in surgery rates. It remains the case that many patients still require multiple operations for Crohn's disease [50,665].

Surgery for Crohn's disease has high stakes due to the nature of the disease, particularly in the context of disease-modifying therapies which affect immune functions and tissue healing. This is particularly the case in surgery for recurrent disease. Intestinal failure is a feared consequence of luminal Crohn's disease, and is often regarded as an end-stage condition resulting from sequential small bowel resections for relapsing disease. Bowel-sparing techniques such as strictureplasty have been developed to minimize this risk [666]. However, a detailed case study from an intestinal failure unit in England found that loss of small bowel length due to repeated bowel resections was the cause of intestinal failure in a minority (22%) of patients with intestinal failure and Crohn's disease [667]. The majority (61%) developed intestinal failure due to abdominal sepsis in the immediate period after surgery for Crohn's disease. Patients in this large group typically underwent multiple re-laparotomies within a short time frame after the initial operation. This then led to loss of short bowel, enterocutaneous fistulation or both.

Recent data confirm the real risk of intestinal failure in the patient population who require abdominal surgery for Crohn's disease. A multicentre study of some 1700 patients found that the incidence of intestinal failure (defined as dependence on parenteral nutrition for more than 12 months) over 5, 10 and 20 years after index surgery was 0.8%, 3.6% and 8.5%, respectively [180].

The risk of septic complications in particular must therefore be managed. The risk factors for septic complications are modifiable by meticulous planning of care. In view of the stakes involved, recurrent Crohn's disease should be managed within an experienced multidisciplinary team.

Reducing the risk of recurrent disease

When working within the multidisciplinary team, it is important that surgeons have a working knowledge of the management options and their efficacy and risk profiles. There is a danger in the era of enhanced recovery pathways for the surgical team's focus to be on uneventful recovery and early discharge rather than long-term management strategies. This is amplified as postsurgical prophylaxis is controversial and so not a matter of defined protocol.

Smoking cessation

There is clear evidence that patients with Crohn's disease who smoke have an increased risk of recurrent disease, with a relative risk of 2.5 in patients who smoke and a substantial reduction of this risk in people who stop smoking [668,669]. Interventions including nicotine replacement therapy to promote smoking cessation should therefore be a central component of disease management. It has been shown that smoking cessation even in the setting of surgery is difficult and professional support is required for high cessation rates. Adequate resources are therefore required for smoking cessation support [670]. Whilst ideally patients will have stopped smoking before their resection, when this has not been possible the postoperative period can be an ideal time to intervene and provide support.

Statement 12.1.

Patients with recurrent ileocaecal Crohn's disease who are also smokers should be referred for smoking cessation support, particularly if considering further surgery.

Level of evidence: I

Grade of recommendation: A

Consensus: 97.1% (SA 73.5%, A 23.5%)

Medical reduction of the risk of recurrence

It is important to have a structured approach to medium- to long-term care and consider this during the postoperative hospital stay in order to prevent delays in secondary prophylaxis or follow-up surveillance. Close collaboration within the wider multidisciplinary team is again essential. Evidence for medical maintenance of remission postsurgery is covered in the BSG guidelines.

Postoperative surveillance

Postoperative stratification of risk for recurrent disease to guide treatment and surveillance is appealing but at present there is no validated model or score. However, a number of models have been proposed and stratification based on the ECCO definition of established risk factors has gained some traction: specifically, these are smoking, previous surgery, perforating disease, perianal disease and extensive resection [2,671].

At present there is every reason to tailor treatment on an individual basis guided by early evidence of recurrent disease. Endoscopy is currently the gold standard as it has been demonstrated that recurrent mucosal disease precedes clinical recurrence [672]. Endoscopic appearance is important, and the Rutgeerts severity score has been shown to predict subsequent clinical

course [193]. A colonoscopy 6 months after surgery to assess mucosal disease activity and guide escalation of therapy, as was used in the POCER trial, can currently be regarded as a reasonable standard [2,673].

The role of imaging in this scenario is not currently defined; both CT and MRI have appeal as noninvasive methods, and there are studies showing acceptable sensitivity and specificity for recurrent disease [674,675]. However, they lack the validation of the Rutgeerts score and colonoscopy has the additional benefit of allowing biopsies to be taken.

There is great interest in the potential role of biomarkers such as serum CRP and faecal calprotectin as surrogate markers for inflammation in the extended postoperative setting. Faecal calprotectin levels have been shown to have some correlation with endoscopic recurrence in a meta-analysis of 613 patients [676]. Retrospective reanalysis of the POCER trial data found that a cut-off of faecal calprotectin of > 100 µg/g would have reduced the need for colonoscopy by 41%, although this would have come at the cost of missing 11% of patients with endoscopic recurrence [677,678]. Results of the TOPICC trial suggested that a faecal calprotectin level of > 100 µg/g had a much lower sensitivity at detecting recurrence [679]. Faecal calprotectin appears to be more sensitive in symptomatic rather than asymptomatic patients [680], with the precise threshold for intervention still unclear. Faecal calprotectin monitoring may offer a reasonable alternative in patients who decline colonoscopic surveillance after Crohn's ileocaecal resection. The data have not shown a consistent correlation between raised CRP and endoscopic or clinical recurrence and so routine use is not to be recommended.

Statement 12.2.

After small bowel or ileocaecal resection for Crohn's disease, patients should undergo endoscopic assessment at 6–12 months to assess mucosal inflammation.

Level of evidence: II

Grade of recommendation: B

Consensus: 87.5% (SA 56.3%, A 31.3%)

Nonoperative interventions in recurrent Crohn's disease*Endoscopic balloon dilatation*

A considerable literature has demonstrated that balloon dilatation is relatively safe and successful in the treatment of postoperative strictures. The published experience relates almost exclusively to anastomotic

strictures in the neo-terminal ileum or colon and does not apply to primary stricturing disease. Specifically, balloon dilatation has been shown in large case series to be successful in some 90% of cases, and when this is the case repeat surgery is delayed by 3–6 years [109,681]. Importantly, the perforation rate is around 5%, hence surgical resection should be immediately available [109]. Balloon dilatation may be appropriate for strictures with a length of up to 4 cm (see Sections 2 and 3).

Radiological drainage

One in five patients with symptomatic small bowel Crohn's disease develops an abdominal mass at some point [682]. Cross-sectional imaging will determine whether this is caused by an abscess or a phlegmon. The presence of a Crohn's mass has traditionally been considered an indication for resection. However, case series from a number of centres in North America reflect a shift in management of Crohn's masses towards a more conservative approach, at least initially. These data demonstrate that some 30% of patients with a Crohn's mass can be managed nonoperatively [121]. Subsequent aggressive medical therapy may then be instituted cautiously (see Sections 2 and 3).

Many patients will still require surgery in the medium or long term, but in this group the staged approach is likely to reduce morbidity and stoma rates and enable laparoscopic resection rather than laparotomy. Hence, aggressive nonoperative initial treatment of penetrating disease is likely to improve outcomes in Crohn's disease, and this is the approach recommended by the ECCO [2]. These principles apply particularly to recurrent disease, where surgery is especially challenging.

Occasionally, fistulas are diagnosed between loops of small bowel or colon in patients with minimal symptoms. Such inter-loop fistulas probably represent established penetrating disease, and unless associated with a phlegmon or abscess do not warrant resection. First principles of Crohn's disease management apply; surgical or indeed medical intervention for asymptomatic disease is rarely indicated. When such inter-loop fistulas cause symptoms, such as diarrhoea or malabsorption, medical therapy is unlikely to close them.

Preoperative optimization

Several risk factors for poor outcomes after major abdominal surgery have been identified, including recent weight loss, intra-abdominal abscess, high-dose corticosteroid therapy, iron-deficiency anaemia, hypoalbuminaemia (a marker of systemic inflammation, not malnutrition) and smoking [186]. All of these risk

factors increase overall morbidity and most increase the risks of anastomotic dehiscence. Preoperative optimization pathways that combine interventions to correct such risk factors before surgery have recently been described [186,237,683,684] (see also Statement 3.13). Such pathways are similar to perioperative enhanced recovery after surgery pathways and complement these perioperative pathways by addressing the more long-term issues described above. They aim to improve early postoperative outcomes, allowing a safe primary anastomosis, avoiding a stoma in a higher proportion of cases and enabling a laparoscopic approach more often.

The duration of such pathways varies between centres. A washout period from steroids (> 10 mg prednisolone/day) and biological therapies of approximately 6 weeks prior to an elective gastrointestinal anastomosis is reasonable. During this time, an exclusive enteral diet is often necessary to prevent progression of disease and correct malnutrition [685], and in some cases parenteral nutrition is indicated. Abscesses and phlegmons, anaemia, smoking and psychological and other needs are addressed during this time.

Role for laparoscopic surgery

In addition to data from the large Phase III trials of laparoscopic *vs* open surgery for colon cancer which demonstrate short-term benefits of laparoscopic surgery, smaller randomized trials and large database studies demonstrate both short-term and long-term advantages from laparoscopic bowel resection for Crohn's disease. Specifically, those advantages include quicker recovery and shorter hospital stay, reduced 30-day postoperative morbidity and reduced risk of reoperation for incisional hernia and adhesions [131–133,165,686]. Some technical challenges have been highlighted by larger case series, such as the need to consider conversion if enteroenteric or entero-sigmoid fistulas are suspected, as these are not amenable to laparoscopic dissection and can be overlooked without the benefit of direct examination [168,687].

Although the merits of laparoscopy in surgery for recurrent disease have not been specifically studied, similar advantages are likely in this scenario. However, laparoscopic dissection is likely to be more complex due to adhesions, an issue specifically addressed by two large case series [688,689]. The conversion rate was significant (25–32%) and mainly due to adhesions. The rate of intra-operative complications was low (2–2.5%) but potentially serious (paraduodenal haematoma and ureteric injury). Notably, nearly all patients had previous open surgery. Thus, it appears reasonable to consider a

laparoscopic approach in reoperative abdominal surgery for Crohn's disease, even after previous open surgery, as long as the threshold to convert to laparotomy is low.

Statement 12.3

Laparoscopic surgery for recurrent Crohn's disease in experienced hands may have benefits but requires a low threshold for conversion to laparotomy.

Level of evidence: III

Grade of recommendation: B

Consensus: 93.5% (SA 54.8%, A 38.7%)

Surgical techniques in recurrent Crohn's disease

Preoperative planning is critical in surgery for recurrent Crohn's disease. Careful review of imaging to establish a preoperative road map minimizes the risk of surgical misadventure. Almost inevitably preoperative cross-sectional imaging is performed and there are particular advantages to reviewing these at the multidisciplinary team meeting with an interested gastrointestinal radiologist. Particular care should be taken to look for fistulas and where an incisional hernia is present to map the abdominal wall defect as well as intestinal anatomy. An up to date colonoscopy, to avoid missing active colonic inflammation or strictures, also helps avoid surprises.

Ureteric injury is a concern with re-do surgery of all kinds and insertion of temporary ureteric catheters at the time of surgery is worth considering. Quoted rates of ureteric injury at colorectal surgery vary widely; there are concerns regarding complications of ureteric catheterization itself and there are no RCTs. However, if there is a reason to feel the ureters are likely to be hard to find and at risk (multiple laparotomies, previous psoas abscess/retroperitoneal sepsis, proximity on cross-sectional imaging) the benefits outweigh the risks [690].

As with any challenging adhesiolysis there are advantages to sharp scalpel dissection to minimize the risk of serosal injury or indeed enterotomy. Dense adhesions are often stronger than thinned bowel, so great care should be taken to minimize traction during the adhesiolysis. There is an inevitable decision to be made as to whether to perform a complete adhesiolysis to allow assessment of the whole small bowel or a more limited mobilization of the targeted segment. This is where careful preoperative planning and review of imaging at the multidisciplinary team meeting is essential.

There is ongoing interest in the extent of mesenteric resection in surgery for Crohn's disease and some advocate radical resection of inflamed mesentery, on the

basis that the mesentery is a driver for ongoing pathology [175]. However, extensive mesenteric dissection is associated with a risk of bleeding and mesenteric haematoma, which may compromise perfusion of the anastomosis. The current evidence does not support radical mesenteric resection.

Anastomotic technique

Surgery for recurrent Crohn's disease can be prolonged and technically demanding. The decision as to whether to form an anastomosis or exteriorize the ends of the bowel has to be guided by clinical judgement and experience rather than guidelines. Patients who are malnourished, are on steroids, have active sepsis, evidence of penetrating disease or are unstable under anaesthetic are more likely to have an anastomotic complication [186]. A more selective approach to anastomosis appears to be associated with improved outcomes [691]. There is a balance between the safety of stoma formation and the complications associated with stomas themselves.

When the decision is made to form an anastomosis there is a choice to be made between an end-to-end or a side-side anastomosis. In patients with a history of recurrent anastomotic strictures, consideration should be given to an end-to-end anastomosis as this may facilitate balloon dilatation of a recurrent stricture. Recurrence is not affected by the choice of anastomotic technique [143]. ECCO guidelines recommend a stapled side-to-side anastomosis based on two meta-analyses of anastomotic technique demonstrating a lower leak rate with stapled side-side compared with hand-sewn end-to-end anastomosis [2,141,142]. These studies were based on primary resections for Crohn's and cancer surgery, rather than recurrent Crohn's disease; the balance may not be the same in patients who have had multiple laparotomies, prolonged adhesiolysis and thin or even defunctioned bowel.

Statement 12.4.

Anastomotic technique in recurrent Crohn's disease is a matter of surgeon preference.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 48.4%, A 51.6%)

Revision and excision pouch surgery

Complications following ileoanal pouch surgery are common and well documented [449,692]. Pouch failure is defined as formation of an ileostomy considered to be permanent, with or without excision of the

pouch. Failure rates around 15% at 10 years and up to 24% have been reported, although some large institutional series have lower rates [326,334,449,693].

Re-do or revision ileoanal pouch procedures have been defined or categorized in different ways by various authors, but for the purposes of this document encompass procedures which involve abdominal exploration and formation of a new IPAA, using either the existing pouch or a newly created one. Re-do pouch surgery has a potential role in the management of some of the complications encountered in patients with an ileoanal pouch.

Both re-do pouch and ileoanal pouch excision are complex procedures, performed infrequently – resulting in a lack of data to inform practice. It is worth bearing in mind that a recent comprehensive meta-analysis [694] included only 900 reported cases of abdominal revisional pouch surgery, many of which did not involve constructing a new IPAA. The biggest single series [47] (part included in the meta-analysis) described 502 re-do pouches, and only three series have reported over 100 patients [47,457,695].

The published experience also encompasses a broad time frame, from the early days of pouch surgery when the indications and technique were in development, to more recent times when better understanding of the causes of pouch failure, improved imaging and more effective drug and other treatments have offered successful nonsurgical management for many patients with pouch-related problems. Indications and patient selection for pouch revision or excision vary greatly within and between series and are often unclear.

Clinical approach to pouch complications

Most complications which might lead to pouch re-do or excision present with symptoms of poor pouch function, predominantly high defaecatory frequency, impaired continence and abdominal, pelvic or anal pain [696]. Some patients with chronic inflammation due to pouchitis or sepsis develop systemic symptoms, weight loss and anaemia.

Care needs to be taken to reach an accurate diagnosis, bearing in mind that some of these patients have more than one problem (e.g. chronic pelvic sepsis and ileoanal anastomotic stricture; anal fistula and proximal small bowel Crohn's disease) [44,696]. Functional pouch disorder (sometimes called irritable pouch or, confusingly, 'pouch dysfunction') [697] is defined as the presence of pouch-related symptoms without clinically apparent pathology. This may be a cause of pouch failure if symptoms are such that the patient would prefer to revert to an ileostomy.

Statement 13.1

A patient with poor function or symptoms related to their ileoanal pouch should be fully investigated to identify all underlying pathology. This should include flexible pouchoscopy (with biopsy), imaging of the proximal small bowel and cross-sectional imaging of the pelvis.

Level of evidence: III

Grade of recommendation: B

Consensus: 100.0% (SA 70.6%, A 29.4%)

Before embarking upon major revisional surgery, or consigning the patient to a permanent ileostomy, it is essential to ensure that all pathologies present have been identified and appropriate nonsurgical treatment options have been exhausted. Several authors have published algorithms to guide diagnosis and management of pouch-related complications [358,697,698], which are particularly useful aids to navigating these complex and rare scenarios.

Statement 13.2

Before undertaking revision or excision pouch surgery it is essential to ensure that appropriate nonsurgical treatment options have been exhausted, as poor pouch function may often be improved with specialist advice.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 94.1% (SA 61.8%, A 32.4%)

Indications for surgery

The indications for re-do pouch surgery have been divided by some authors into 'mechanical' (or 'structural') and 'inflammatory/infective'. In some respects this is useful, and generally outcomes of re-do surgery for the former are better. However, some indications do not fit into this categorization. Examples include acute pouch ischaemia due to thromboembolism of the mesenteric vessels, recurrent ileoanal anastomotic stricture due to chronic pelvic sepsis, some cases of chronic pouchitis that are thought to be due to ischaemia, and pouch or cuff neoplasia.

Construction error

These include creating a pouch that is too small, too large or twisted. There have been reports of incomplete division of the component small bowel segments, leading to a 'spur' within the pouch. The advent of laparoscopically assisted ileoanal pouch formation has been

associated in an increase in patients coming to re-do pouch surgery because of significant retained rectum [694]. A long retained rectal cuff is associated with inflammation, dysplasia, anastomotic stricture and poor function. Advancement of the ileoanal pouch and creation of a new, lower anastomosis is a potentially successful treatment but can be technically challenging [694]. Generally, the outcomes of re-do pouch procedures for these indications are better than those for inflammatory or infective indications [694].

Chronic anastomotic leakage

Chronic anastomotic leakage usually results in a chronic sinus leading from the anastomosis, which can be associated with chronic inflammation of the lower pouch and recurrent anastomotic stricturing. Re-do pouch is only feasible in cases where there is sufficient anorectal cuff between the failed anastomosis and the dentate line to create a sound new anastomosis.

Perianal sepsis/fistula

Some cases of anal fistula in patients with an ileoanal pouch appear to be cryptoglandular in origin, with the internal opening situated at the dentate line, below the anastomosis. Others are related to small leaks or perianastomotic collections, or very rarely have an internal opening on one of the longitudinal pouch suture/staple lines.

Pouch re-do, with advancement of the pouch–anal anastomosis below the internal opening of the fistula, has a place, but only if there is sufficient length below the internal opening to create an new anastomosis between it and the dentate line.

Pouch–vaginal fistula

A proportion of pouch–vaginal fistulas are due to construction error, the vagina being caught between the anvil and head of the circular stapler when the pouch–anal anastomosis is created. Others may be cryptoglandular or due to ‘Crohn’s like’ inflammation. Many of these are amenable to transanal, transvaginal or transperineal repair (16) (also see Section 10), but there is some evidence that failure of such an attempt compromises the outcome of subsequent transabdominal revision [694].

Other pouch fistulas

Fistulas to the bladder, proximal small bowel and abdominal wall have been described. Many of these originate from the ‘blind end’ of the pouch and can be managed by local repair. Occasionally re-do pouch is required.

Ileoanal anastomotic stricture

This is a common problem, more frequent after mucosectomy and hand-sewn than stapled ileoanal

anastomosis [694]. In cases resistant to more conservative measures and where there is sufficient room below the anastomosis, re-do surgery may be considered [694].

Chronic pouchitis

Chronic pouchitis (and associated pouch body and inlet strictures) may be secondary to pelvic sepsis or Crohn’s disease, or be ‘primary idiopathic pouchitis’, thought to be a manifestation of ulcerative colitis. Some authors have also proposed that in a small proportion of cases inflammation is due to chronic ischaemia.

A further confounding factor in interpreting results of re-do surgery for pouch inflammation is that the definition of Crohn’s disease is inconsistent. Some centres label any patient with pouchitis and another ‘Crohn’s like’ feature (such as anal fistula, pouch–vaginal fistula or inflammation or stricturing of the immediate pre-pouch ileum) as Crohn’s disease, whereas others only do so if definitive histological features or proximal skip lesions are identified.

It would be logical to expect poorer outcomes when pouches are revised for Crohn’s disease or primary idiopathic pouchitis, as these are more likely to recur in a new pouch than ischaemia or sepsis. This does seem to be borne out in the literature [47,694], despite the difficulties in interpretation and varying rigour of preoperative investigation.

Neoplasia

Dysplasia and adenocarcinoma can occur in the rectal cuff below the pouch, most cases having arisen in patients with previous colorectal dysplasia or carcinoma, or severe chronic pouchitis. While re-do pouch has been described in the context of dysplasia, such surgery is only likely to be appropriate if there is a long rectal cuff. Most require pouch excision.

A variety of very rare pouch body cancers have also been described. Only a few case reports exist, and the outcomes are poor. While in theory a re-do pouch might be possible for pouch body malignancy, in practice the extensive surgery required to clear the tumour and poor prognosis preclude this.

Acute ischaemia

This is a rare complication, which can result from acute thromboembolism of the mesenteric vessels, twisting of the small bowel mesentery at pouch formation or internal herniation (e.g. acute herniation of a loop of small bowel behind the small bowel mesentery resulting in occlusion of the mesenteric vessels running to the pouch). Provided there is sufficient length of small bowel remaining, re-do pouch formation is often feasible.

Prolapse

This complication is being seen more frequently. This is likely to be due to the increasing use of laparoscopically assisted pouch surgery, which results in fewer adhesions and a more mobile pouch. Pouchopexy procedures are usually successful, but re-do pouch has been described for recurrent prolapse [694].

Poor function

There have been reports of re-do pouch surgery for poorly functioning pouches where no underlying cause has been identified. If some of these patients have a form of gastrointestinal dysmotility or irritable bowel syndrome, a poor outcome is likely.

Preoperative workup and decision-making

Before re-do pouch surgery is considered, it is important to assess the proximal small bowel, pouch and anal canal.

Statement 13.3

Before pouch revision is attempted it should be established whether the procedure is potentially technically feasible and appropriate, and the patient should be fully counselled with regard to the failure rate, complications and alternatives.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.1% (SA 71.4%, A 25.7%)

Proximal small bowel disease should be excluded, and any previous significant loss of small bowel length at surgery should be identified. Such loss may make it impossible for a new pouch to reach the anus, or result in poor function. Even if the existing pouch is healthy, it is sometimes significantly damaged during difficult dissection in the pelvis and cannot be preserved, so a new pouch may need to be constructed. Old ileostomy closure sites and other anastomoses can interfere with this, and ultimately only at surgery can it be established whether the pouch will reach the anus.

Statement 13.4

Counselling and consent from a patient prior to revision surgery should emphasize that an end ileostomy may prove to be the only option once the original pouch is mobilized during surgery.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 74.3%, A 25.7%)

There needs to be sufficient distance between the old anastomosis and the dentate line to create a sound new anastomosis. Usually this can only be assessed at examination under anaesthetic. A successful re-do pouch requires a healthy anal canal and sphincter complex with sufficient function to maintain acceptable continence. While anal physiology testing and endoanal ultrasound are useful adjuncts, they do not give definitive information on ultimate functional outcome.

Thorough and unhurried patient counselling is essential before undertaking a major revisional pelvic procedure with significant morbidity and failure rate, and the sole advantage of potentially avoiding a permanent end ileostomy. Some highly motivated and stoma-averse patients are prepared to accept the risks and uncertainties involved, but for others the acceptance of pouch failure and a permanent ileostomy is preferable.

Technical aspects of surgery

Pouch revision is a difficult procedure, with a median operating time just over 4 h [694]. The authors of the largest series of pouch re-do procedures routinely use ureteric stents or catheters [694] and reported ureteric injury in 0.5%.

A midline laparotomy is performed with the patient in a modified Lloyd-Davies position [694]. Adhesions are divided to allow access to the pelvis. The existing pouch is mobilized to the pelvic floor with sharp dissection, with special care being taken if the aim is to preserve and advance it. The decision whether to reuse the old pouch or create a new one depends on the indication for surgery and the viability and integrity of the mobilized pouch. Chronically indurated tissue associated with chronic sepsis should be excised [47,694].

If a new pouch is being formed this is usually a J pouch, but if there is difficulty with reach to the anus, and there is sufficient small bowel, the efferent limb of a S pouch might provide the required extra length, although pouch evacuation may be compromised and Medena catheterization required.

Mucosectomy and hand-sewn anastomosis is usually required, but a long rectal remnant may allow room for a double-stapled anastomosis. A transanal drain within the pouch is sometimes used. A proximal diverting ileostomy is recommended. It is closed after 3 months, subject to satisfactory contrast enema and examination under anaesthetic.

Statement 13.5

Repair of pouch defects, removal of necrotic and fibrotic pelvic tissues and advancement of the new or

original ileoanal pouch are integral components of revisional pouch surgery for a septic indication.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 87.1% (SA 54.8%, A 32.3%)

Outcomes

A recent and comprehensive systematic review of salvage procedures after restorative proctocolectomy [694] reported complications in 44%, a 74% 'success rate' and a subsequent 18% pouch excision rate after re-do pouch.

The largest single series [47] reported 502 cases of re-do IPAA between 1983 and 2014. In 41% a new pouch was formed, and in the rest the existing pouch was advanced. There were complications in 53 and 18% had failed at 10 years. Indications for re-do associated with poorer outcomes were pouch vaginal fistula, sepsis and Crohn's disease. A small number underwent further re-do, which was successful in some.

Overall, the functional outcomes after re-do are inferior to those after initial ileoanal pouch formation, with an average defaecatory frequency of six during the day and two at night [47,699]. Urgency and major nocturnal incontinence rates are higher [694] and 50% of patients report seepage and regular use of pads [694]. About 20% of patients experienced restriction in each of social, work and sexual functioning [694]. There has been no objective assessment of erectile or ejaculatory dysfunction, but this is likely to be significant, given the nature of the dissection involved. Despite this, patients undergoing re-do pouch surgery are reported to have high levels of satisfaction [47,699].

Statement 13.6

Outcomes, including pouch failure, defaecatory frequency and continence, are poorer after revision pouch than after initial pouch formation, but satisfaction levels are high in carefully selected patients.

Level of evidence: III

Grade of recommendation: C

Consensus: 96.8% (SA 51.6%, A 45.2%)

Pouch excision

The literature on ileoanal pouch excision is even more limited than that on re-do, with a total of just under 400 cases described from five centres [454,700–705]. Two publications each from two of these institutions

report patients from the same cohort. A significant proportion of these pouch excisions were for pouch or cuff adenomas or cancer in the context of FAP, rather than in patients with IBD.

Indications

Some causes of pouch failure (such as neoplasia) mandate pouch excision, but in the presence of others, performing a permanent ileostomy above a pouch left in place is an option that avoids the morbidity associated with pouch excision. One study [694] has reported ileostomy alone and pouch excision to result in similar outcomes. However, anal pain and seepage occurred in some patients who had retained their pouch and was associated with incontinence or outlet obstruction as the cause of pouch failure. No patient who retained their pouch developed dysplasia or cancer, but numbers were small.

Statement 13.7.

It is reasonable to leave a defunctioned failed pouch in situ, as an intermediate or long-term alternative to pouch excision where not clinically indicated. Patients with incontinence or pouch outlet obstruction as the cause of pouch failure are more likely to develop troublesome discharge or pain following this approach.

Level of evidence: III

Grade of recommendation: C

Consensus: 90.3% (SA 51.6%, A 38.7%)

Surgery

The surgery is essentially similar to re-do pouch but without re-anastomosis and with the addition of excision of the anal canal, perineal closure and formation of an end ileostomy. Operative time and ureteric injury have not been addressed in any of the reports of ileoanal pouch excision, but are likely to be similar to re-do pouch.

Complications and outcomes

One perioperative death has been documented [694] and complication rates of up to 62% [694] have been reported. The commonest late complication is persistent perineal sinus (defined as an unhealed perineal wound at 6 months after surgery), occurring in between 29% [694] and 40% [454,701]. Some authors have suggested an association with Crohn's disease [694] (although any patient with anal fistula and an inflamed pouch was probably included in this category), with perineal dissection which leaves the

external sphincter intact [700,704], with sepsis as an indication for pouch excision [701,703] and with smoking [694]. Persistent perineal sinus still present at 1 year is unlikely to heal with conservative measures, and sinus excision and transposition flap [694] may be considered. Erectile dysfunction has been documented in 7% of men [694] and short bowel requiring intravenous nutritional support [694] has also been reported.

Statement 13.8.

Persistent perineal sinus is a common complication of pouch excision, occurring in up to 40% of patients. It is associated with chronic sepsis, Crohn's disease, smoking and sphincter-preserving perineal dissection.

Level of evidence: III

Grade of recommendation: C

Consensus: 86.7% (SA 53.3%, A 33.3%)

Intestinal failure in IBD

Many of the principles of intestinal failure can be generalized and are not necessarily specific to IBD, although up to 50% of patients with intestinal failure have IBD as the underlying diagnosis [706]. In addition, there is significant overlap with intestinal failure and the treatment of recurrent IBD (see Section 12). Therefore, this section is focused on general principles.

Definition

There is a surprising degree of confusion regarding the precise definition of intestinal failure, and more specifically which surgical problems might be considered to be in the domain of the highly specialized centres that carry out significant numbers of these operations. The third attempt at a national commissioning process is currently under way. It is hoped that this will identify a network of specialist units that will provide the medical and surgical expertise to manage these most complex problems. Referral guidelines have not yet been formalized.

Fleming and Remington [707] are generally credited with coining the term intestinal failure, which they defined as 'a reduction in the functioning gut mass below the minimal amount necessary for adequate digestion and absorption of food'. Many authorities have since refined the term and offered their own definitions.

The essence of all definitions is that the condition is characterized by a failure of gut absorptive function so that intravenous supplementation or nutrition is needed. The European Society of Parenteral Nutrition [708] distinguished between intestinal failure, where there is a reduction of gut function such that intravenous therapy is required to maintain health or growth, and intestinal insufficiency, where the reduction in function is significant but does not require intravenous therapy.

In 2013 the NHS review [709] into intestinal failure services suggested a functional classification of intestinal failure in order to simplify decision-making, transfer and management of these patients:

Type 1: short term, usually self-limiting loss of gut function. This is typically seen in postoperative patients and is often referred to as 'postoperative ileus'. Patients in this circumstance may need intravenous nutrition but the treatment is not usually prolonged.

Type 2: this is usually seen as a failure of Type 1 intestinal failure to resolve. It is a prolonged but reversible loss of intestinal function that lasts weeks or even months and is often associated with sepsis, major complications of surgery or renal impairment and metabolic disturbance. The management of these patients often requires a complex interaction of surgical, medical, radiological, nursing, dietetic and critical care teams. Referral to a specialist centre is strongly recommended.

Type 3: this refers to the long-term need for intravenous nutritional therapy with no prospect of remediation. This may be due to loss of intestine, malabsorption or long-term dysmotility. These patients need home total parenteral nutrition (TPN) therapy.

Intestinal failure in IBD

Crohn's disease is most commonly associated with Type 3 intestinal failure. In the UK about one-third of cases of Type 3 failure are in Crohn's disease [710]. The incidence in ulcerative colitis is much lower, due mainly to sparing of the small bowel. However, cases still occur through complications such as delayed colectomy in acute severe colitis or mesenteric infarction following colectomy.

In Crohn's disease intestinal failure arises as a result of:

- Complications of surgery for intra-abdominal sepsis.
- Extensive small bowel disease
- Multiple resections and short bowel syndrome (see later).

Of these three causes, surgical complication is by far the most common, with incidences as high as 8.5% 20 years after the index surgical procedure [180,667]. Predisposing factors include younger age at diagnosis and first operation, stricturing disease and family history of IBD [711].

Pathogenesis

Type 1 and 2 intestinal failure are, by definition, situations which are potentially remediable. Most commonly, failure is caused by acute perioperative physiological disturbance. These conditions may occur immediately following any abdominal surgery but can also recur after apparent resolution has been achieved. Acute loss of intestinal function in this manner has a confused terminology. The terms postoperative ileus and small bowel obstruction are both employed even though specific diagnostic tests to distinguish between these entities are seldom undertaken. It is often not critically important to make that differentiation since the treatment paradigm is usually conservative. Many operations are complicated by a short-term derangement of gut function; recovery is often heralded by the passage of flatus or the action of a stoma. It is essential to realize that this first evidence of the return of intestinal motility does not show that an ileus has fully resolved. The safest and probably the best definition of a full return to normal gut function is when an individual can tolerate a full diet [712] without any nausea or vomiting and they are passing flatus or stool.

Type 1 intestinal failure

There is no clear cut off between Type 1 and Type 2 intestinal failure. Type 1 can be considered as a prolongation of the 'normal' loss of intestinal function and a delayed return to normal gastrointestinal motility after an abdominal operation. A small number of studies suggest that gastrointestinal motility returns very rapidly after surgical insult. The traditional teaching that it normally takes several days for gastrointestinal function to normalize in the absence of complications is not borne out by modern experience. The enhanced recovery after surgery programmes that have been so successfully introduced are strong clinical evidence that the gut is capable of functional activity very soon after surgery, even when an anastomosis has been fashioned [713].

The key issue in the management of this complication is whether and when to consider intravenous nutrition if gut function is not rapidly restored. A lack of oral intake has been shown to be associated with diminished intestinal muscle function and loss of the gut barrier function.

TPN does not protect against these. Therefore oral/nasogastric feeding is always preferable if it can be tolerated. NICE guidance suggests that intravenous nutrition should be considered when a patient has had little or nothing by mouth for 5 days and is likely to eat little or nothing for the next 5 days [714].

Statement 14.1

Enteral nutrition should be re-introduced as soon as practicable after surgery for IBD. Intravenous nutrition should be considered after elective and emergency IBD surgery in patients who are malnourished and in whom establishment of diet within the next few days is considered unlikely.

Grade of recommendation: IV

Level of evidence: D

Consensus: 93.9% (SA 57.6%, A 36.4%)

Type 2 intestinal failure

The management of patients in this group is always complex and requires sophisticated multidisciplinary team working. Emergency surgery for intestinal perforation, anastomotic leak, persistent sepsis, wound complications, deep sepsis and full-thickness abdominal wound dehiscence are all common pathways into this scenario.

The management of these patients should adhere to broad principles. However, each case presents unique challenges and should be considered on its own merit. The elements of care can be broken down into four key areas [714].

Nutritional requirements

Hospitals should all have a nutrition team for the management of intravenous nutritional therapy. Patients require personalized prescriptions addressing their specific needs [715]. TPN may be delivered by peripheral or central venous access. Peripheral TPN is not employed in the longer term and should be reserved for those patients who are likely to need intravenous therapy for fewer than 14 days. Prolonged TPN requires the use of tunnelled central lines.

The 2010 NCEPOD audit into intravenous nutrition in the UK found that the decision to commence TPN was delayed in almost a fifth of patients [716]. Nine per cent of patients had a delay in the provision of TPN after prescription. Conversely a significant number of patients had TPN for 3 days or fewer suggesting that the decision to treat with TPN was erroneous. Overall NCEPOD concluded that TPN was not indicated in almost 30% of the patients they studied. Shockingly, NCEPOD judged the nutritional care to be 'good' in

only 19% of patients. TPN requirements were found to be poorly documented in just over half the patients and the treatment was adequately monitored in just over half the patients.

In principle a TPN prescription is relatively simple, comprising water, electrolytes, energy (a combination of fat and carbohydrate), essential amino acids, vitamins and trace elements. In practice this is much more complicated and requires expert prescription and supervision. Modern formulations are most often provided as single 'big bags' that are prepared in sterile conditions and provide a single day's requirements in one infusion unit. More complex prescriptions can be catered for by the use of multichambered bags.

A typical prescription might include:

- Water 25–35 ml/kg/day;
- Nitrogen 0.17–3 g/kg/day. Grams of nitrogen is shorthand for the 'protein' component in a TPN prescription: this comprises the essential amino acids and glutamine; the building blocks for protein synthesis;
- Carbohydrate: typically providing up to 60% of daily energy requirements this is usually given in the form of dextrose and can be provided in a range of concentrations;
- Lipid: the most potent source of energy, this is used to reduce the amount of carbohydrate required. It also acts as a vehicle for the infusion of the fat-soluble vitamins. Lipid infusion reduces the need for large volumes of glucose and addresses the need for essential fatty acids. The daily dose should not exceed 1–1.5 g/kg/day;
- Electrolytes and micronutrients: daily losses will dictate the electrolyte prescription which must be tailored to maintain homeostasis. In cases where there has been significant loss of intestinal length it is important to ensure that calcium and magnesium levels are adequately maintained.

Monitoring of TPN

A wide variety of clinical and laboratory tests are required in order to monitor TPN prescriptions accurately. In the surgical patient with Type 1 or 2 intestinal failure there may be considerable difficulties with intestinal flux and/or the presence of sepsis. The vast majority of these patients should be considered to be nutritionally unstable and therefore undergo relatively intensive monitoring.

Daily weighing should be carried out if possible. This is more a measure of day-to-day fluid balance rather than nutritional progress, nevertheless it is a key parameter. Other anthropometric measures such as grip strength and triceps fat thickness may be measured less frequently but offer validated measures of nutritional status.

Serum electrolytes, liver function, calcium, magnesium and phosphate should be measured daily until stability has been established. The inflammatory markers CRP and white cell count should be monitored until stable. Cholesterol and triglycerides should be measured on a weekly basis. Trace elements should be measured as a baseline at commencement of treatment and then monitored accordingly.

The NCEPOD report [716] established that significant numbers of patients developed metabolic complications of treatment that could have been reduced or even eliminated by an adequate monitoring regime. The report called for regular and documented clinical monitoring as a mandatory recommendation, with clearly defined objectives for TPN.

Statement 14.2.

The recommendations of BAPEN, NICE and NCEPOD on perioperative nutritional support are all clearly set out and provide guidance for firmly enforced protocols and bundles of care in all hospitals.

Grade of recommendation: IV

Level of evidence: D

Consensus: 93.8% (SA 62.5%, A 31.3%)

Route of administration

Peripheral TPN may be administered, though it is unsuitable for long-term use or the infusion of high-energy, high-osmolality feeding regimes. Central venous catheter placement inserted with imaging guidance, placing the tip of the catheter in the superior vena cava, is the most commonly employed method of administration.

Complications of TPN

In common with all complex treatments the potential complications of TPN are legion. They can be broadly classified as line-related and metabolic.

The NCEPOD report found that 26% of patients suffered catheter-related complications; half of which were thought to have been preventable [716]. Complications of insertion are the same as any central venous catheterization and include pneumothorax, bleeding and extravasation. Line fracture and infection are the two complications specific to TPN lines that merit discussion. Line fracture is most often seen in Type 3 patients on home TPN. These fractures can sometimes be salvaged by specialist centres. Most of these patients will have access to advice and help in the management of this complication.

Central line sepsis is a more significant risk that is not uncommon in the hospital setting, particularly when patients are critically ill requiring treatment on the intensive care unit or transfer between hospitals. Line infection rates vary considerably between hospitals. The major cause of line sepsis is poor management of the line itself. It is widely held by TPN specialists that feeding lines should be tunnelled central lines placed exclusively for the administration of TPN. Other uses, blood sampling, drug and supplementary fluid administration should not be carried out through the designated feeding line. TPN line infections can be minimized by the implementation of bundles of care that ensure minimal handling of the line and rigorously enforced care of the line [714].

Statement 14.3

Management of patients with Type 2 intestinal failure who have had surgery for IBD should adhere to best practice principles including use of dedicated lumen tunnelled lines where feasible, care bundles to reduce the risk of line sepsis, prescription and oversight by a multidisciplinary nutrition team, regular and accessible monitoring of metabolic status, and audit of outcomes.

Grade of recommendation: IV

Level of evidence: GP

Consensus: 90.3% (SA 51.6%, A 38.7%)

Surgical management of Type 2 intestinal failure

Each patient presents a unique set of surgical, medical, nutritional, psychological and nursing challenges. All-encompassing generalizations regarding their management are problematic but it is helpful to consider three phases of management.

Stabilisation of the patient

1. Sepsis. Type 2 intestinal failure often arises as a complication of a catastrophic abdominal illness. It is incumbent upon colorectal and emergency surgeons to recognize when a patient is at high risk of developing septic complications and thereby seek to keep the surgical management as simple as possible. The ACPGBI guidance on the management of anastomotic leakage offers strong advice to avoid overambitious attempts to salvage a failed anastomosis [717].

There is an increasing trend towards damage control surgery with temporary abdominal closure, in parallel with the damage control philosophy from trauma surgery, in very severely ill patients [718–720]. A number of patients will require this salvage technique to manage

an abdomen that is too tight to close or where abdominal compartment syndrome has developed. Many patients with Type 2 intestinal failure have suffered from failure to close the abdominal wall. It is vital to establish abdominal wall closure whenever possible. Series from the USA and Europe show that restoration of the midline can be achieved in up to 90% of patients by utilizing techniques such as topical negative pressure wound therapy with mesh-mediated medial abdominal wall traction or devices such as the ABRA system [718]. Failure to close the abdominal wall, leaving the patient with a laparotomy, is profoundly morbid resulting in the formation of an enterocutaneous fistula in up to 25% and increased mortality [721].

A key to the management is to identify the underlying cause of the persistent loss of gut function after surgery. Many of these patients have unresolved complications; most of which are septic. Monitoring the systemic inflammatory reaction by CRP, platelet count and white cell count is helpful to document changes over time. A very high index of suspicion should be maintained and sources of sepsis sought when there is a failure to progress. Anecdotally most specialist services will perform a CT on a transfer patient on arrival to screen for unresolved intra-abdominal sepsis.

Surgical intervention around the time of diagnosis of Type 2 intestinal failure is very rarely employed. These patients, between 2 and 4 weeks after their index surgery, have very hostile abdominal cavities where the risks of surgery far outweigh the benefits. Deep sepsis, when identified, is best managed by interventional radiology. Systemic antibiotics or antifungals may be required according to the results of appropriate cultures.

Statement 14.4

Midline closure should be achieved in more than 90% of temporary abdominal closure cases. Local audit should ensure that patients are not left with avoidable laparostomy wounds.

Grade of recommendation: IV

Level of evidence: GP

Consensus: 87.1% (SA 51.6%, A 35.5%)

2. Metabolic and fluid flux. Patients with proximal small bowel stomas or fistulas may additionally have very challenging fluid requirements. In these cases scrupulous attention needs to be paid to maintaining fluid and electrolyte balance, including serum potassium and magnesium levels [722]. Excessive losses must be replaced with appropriate intravenous fluids. Care should be taken with oral intake since some patients

with short bowel will be net excretors of fluids and this may be exacerbated by oral intake.

Intestinal flux can be modified by a number of pharmacological agents. The most commonly employed are proton pump inhibitors and octreotide.

Growth hormone and glutamine in addition to diet have been shown in a few studies to be effective in increasing the absorptive capacity of the small bowel. Byrne *et al.* found a 39% increase in protein absorption and a 33% decrease in stool volume in 16 patients [723]. However, these findings have not been replicated in other series and double-blind cross-over trials [724,725].

Octreotide is widely employed to prolong gut transit time and to reduce intestinal output. There is some evidence to suggest that this is an efficacious treatment, although its effect is often modest [726].

Loperamide and other opiates are also known to slow gut transit and have a role in attempts to manage high-output stomas. Omeprazole and other H₂ antagonists have been shown to result in a modest increase in water reabsorption, although there is little evidence to show that it has the potential to help a patient get off TPN [727].

Statement 14.5

Meticulous attention must be paid to maintaining fluid and electrolyte balance in patients with proximal small bowel stomas or fistulas.

Grade of recommendation: IV

Level of evidence: GP

Consensus: 97.1% (SA 73.5%, A 23.5%)

Management of the wound

Enterocutaneous (sometimes named entero-atmospheric) fistulas are a common complication in patients with Type 2 intestinal failure. These are often poorly controlled, arising in exteriorized loops of small bowel in a wide-open abdomen after dehiscence or planned laparostomy. Management of the wound is complex and may require a variety of approaches. Attempts to control fistulas by the use of indwelling catheters are seldom helpful in our experience. The principal aim of management is to try to isolate the active fistula in order to collect gut output as neatly as possible to allow the rest of the wound to granulate and heal [722].

Topical negative pressure has often been cited as a cause of fistula development in the open abdomen. However, there is little convincing evidence to support this assertion [728]. It can certainly be employed in the presence of a fistula as long as a good seal can be obtained and the fistula output collected effectively [729].

More often it is impossible to manage wounds in this fashion and a wide-mouthed wound manager can be employed akin to a giant stoma appliance. Scrupulous care must be taken to try and prevent leakage of intestinal contents onto the abdominal skin as the wound matures and contracts. Dressing these wounds is onerous and requires a good degree of skill and experience. Larger centres will have specialist teams combining wound management and stoma therapy expertise.

Where there is a significant length of small bowel downstream from the wound nutritional management can be simplified by the practice of distal enteroclysis, for example tube feeding into the distal defunctioned gut [730]. This phase of treatment would usually commence after a patient has been fully stabilized from a wound and metabolic point of view.

Statement 14.6.

In patients with Type 2 intestinal failure, wound management of the open abdomen and enterocutaneous fistulas is complex and may require a variety of multidisciplinary approaches.

Grade of recommendation: IV

Level of evidence: GP

Consensus: 96.7% (SA 63.3%, A 33.3%)

Surgery

Indications for surgery in the short term are very limited. Every effort should be made to avoid surgical intervention until at least 6 and preferably 12 months have passed from the original surgical illness [731,732]. The development of prolapse in an abdominal fistula is generally taken to be a sign that there is some movement within the abdominal cavity, suggesting that the peritoneal cavity has become surgically navigable. The 'pinch test' where the thin skin of a laparostomy can be pinched together without picking up underlying bowel loops is another helpful sign. Great patience may be required as the surgical team can come under intense pressure to act sooner than is judicious. These patients and their carers often suffer tremendously with very difficult wounds. Social and psychological support is an integral part of managing the problem in a holistic and coordinated fashion.

The aim of most surgery in this context is to restore intestinal continuity and thereby obviate the need for intravenous nutrition. Work-up for these patients includes the construction of a full road map of the intestinal anatomy by antegrade and retrograde contrast examinations. Fistulography or thorough assessment by CT is almost always required [731,732]. These

radiological investigations allow the team to measure the total residual small bowel length and thereby the likelihood of success in weaning a patient off TPN. The investigations also help the surgeon to understand the anatomy of the small bowel before embarking upon technically demanding and high-risk surgery.

Meticulous surgical technique is required in order to gain access to the abdominal cavity. Dissection of the bowel loops from a laparostomy scar can be particularly challenging, often necessitating delicate sharp dissection to avoid damage to the residual small bowel. Unwavering efforts to preserve intestinal length while freeing adhesions and preparing an anastomosis are mandatory. There is no good evidence to show that any anastomotic technique is clearly superior. Anecdotally many experts in the field profess to prefer a hand-sutured single-layer interrupted serosubmucosal method. When multiple anastomoses have been fashioned there is a case to be made to defunction the reconstruction with a proximal loop stoma. When intestinal continuity is restored in a patient needing an extensive soft tissue reconstruction of the abdominal wall defunctioning should also be considered, but is by no means mandatory.

Bowel that has been defunctioned for a long time can become very narrow and appear quite atrophic. This presents a particularly difficult anastomosis to fashion, with a protracted postoperative course being the expectation. Distal feeding via a tube into a distal fistula may have a place to play in preparing the distal small bowel for being brought back into continuity, although this technique has not been formally published.

Restoration of continuity in patients with critically short small bowel may well be of considerable therapeutic benefit. If the whole colon remains *in situ* patients often have surprisingly normal stool frequencies. The absorptive capacity of the colon makes fluid balance management considerably easier. This alone can be enough of an indication to restore continuity even when it is not expected that the patient will be able to wean off TPN. A small number of patients with critically short bowel will succeed in weaning off TPN after restoration of intestinal continuity after enterocolic anastomosis, though it is not always easy to predict the degree of adaptation that will occur in an individual patient.

Statement 14.7.

In patients with Type 2 intestinal failure the principal aim of definitive surgery is to restore intestinal continuity and eliminate need for intravenous nutrition, at a time when the patient's metabolic and nutritional status are optimized and sufficient intra-

abdominal healing has taken place to minimize the risks of the restorative surgical procedure.

Grade of recommendation: IV

Level of evidence: GP

Consensus: 93.5% (SA 58.1%, A 35.5%)

Abdominal wall reconstruction

Patients with Type 2 intestinal failure often present with large midline hernias or defects that require repair at the same time as their intestinal surgery. The timing of these operations is critical and surgery should not be attempted until the abdominal cavity and the patient have fully recovered from the index procedure. A rule of thumb is that salvage surgery of this nature should not be undertaken < 6 months after the last operation; an interval of 1 year is often preferable. This allows time for the abdomen to settle, the patient to be stabilized on TPN or enteral feeding and for a comprehensive preoperative work-up to be carried out. Further details of techniques for surgery are out with the scope of this section. The reader may refer to the ESCP consensus guidelines on intestinal failure [733].

Type 3 intestinal failure

Surgery has relatively little to contribute in the management of Type 3 intestinal failure and most need home parenteral nutrition. Some patients in this category will be suitable for small bowel transplantation. A low threshold should be maintained for referral to one of the two commissioned centres.

Bowel lengthening and reverse loop procedures

Procedures to slow intestinal transit by reversing segments of small bowel such as the Bianchi or serial transverse enteroplasty techniques are rarely performed in adults and have only been reported in two patients with IBD [734].

Intestinal transplantation

Currently 100 adult intestinal transplants are performed in the world each year. Around 11% of transplants for short bowel are due to Crohn's disease [735]. The choice between transplant and home parenteral nutrition relates to predicted survival, with home parenteral nutrition offering superior long-term outcome and therefore being the first choice for most Crohn's patients with Type 3 intestinal failure. Transplant is reserved for those with complications of parenteral nutrition.

Short bowel in IBD

This is seldom seen in ulcerative colitis and is usually the result of complications at the time of emergency colectomy. Less often it might be seen after ileoanal pouch surgery.

Short bowel syndrome and Type 3 intestinal failure occur more frequently in patients with Crohn's disease, although the frequency appears to be decreasing. This reflects the increasing effectiveness of modern immunomodulatory therapies in Crohn's disease and a more conservative approach to resection in surgical patients. The predominant cause of short bowel in this cohort historically is thought to have been excessive resectional surgery. Patients with multifocal and complex small bowel Crohn's disease should probably be confined to highly specialized centres.

IBD surgery in adolescents and transition

The incidence of IBD in the paediatric population is rising worldwide [736]. Up to 25% of patients with IBD present before the age of 18 years and a national survey of IBD in children in the UK aged < 16 years showed the incidence to be 5.2 per 100 000 individuals [737]. However, the incidence has increased to 7.2 per 100 000 in Scotland [738] and 9.3 per 100 000 in southern England [739] over the past two decades. IBD in adolescence can lead to multiple problems, including growth failure, delayed sexual development, poor nutrition and loss of education due to reduced school attendance. Therefore, the aims of treatment are not solely focused on symptom control but also to facilitate normal growth and sexual development, to minimize disruption to education and to enhance self-esteem and healthy peer relationships.

Despite advances in medical therapy, surgery remains an important treatment modality in adolescents with IBD. It is generally reserved for patients with disease that is refractory to medical management, when there are complications of the medical treatment, when there is significant growth retardation despite medical therapy or when there are complications that require more urgent or emergency intervention, such as bowel obstruction, perforation or haemorrhage.

Given the complex and multifactorial nature of the decision-making in adolescent IBD, it is imperative that any surgeon working within this setting is a member of a paediatric IBD multidisciplinary team. Surgeons operating on adolescents with IBD should be experienced and well-trained specialist IBD surgeons, whether this is from an adult colorectal surgery or paediatric surgery background. Sometimes it will be appropriate for both specialties to advise and operate together. Other members of

this multidisciplinary team are likely to include paediatric gastroenterologists, specialist nurses, dieticians, radiologists and stoma nurses, with easy access to psychological and psychiatric support when required. There are data confirming that colorectal surgeons whose main practice is in treating adults can provide safe and effective surgical care to adolescent patients when working within a paediatric IBD multidisciplinary team [740,741].

Statement 15.1

Resection is the gold standard surgical treatment in adolescents requiring surgical intervention for Crohn's disease, with laparoscopic approaches having potential advantages over open surgery.

Level of evidence: III

Grade of recommendation: C

Consensus: 93.8% (SA 46.9%, A 46.9%)

Crohn's disease

Resection

Ileocaecal and small bowel resections are the most frequent operation that adolescents with Crohn's disease undergo. The main indications for surgery are stricture formation, medically resistant disease and perforating/fistulizing disease. Use of small bowel MRI enteroclysis provides detailed anatomical and disease-specific information, and aids clinical decision-making when considering surgical intervention [742]. In an adolescent with limited symptomatic ileocaecal Crohn's disease, it is reasonable to discuss as a multidisciplinary team the option of surgery at the time of considering escalation to biological therapy, as there are rare but potentially significant complications of anti-TNF therapy in the adolescent population, namely hepatosplenic T-cell lymphoma [743], and it may be appropriate to leave biological therapy for later in adult life when the disease recurs. There are several case series confirming that small bowel and ileocaecal resection procedures can be performed safely with a laparoscopic approach in adolescents, with reductions in postoperative pain and hospital stay achievable with this approach [744,745]. SILS has also been shown to be feasible in this cohort [746], although its benefit over standard laparoscopic resection is yet to be demonstrated (see Section 3).

Strictureplasty

The aim of preserving as much bowel length as possible in all patients with Crohn's disease should always be borne in mind, but this is particularly pertinent in adolescents due to their high likelihood of requiring further surgery later in adult life. There are few data on

strictureplasty in adolescents, but it has been shown to be safe [747]. However, one series does suggest a higher disease recurrence rate in adolescents after strictureplasty when compared with resection [748].

Statement 15.2.

Strictureplasty is a bowel-preserving technique that may be considered in adolescents with small bowel Crohn's disease. Clinicians should be aware that there is concern of possibly higher recurrence rate when compared with resection, with an experienced inflammatory bowel disease surgeon balancing relative risks of disease recurrence and long-term short bowel syndrome.

Level of evidence: III

Grade of recommendation: C

Consensus: 90.6% (SA 34.4%, A 56.3%)

Perianal Crohn's disease

Symptoms from perianal Crohn's disease can be particularly disabling and have a high impact on quality of life in the adolescent population [749]. Up to 15% of adolescents with Crohn's disease will have evidence of perianal involvement at the time of presentation [750], and surgical intervention is often required [751]. The role of the surgeon, in combination with the multidisciplinary team, is to drain any sepsis and control any anal fistulas with loose setons such that medical therapy (particularly azathioprine and anti-TNF therapy) can then be initiated by the paediatric gastroenterology team. Imaging with MRI is useful for the operating surgeon in terms of delineating the anatomy of any collections and fistula tracks. A conservative, nonexcisional approach should be recommended for anal skin tags, as wound healing may be problematic. In severe, medically resistant cases of perianal Crohn's disease, defunctioning with a stoma may be necessary, but there should be careful counselling of the patient and their family as the risk of subsequent proctectomy and permanent stoma is as high as 50% in this patient group [752].

The more novel, sphincter-conserving methods for anal fistula treatment, such as anal fistula plug, fibrin glue, over the scope clip and adipose-derived stem cells, are not well described in the adolescent literature.

Statement 15.3

Perianal Crohn's disease in adolescents requires joint medical and surgical management, with surgery aimed at draining sepsis and controlling fistulas with loose setons. Diverting stoma or permanent stoma

with proctectomy is reserved for the most severe, medically resistant cases.

Level of evidence: IV

Grade of recommendation: D

Consensus: 100.0% (SA 55.9%, A 44.1%)

Ulcerative colitis

Colectomy

Surgery in adolescents with ulcerative colitis is generally in the form of an initial subtotal colectomy and ileostomy. The indications for this are much the same as in adults, with failure of medical therapy being most common. Once again, the additional issues around delayed growth and sexual maturation, potential poor nutrition and loss of education need to be borne in mind when considering this possible surgical treatment option in adolescents. The aim of removing the colon in this setting is to return the adolescent patient to a good quality of life without the need for any oral medication. Laparoscopic surgery is a safe approach for subtotal colectomy and ileostomy in adolescents [740,744,753], where expertise for this exists. In addition, single-port colectomy has been shown to be safe and feasible in this setting [754].

The impact of a stoma on the adolescent patient is not to be underestimated. This should be broached openly with the patient and family at as early a stage as possible when surgery is being considered. The input of stoma nurses and specialist IBD nurses is key, with counsellors and psychologists providing additional input as required. Although subsequent proctectomy and permanent ileostomy is possible for all patients with ulcerative colitis, adolescents are generally keen to be considered for possible reconstructive surgery.

Statement 15.4.

Subtotal colectomy and ileostomy is the procedure of choice for adolescents with ulcerative colitis who require surgery, with a laparoscopic approach conferring some advantages over open surgery.

Level of evidence: III

Grade of recommendation: C

Consensus: 96.9% (SA 56.3%, A 40.6%)

Reconstructive surgery in ulcerative colitis

Ileal pouch anal anastomosis

The role of IPAA in adolescents with ulcerative colitis is somewhat controversial, with no quality data to guide

practice. There is no doubt that IPAA is feasible in children and adolescents [755], with high levels of satisfaction at long-term follow-up [756]. However, as the sole indication for this procedure is for the quality of life of living without a stoma, there is an argument to suggest that this could be reserved until the adolescent patient with an ileostomy has completed their growth and education, thus entering adulthood. This argument needs to be balanced against the impact of living with a stoma during the crucial development years of adolescence.

Anecdotally, experienced practitioners tend to wait until adulthood if at all possible, as many of the potential complications of IPAA surgery may be difficult to fully comprehend and weigh up during the adolescent years. These include impotence, retrograde ejaculation, infertility, dyspareunia, inability to orgasm and pouch–vaginal fistula, amongst others.

There are some emerging data from the adult IBD literature to suggest that laparoscopic IPAA surgery may lead to reduced rates of infertility [298] and increased rates of pregnancy [417] in women, probably as a result of reduced pelvic adhesions [757] (see Section 6), thus making a laparoscopic approach potentially attractive in this particular patient group.

Statement 15.5.

Ileal pouch–anal anastomosis is a common treatment choice for restoration of intestinal continuity in adolescents with ulcerative colitis, although the optimal timing of surgery has yet to be defined. A laparoscopic approach in female patients may reduce rates of infertility.

Level of evidence: IV

Grade of recommendation: D

Consensus: 87.9% (SA 36.4%, A 51.5%)

Ileorectal anastomosis

Ileorectal anastomosis is one option to potentially allow a patient to live without a stoma and also to avoid the potential morbidity that is associated with the proctectomy component of IPAA (including infertility). There is generally a reduced stool frequency after ileorectal anastomosis compared with IPAA. However, colectomy with ileorectal anastomosis is not commonly formed in the setting of ulcerative colitis, with no data available from the paediatric literature. In adults, it is usually considered as a two-stage procedure with initial colectomy and ileostomy while the patient is on maximal medical therapy followed by a subsequent second operation with ileostomy take down and ileorectal anastomosis. Due to the high likelihood of recurrent proctitis,

patients would generally be advised to use topical therapy to treat the rectum following ileorectal anastomosis for ulcerative colitis. There is currently a resurgence of interest in this technique in the treatment of adults with ulcerative colitis who require surgery [430] (see Section 7) but to date this does not seem to have been widely adopted in the treatment of adolescents.

Statement 15.6.

Ileorectal anastomosis is a possible surgical option in adolescents with ulcerative colitis, but no data exist to suggest it should be considered more frequently in the adolescent population.

Level of evidence: IV

Grade of recommendation: D

Consensus: 87.9% (SA 36.4%, A 51.5%)

Transition care

The transition from paediatric to adult care can be a potentially stressful time for the adolescent with IBD. It is generally undertaken between the ages of 16 and 18 years, but ideally when the patient has also acquired some self-management skills in terms of being able to speak with the treating doctor or nurse alone, understanding their disease process and management and being willing to adhere to any treatment with an understanding of the risks, benefits and alternatives to this [46,758]. A joint paediatric–adult clinic, as part of the transition process, is the ideal model. A specialist IBD nurse is an essential coordinator during this process, but an adult colorectal surgeon who has been part of the paediatric IBD multidisciplinary team may often facilitate transition too, by providing continuity through to the adult IBD multidisciplinary team treating the patient in the future.

Statement 15.7

The process of transition for patients with IBD from paediatric to adult care requires careful coordination, ideally within a supportive joint paediatric–adult clinic environment.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 100.0% (SA 60.0%, A 40.0%)

Surgery for IBD in pregnancy

The incidence of IBD peaks during the reproductive years, with 50% of diagnoses being made before the age of 35 years. Ulcerative colitis affects the sexes equally

whereas Crohn's disease has a slight female preponderance. About a quarter of women affected with IBD will conceive after their diagnosis is made [759,760].

Evidence suggests that pregnancy has a mixed influence on IBD. The incidence and disease course in Crohn's disease appears unaffected by pregnancy provided the patient continues to take IBD medication. The incidence and activity of ulcerative colitis, however, is slightly increased during pregnancy [761–764]. Of those who conceive while in remission about a third will flare during pregnancy. Of those who conceive with active disease this activity continues throughout pregnancy in two-thirds of patients [763,765–768].

Inflammatory Bowel Disease appears to have a detrimental effect on pregnancy. There is an increased incidence of prematurity, low birth weight, congenital abnormalities and increased caesarean section rates in woman with active IBD [769]. It is the active disease that confers the risk [770–772]. Disease control is thus paramount.

The medical management of IBD during the pregnancy is now well defined. Although beyond the scope of this section, there is mounting experience to support the safe use of most disease-modifying drugs. With the notable exceptions of methotrexate, mycophenolate mofetil, thalidomide and certain of the anti-TNF agents in the third trimester there is a clear benefit in continuing medications and maintaining remission [762,764,768,772–774].

Despite advances in the medical management some patients will still require surgery during pregnancy. Management is complicated by the presence of two patients, the woman and her unborn fetus. The management strategy adopted will be uniquely case specific and requires a multidisciplinary approach with obstetricians, neonatologists, obstetric anaesthetists, gastroenterologists and colorectal surgeons [775–777].

Statement 16.1

The decision to undertake abdominal surgery for IBD in pregnancy should be made as part of a multidisciplinary team of obstetrician, neonatologist, anaesthetist, gastroenterologist and colorectal surgeon.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 97.2% (SA 80.6%, A 16.7%)

Assessment and staging

Accurate assessment of disease activity is important if appropriate decisions are to be made. Clinical

assessment is compounded by the normal physiological changes of pregnancy and abdominal assessment is compounded by the gravid uterus. Commonly used laboratory indices such as haemoglobin concentration, serum albumin and ESR are affected by the physiological changes of pregnancy and can mislead the unwary. Parameters such as temperature, stool frequency and CRP levels are unaffected and may take more prominence in assessment [761,778].

Symptoms and signs of sepsis can be atypical in pregnancy: classical signs may not be present and progression can be more rapid than in the nonpregnant state. Tools such as the Modified Early Obstetric Warning Score (MEOWS), early assessment of arterial blood gases with early recourse to broad-spectrum antibiotics and critical care input should be considered. It is important for the IBD team to note that amoxicillin/clavulanic acid is associated with necrotizing enterocolitis in the neonate [779].

The surgeon should be aware of current thoughts on the safety of imaging techniques in pregnancy and weigh up the risks of the investigation against the information it is likely to return.

Upper gastrointestinal endoscopy during pregnancy appears safer than colonoscopy [780,781]. Data on the safety of lower gastrointestinal endoscopy during pregnancy are poor but it probably does involve a small risk to the fetus. The fetus is inherently sensitive to maternal hypoxia and hypotension secondary to sedation, dehydration or aortocaval compression by the uterus. The most significant reported risk is preterm labour in up to 5% of cases [782]. The American Society of Gastrointestinal Endoscopy guidelines suggest colonoscopy where deemed necessary should not be unreasonably withheld, preferably in the second trimester using no or minimal sedation. Attention should be given to patient positioning, maternal and fetal monitoring as appropriate and use of minimal abdominal pressure directed away from the uterus [783]. In practice an unprepared, unседated flexible sigmoidoscopy will suffice in most acute situations.

Statement 16.2

Lower gastrointestinal endoscopy in pregnant women with IBD should be deferred to the puerperium where possible. Where strong indications exist, it should still be performed by an experienced endoscopist, preferably during the second trimester.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 96.9% (SA 43.8%, A 53.1%)

Ultrasound and MRI scanning are the imaging modalities of choice in pregnancy as they are not associated with known risk to the fetus [784]. Gadolinium is teratogenic and should be avoided wherever possible, particularly in the first trimester.

Imaging techniques that expose the fetus to ionizing radiation are controversial. The radiation dose to embryo or fetus from any diagnostic procedure in current use today should pose no risk of death, malformation, growth retardation or mental impairment in the unborn child. These risks become relevant at extreme doses over 100 mGy [785]. More controversial is the risk of inducing cancer in the unborn fetus after birth with techniques that use lower-dose radiation. This risk increases as the dose of radiation increases. At a radiation dose of about 25 mGy, CT scanning of an abdomen and pelvis is estimated to double the natural risk of childhood cancer (to below 1 in 200 and mostly below 1 in 1000) but the absolute risk of lifetime cancer is likely to still be < 1%. The dose of radiation from a plain abdominal radiograph by comparison is between 0.1 and 3 mGy. Such examinations should be avoided unless the health of the mother is threatened and then should not be unreasonably withheld [784–786].

Many factors affect radiation dosage to the fetus so advice from a radiologist should be taken. However, very low-dose, low-resolution CT scans that fail to answer the clinical question offer only harm without benefit.

Statement 16.3

Ultrasound and MRI scanning are the imaging modalities of choice for patients with IBD during pregnancy. Abdominopelvic CT scanning exposes the fetus to high-dose ionizing radiation, with doubling of the childhood cancer risk, and should be avoided where possible.

Level of evidence: III

Grade of recommendation: GP

Consensus: 90.9% (SA 69.7%, A 21.2%)

Surgical indications and technique

There is a paucity of published data on surgery for IBD during pregnancy and much of the available data pre-date use of the newer therapeutic modalities available today. Surgery is required in all trimesters of pregnancy in both ulcerative colitis and Crohn's disease with nearly half in the second trimester [777]. The literature reflecting current practice suggests the risk of surgery to the woman is similar to that in her nonpregnant state.

Abdominal surgery for IBD in the third trimester is associated with almost universal precipitation of preterm labour [777]. Surgery in the first trimester is associated with higher rates of miscarriage prompting some to suggest a preference for the second trimester, but no trimester is immune from these complications [787–790].

If surgery is required between 26 and 33 weeks' gestation and delivery is likely then there is strong evidence that 24 h of corticosteroid administration to the woman improves neonatal respiratory, infective and neurological outcomes and ultimately survival without evidence of septic harm to her [791,792]. Current recommendations extend this to 39 weeks if elective caesarean section is planned [792]. Administration of magnesium sulphate within 24 h of delivery between 24 and 29 (and possibly to 33) weeks' gestation offers further fetal neuroprotection [792,793]. Tocolysis (inhibition of uterine contractions) is associated with a prolongation of pregnancy for only up to 7 days and is used only as a holding measure while steroids and magnesium sulphate take effect [792]. The maturity of the unborn fetus and the acuteness of the maternal condition will influence strategy.

Statement 16.4

If indicated, surgery for IBD is most commonly performed in the second trimester when it may carry least risk to the fetus in terms of miscarriage or preterm labour. Surgery in the third trimester is associated with very high rates of preterm labour.

Level of evidence: IV

Grade of recommendation: D

Consensus: 90.6% (SA 56.3%, A 34.4%)

The reported indications for surgery in pregnancy include refractory colitis with or without megacolon [776,794–798] and perforated or obstructed Crohn's disease [775,799–801]. Uncontrolled bleeding has also been cited [802]. Fetal distress secondary to poorly controlled disease may itself initiate surgical intervention [802].

Statement 16.5

The indications for emergency abdominal surgery in pregnant patients with IBD are identical to those in nonpregnant patients with the additional indication of fetal distress.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 96.8% (SA 58.1%, A 38.7%)

Refractory colitis

Most authors suggest that the appropriate surgical option in unresponsive colitis is subtotal colectomy and ileostomy [795,796,798,803–805]. The gravid uterus and pelvic and retroperitoneal vascular engorgement may hinder access within the abdomen. Bleeding is cited as a problem on mobilization of the colon or rectum from the retroperitoneum [797,798]. Technical modifications such as minimal colonic mobilization just sufficient to allow excision of the colon and creation of an end ileostomy, utilizing a ‘near colonic’ approach to the rectosigmoid, thus avoiding pelvic retroperitoneal dissection and utilizing the newer energy devices which cut and seal have anecdotally proved useful.

Statement 16.6

Colectomy and ileostomy is the recommended surgical procedure for acute severe colitis during pregnancy.

Level of evidence: III

Grade of recommendation: GP

Consensus: 100.0% (SA 65.6%, A 34.4%)

Historically very high maternal and fetal morbidity and mortality rates were reported with subtotal colectomy for toxic megacolon in pregnancy. The Turnbull blowhole colostomy–loop ileostomy technique is a less invasive technique which avoids hazardous dissection in a vascular retroperitoneum and avoids the difficulties of creation of a rectal stump mucus fistula. The technique’s attraction is its simplicity, but as current literature reports much lower morbidity and mortality figures for colectomy than 30 years ago this technique has not been widely adopted [776,797,806].

An enlarged uterus may exert pressure on the rectal stump and obstructing it; this has been suggested as a cause of rectal stump ‘blow-out’ [794]. As in nonpregnant patients there is debate as to the role of creation of a mucus fistula. It may be technically difficult to bring out a mucus fistula through the anterior abdominal wall as the broad ligaments draped across the abdominal cavity will obstruct its siting. Tunneling the mucus fistula retroperitoneally across the (dilated) ovarian and retroperitoneal vessels has been proposed but this exposes the patient to the risk of significant haemorrhage [804]. Other strategies include over-sewing of the rectal stump with or without omental patch support [794,798]. Simple rectal stump decompression with daily proctoscopy drainage

or use of an indwelling rectal catheter has also been employed.

Statement 16.7

Following colectomy during pregnancy the retained rectum may be at high risk of blow-out. Strategies should be considered to minimize this risk. Temporary use of an indwelling rectal catheter may provide the simplest option.

Level of evidence: IV

Grade of recommendation: D

Consensus: 90.3% (SA 41.9%, A 48.4%)

As surgery in the third trimester is universally associated with premature labour, consideration should be given to the performance of caesarean section immediately prior to colectomy.

Fulminant Crohn’s colitis would reasonably be managed similarly with the proviso that segmental involvement may permit a segmental resection and colostomy as appropriate. There are few clinical scenarios where rectal resection could be deemed unavoidable during an on-going pregnancy without considering simpler alternatives.

The use of a defunctioning ileostomy to ‘rest’ the inflamed Crohn’s colitis during an ongoing pregnancy has not been widely reported in the literature although it has been instituted at the time of caesarean section for poorly controlled disease [775]. This strategy may be more appropriate for ‘sub-acute’ Crohn’s colitis and be reasonably deferred until after pregnancy.

Small bowel and ileocaecal disease

Small bowel perforation is the most frequently reported indication for surgery for Crohn’s disease during pregnancy. In the presence of peritoneal sepsis, high rates of anastomotic dehiscence after primary anastomosis have been reported, prompting many to advocate avoidance of an anastomosis. Significant peritoneal sepsis is known to adversely affect fetal outcomes [775,799,801,807]. A recent systematic review reports that five of six patients treated with resection and primary anastomosis developed anastomotic leakage [777].

The presence of a stoma does not preclude a trial of normal labour. Obstructive stomal complications have been reported in the third trimester which resolve after delivery [807–809]. Gastrointestinal bleeding and small bowel obstruction are infrequently reported indications for surgery during pregnancy and are managed similarly [810,811].

Statement 16.8

For perforated Crohn's disease occurring during pregnancy, expeditious control of sepsis with bowel resection and avoidance of an anastomosis should be the primary aim.

Level of evidence: IV

Grade of recommendation: D

Consensus: 96.8% (SA 58.1%, A 38.7%)

Statement 16.9

Interventional radiological techniques in pregnant patients with IBD are currently unproven but may optimize sepsis control and allow deferral of surgery until a more favourable time.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 93.8% (SA 37.5%, A 56.3%)

Laparoscopic abdominal surgery for nonobstetric indications has been safely performed in all trimesters of pregnancy with many of the same advantages seen in nonpregnant patients [812,813]. No increase in spontaneous abortion or miscarriage rates has been observed with the laparoscopic technique and decreased uterine manipulation with laparoscopy is theoretically attractive [810,811]. A suggested upper gestational age limit of 26 to 28 weeks for laparoscopy has been challenged [814,815].

Experience with laparoscopic techniques specifically for IBD in pregnancy is limited, with only a few authors reporting experience of this technique [810,816]. Patient positioning, care with port placement and insufflation pressures kept to a minimum (10–15 mmHg) are important. Fetal acidosis with CO₂ insufflation has been observed in animal models so maternal end tidal CO₂ monitoring as a reflection of acid–base status should be continually monitored [817]. Pregnancy is a prothrombotic state, and as in all IBD surgery appropriate prophylaxis for deep vein thrombosis should be undertaken [818]. If additional individual risk factors exist, including the need for caesarean section, then extended thromboembolic prophylaxis from 28 weeks to 6 weeks postpartum is recommended [819]. A pragmatic surgeon will consider the stage of pregnancy and the challenges it brings, the surgery required and the skill mix of the surgical team when considering a laparoscopic approach.

There is little published literature on the use of interventional radiological techniques for the drainage of sepsis in pregnancy, and what is available has shown disappointing results [820]. Over recent years there has been significant growth in the use of interventional radiological techniques in general with upskilling of interventional radiological teams. These techniques may allow deferral of surgery until a more favourable time in a pregnancy [777]. A futile radiological intervention can also introduce harmful delay and the clinician must set clear achievable objectives with regular clinical review.

Perianal Crohn's disease

The presence of perianal Crohn's disease may impact on the mode of delivery and is covered in Section 17. There are no data specific to the surgical management of active perianal Crohn's sepsis during pregnancy. Sepsis, however, is known to have a negative impact on pregnancy and so emphasis should be placed on expeditious control of perianal sepsis, delaying any more definitive procedures until the puerperium.

IBD stomas during pregnancy

IBD patients with preexisting stomas may safely carry a pregnancy to term [821,822], although this situation is probably worthy of further research [823]. Some changes to stoma anatomy and function may be experienced during the course of a pregnancy, with the greatest change occurring in the third trimester [821]. Patients may report flattening or even retraction of the stoma, which is usually amenable to correction with advice from a stoma therapist about change in stoma appliance [821]. As in all women, the gravid uterus may exert a pressure effect on the colon, resulting in symptoms of constipation and altered bowel function during the latter stages of pregnancy. There are a small number of reported cases of intestinal obstruction during pregnancy in patients with preexisting stomas, with adhesional obstruction and pressure effects being the most common causes [809,822,824].

Inflammatory Bowel Disease patients with an ileostomy who experience hyperemesis gravidarum are at particularly high risk of dehydration, renal failure and metabolic derangement. Admission for anti-emetics and rehydration may occasionally be required [825].

While most stoma changes experienced during pregnancy usually revert with a few weeks of delivery, postpartum changes in the abdominal wall and skin laxity may result in problems with postpartum fitting of stoma appliances [821]. The increased abdominal pressure of pregnancy may also predispose to

development of parastomal hernia in some patients, although the literature does not suggest that this is a significant risk [826,827].

Summary

In summary, the literature has shown a step change in improved outcomes for both the woman and the fetus over the last 30 years. The published literature on IBD surgery during pregnancy is limited to case reports and small case series but a degree of consensus regarding technique may be reached. A central repository of surgical patient episodes in this group of patients may help develop our understanding further.

Modes of delivery in pregnant women with IBD

Mode of delivery is a common dilemma and a frequently asked question from patients with IBD. This is due to the obvious fact that the disease is most frequently diagnosed in women during their peak reproductive years. Although many studies have reported on the outcomes for neonates born to women with IBD there are very few that have focused on the indications for, or complications of, different modes of delivery. Of those studies that are available for analysis many combine Crohn's disease and ulcerative colitis patients together and the indications for, and modes of, delivery are rarely well described. In addition, there are confounding variables over and above the specific disease process that influence mode of delivery. Pregnant women, especially those with Crohn's disease, have a lower BMI than age-matched pregnant controls and are more likely to be smokers [828]. Approximately 30–40% of women with IBD active at the time of conception will develop flare-ups during pregnancy [761,829] and may be more likely to undergo premature labour with its attendant obstetric priorities regarding mode of delivery and potential for complications for the woman and her baby.

With the above limitations, the following conclusions and recommendations are presented, together with the level of evidence on which the recommendations are made.

Vaginal delivery

Risk of perineal tearing

A Swedish population-based study of over 12 000 women (1209 women with ulcerative colitis and 787 with Crohn's disease) who gave birth to over 13 000 singletons showed that there was no increase in the risk of vaginal tears in women with either Crohn's disease

or ulcerative colitis undergoing vaginal delivery [828]. Indeed, the risk for a grade 3 or 4 perineal tear was less than the risk in the non-IBD group (OR 0.68, 0.47–0.98). This presumably relates to the higher rate of planned caesarean section in these groups (see below).

The situation may be different for perianal Crohn's disease. A population study of over 6.7 million pregnant women [830] showed that there was a significant increase in risk of fourth-degree tears in this subgroup undergoing vaginal delivery. The rate of fourth-degree tears was 12.3% in women with perianal Crohn's disease, 1.4% in women with luminal-only Crohn's disease and 1.3% in other women (OR 10.9, 8.3–4.1). A much smaller study by Smink *et al.* showed that 2/27 women with perianal Crohn's disease and 14/87 with luminal disease only suffered a second-degree tear with no third- or fourth-degree tears in either group [831].

Statement 17.1.

Women with IBD, excluding those with perianal Crohn's disease, do not appear to have an increased risk of perineal tearing during vaginal delivery.

Level of evidence: II

Grade of recommendation: C

Consensus: 96.8% (SA 35.5%, A 61.3%)

Risk of episiotomy

There are very few studies reporting specifically on either the indications for, or outcomes of, episiotomy in women with IBD. Many studies do, however, make some comments about various factors related to the subgroups of IBD patients who undergo episiotomy. A Cochrane Review on episiotomy concluded that episiotomy should only be recommended for obstetric reasons and not as routine practice [832]. In the light of this, many units have become more conservative with regard to episiotomy over the last decade.

The study by Smink *et al.* [831] reported that 9/27 women with perianal Crohn's disease and 43/87 women with only luminal Crohn's underwent episiotomy for delivery. The indications for episiotomy were not detailed. The outcomes of these patients at 2 years were analysed in conjunction with those for patients who sustained perineal tears, which confounds the conclusions. However, it was shown that 6/11 (55%) women who had an episiotomy, who also had pre-existing perianal Crohn's, had progressive perianal Crohn's at 2 years, including two women who had developed a fistula. Similarly, 32/57 (56%) women who had either had an episiotomy or a tear and had luminal-only disease at the time of delivery, had progressive

perianal Crohn's at 2 years, including three fistulas. In the nine women with perianal Crohn's disease who had neither an episiotomy nor a tear, seven reported progression in disease activity at 2 years but without fistula formation.

Brandt *et al.* [833] reported on 117 women with Crohn's disease who had undergone vaginal delivery with or without episiotomy and found that the latter predisposed to development of postpartum perianal problems even in those with no perianal problems before delivery.

The data for ulcerative colitis are even more limited. In those with an IPAA it is clearly essential that trauma to the sphincters is avoided. Many would recommend that such patients undergo a caesarean section to avoid the potential for trauma (see below), but in the situation where a vaginal delivery is planned episiotomy should be dictated by the obstetric indications.

Statement 17.2.

Episiotomy should only be performed if indicated for obstetric reasons in women with Crohn's disease as it may predispose to unmasking or worsening of perianal disease.

Level of evidence: II

Grade of recommendation: B

Consensus: 81.3% (SA 40.6%, A 40.6%)

Risk of faecal incontinence

The link between perineal tears and subsequent impairment of faecal continence has long been established [834]. However, most studies include mainly women without IBD. The studies of women with IBD often analyse ulcerative colitis and Crohn's disease together.

A survey by Broms *et al.* [828] of 10 000 patients with IBD reported no association between faecal incontinence and vaginal delivery in women with IBD. Conversely a smaller survey of 777 IBD patients by Ong *et al.* [835] showed an increased rate of faecal incontinence among women with IBD.

Statement 17.3.

Vaginal delivery does not appear to increase the overall risk of faecal incontinence in women with IBD. As with all decisions about management, women should be counselled about the risks and benefits of different modes of delivery.

Level of evidence: II

Grade of recommendation: C

Consensus: 87.5% (SA 40.6%, A 46.9%)

Other risks of vaginal delivery in Crohn's disease

Premature rupture of membranes. A large multicentre study of over 4.2 million deliveries in the USA showed no evidence of premature rupture of membranes in women with Crohn's disease or ulcerative colitis [836].

Instrumental vaginal delivery. The study by Broms *et al.* [828] did not demonstrate any increase in the risk of instrumental vaginal delivery for women with IBD compared with non-IBD controls.

Induction of labour. The study by Bröms *et al.* [828] did not demonstrate any increase in the risk of induction of labour for women with IBD compared with non-IBD controls.

Caesarean section

Likelihood of undergoing caesarean section in women with IBD

The ECCO consensus paper on reproduction and pregnancy in IBD [837] states that caesarean delivery is more frequent in women with IBD. The paper was produced through combined systematic literature review and discussions among the expert group chaired by the senior author. These findings are almost universal in each of the studies that have examined this association [831,836,838–844].

A study of approximately 4.2 million deliveries in the USA demonstrated that there was a higher rate of caesarean section in women with Crohn's disease compared with those without IBD (45.9% *vs* 30.9%, $P < 0.0001$, OR 1.72) [836]. Although this is a large population-based study, it only considered deliveries in hospital. Planned home births, which are disproportionately offered to very low risk women, and unplanned out of hospital births, which are disproportionately found amongst uninsured patients, may have confounded the findings in this study.

The huge population-based study of over 6.7 million pregnant women by Hatch *et al.* [830] also confirmed that the rates of caesarean section were significantly higher in women with Crohn's disease compared to the general population. Only 2882 of the women in this study had Crohn's and the rates of caesarean section were higher for these women than for those without Crohn's. Furthermore 83.1% of women with perianal Crohn's had caesarean section compared with 42.8% of those with luminal Crohn's only. The rates for non-Crohn's women in this study were 38.9% for women without Crohn's and 25.6% for women without any form of perianal disease ($P < 0.001$).

A meta-analysis of over 3000 women with IBD (64% with Crohn's disease) by Cornish *et al.* [843] showed that women with Crohn's disease are 1.65 times more likely to undergo caesarean section. However, this study did not look at the risk factors for undergoing caesarean section, nor perform any subgroup analysis.

A single-centre Dutch study of 114 women with Crohn's disease who underwent one or more singleton pregnancies during the time of the study showed that there was an increased risk of caesarean section in women with both luminal and perianal Crohn's [831]. The overall caesarean section rate was relatively high at 32% compared with the general caesarean rate in the Netherlands which stands at 13.6%. Women with perianal disease had the highest rate of caesarean section with an OR of 4.6 (1.8–11.4).

Similarly, the study from Manitoba by Ilnyckji *et al.* [839] showed that women with IBD (both Crohn's disease and ulcerative colitis) had a higher rate of undergoing caesarean section than non-IBD women (20.9% for women with Crohn's, 20.8% for women with ulcerative colitis, 15% for non-IBD women; $P < 0.01$).

The most recent study is a 10-year retrospective single-centre cohort study comparing 59 patients with Crohn's and 65 patients with ulcerative colitis with 21 805 women without IBD. They found the likelihood of caesarean section to be the same as in the general population for Crohn's but was double the general population value in the ulcerative colitis group, with the highest incidence being in those with an IPAA [844].

Although multiple studies confirm the association between IBD and caesarean section, there is very little evidence about the reasons for this. Due to methodological variance in both the individual studies above and in the systematic reviews and meta-analyses it is difficult to draw robust conclusions. It is, however, reasonable to conclude that the reasons are multifactorial and include the presence or risk of perianal Crohn's disease, fetal growth problems due to maternal ill health and smoking-related factors. There are other confounding factors such as the level of medical insurance in the USA and similar healthcare systems, and the more detailed antenatal monitoring that women with IBD undergo.

An interesting study by Selinger *et al.* [845] surveyed the views of 145 women with IBD with regard to their attitudes to various aspects of fertility, pregnancy and delivery. Over 75% of participants agreed that women with IBD are more likely to have a vaginal delivery (irrespective of participant knowledge scores) and approximately 68% expected to have a healthy baby. This small study would seem to indicate that there is

not a widespread expectation of elective caesarean section among IBD specialists and patients.

Statement 17.4.

There is an increased likelihood of women with both ulcerative colitis and Crohn's disease undergoing caesarean section.

Level of evidence: II

Grade of recommendation: B

Consensus: 90.3% (SA 41.9%, A 48.4%)

Potential for harm after caesarean section

There is an increased rate of complications after caesarean section in both ulcerative colitis and Crohn's disease. The study by Broms *et al.* [828] showed that the risk of complications after elective caesarean was doubled among women with both ulcerative colitis and Crohn's. This clearly should be taken into account before recommending caesarean section in all IBD patients.

Mode of delivery after surgery for ulcerative colitis

There is very little evidence to dictate the mode of delivery in patients after surgery for ulcerative colitis. The ECCO guidelines recommend the presence of an ileoanal pouch to be a relative indication for caesarean section [837]. This is based on the assumption that such a patient is borderline incontinent and any risk at all to the anal sphincter will severely affect function. However, a questionnaire administered to 232 pregnant women with a pouch reported no difference in the rates of pouch-related complications or functional problems after vaginal or caesarean delivery [846]. A recent systematic review reached the conclusion that uncomplicated vaginal delivery only moderately influenced pouch function, with no significant difference in overall continence or stool frequency. Nevertheless, function was significantly worsened in a complicated delivery, perhaps still justifying an elective caesarean in these patients [847].

Regarding patients who have an ileorectal anastomosis, there is clearly intact rectal function and patients may not be so 'borderline incontinent'. However, the risks of recurrent disease and further surgery are high (see Section 7). Indeed, the same argument could be used for those with an intact colon, one in five of whom will need surgery in their lifetimes (see Section 4). Counselling patients with regard to mode of delivery can only be individualized based on risks of surgery and patient preferences.

Statement 17.5

Previous ileoanal pouch surgery is a relative indication for caesarean section.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 94.1% (SA 50.0%, A 44.1%)

Mode of delivery in women with perianal Crohn's disease

Although there is no evidence to recommend the use of elective caesarean section in women with Crohn's disease generally, there is some evidence to promote its use amongst women with active perianal Crohn's. The Toronto Guidelines [848] and the ECCO guidelines [837] make a statement to this effect, although they admit that this is a recommendation made on low-quality evidence.

Most of the justification for recommending caesarean section comes from the large population-based study indicating an increased risk of fourth-degree tears in these patients [830]. Other evidence comes from studies (mentioned above) suggesting that progressive perianal disease occurs after episiotomy (5,7). Other studies suggest there may be worsening of perianal disease after vaginal delivery, even without a tear or episiotomy [841]. One small study even suggests that vaginal delivery may predispose to perineal involvement in women with luminal Crohn's [833]. In this particular questionnaire study of 117 women with Crohn's disease, 67.6% of those with no pre-existing perianal disease went on to develop disease, 60% within 2 months of vaginal delivery.

However, the protective effect of caesarean section in avoiding progression of perianal Crohn's disease has been questioned by other studies. A small study by Rogers and Katz [849] showed that three out of four women who underwent elective caesarean due to active perianal Crohn's disease at the time of delivery went on to develop progressive perianal Crohn's, with one also developing a fistula in the caesarean wound. However, these results may have been confounded by the indications for caesarean section, which may have been performed in a higher-risk group. A single-centre study by Cheng *et al.* also questioned the protective effect of caesarean section on the relapse of perianal Crohn's disease after childbirth [850]. Pregnant and nonpregnant women with perianal Crohn's (61 in each group) were compared – approximately 36% of women had a relapse of perianal Crohn's within 1 year and this was not significantly different between those who had caesarean section or vaginal delivery or between pregnant and

nonpregnant women. Another study of 121 Crohn's patients showed no association with mode of delivery and progression of disease [851].

A recent meta-analysis of the available evidence suggests that for new or recurrent perianal Crohn's disease there is no increase associated with mode of delivery [847]. However, for patients with active disease, worsening of symptoms was noted in two-thirds of cases. Pending further data from well-designed trials, the suggestion is that systematic Caesarean section should be offered to women with active perianal disease.

Statement 17.6

Pregnant women with active perianal Crohn's disease should be offered elective caesarean section due to the risk of worsening symptoms and progressive disease.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 91.2% (SA 41.2%, A 50.0%)

Summary

The overall evidence for mode of delivery in IBD is weak. The emphasis remains on recommending shared decision-making between surgeons, obstetricians, gastroenterologists and patients. Discussions should involve patient preferences along with the current evidence, stressing the uncertainty that exists.

Impact of medication on surgery for IBD

With the advent of disease-modifying therapy, surgical practice in the management of IBD is in the midst of a revolution. Traditional indications and surgical approaches are being challenged by the rapidly evolving advances in medical therapy and the increasing number of options in the medical armamentarium. The transition from the mainstay of corticosteroid therapy through to immunosuppressants, calcineurin inhibitors and the widespread introduction of biological therapy has recently been turned on its head with the introduction of 'top-down' aggressive medical approaches aimed at early disease control using agents targeting specific immune components. These novel medical approaches are rapidly evolving, with major new studies being published annually. Increasingly, biological agents are used as first-line therapy. Surgical practice has already been profoundly affected by this paradigm shift in medical management.

This brief review addresses the specific theme of the impact of current medical therapy on IBD surgical practice, on operative outcomes and attempts to synthesize guidelines for current surgical practice. This guidance is based on the current status of available evidence with respect to biological agents, but the evidence is somewhat more mature for corticosteroids, immunosuppressants and calcineurin antagonists, given the longer time available for observation of complications. However, it should be noted that there is no Level 1 evidence contributing to these recommendations, given that all studies of surgical outcomes following treatment are, by their nature, observational and complications are highly co-linear with disease severity.

Medication impacts on surgical practice both directly and indirectly, dependent on clinical circumstances. Firstly, the need for surgical intervention may be avoided altogether, or delayed, by medical rescue in the acute phase, or through improved maintenance therapy comprising more effective and/or aggressive medical therapies. There is some circumstantial evidence that control of mucosal inflammation has the potential to reduce long-term disease-related complications such as cancer risk and stricturing. Secondly, medical therapy influences the nature of operative intervention. This is due to the growing expectation of successful control of medical symptoms and disease activity, thus ameliorating the magnitude of the required surgery or completely altering overall surgical strategy. Medication may also have an indirect impact on surgical practice through effects on the frequency and/or severity of postoperative complications, such as surgical site infection and anastomotic leak.

Beneficial impact of medical therapy on surgical management and outcomes

Grouping Crohn's disease with ulcerative colitis as a common entity, namely IBD, is unhelpful when considering the impact of medications on surgical practice. The surgical issues are very different between the two conditions and so they are considered separately here. While not the remit of this brief guidance, it is clear that there is now demonstrable evidence that biological therapy has proven efficacy in the induction and maintenance of remission of both Crohn's disease and ulcerative colitis [852–855]. Anti-TNF and anti-integrin biologicals are effective in inducing mucosal healing of ulcerative colitis, with adalimumab being somewhat inferior. Biological agents are also of proven benefit in the management of Crohn's disease. However, it should be noted that there is a well-established placebo effect [856]. Furthermore, the absolute reduction in risk of

colectomy is small [855]. Hence, it is essential that surgeons maintain a central role in the management of IBD patients.

Crohn's disease – beneficial impact on risk of relapse and nature of primary operation

For luminal disease, the frequency of clinical or significant endoscopic recurrence is highly heterogeneous in published studies, ranging from 13% to 36% without treatment, 22% to 56% with thiopurines and 0% to 9% with anti-TNF therapy at 1 year. This heterogeneity undermines the strength of evidence supporting any recommendations. However, a number of studies indicate a lower requirement for stoma and improved salvage of ileorectal anastomoses with biological agents in Crohn's disease. A descriptive retrospective cohort study conducted by Coscia *et al.* [857] compared two temporally distinct patient cohorts with colonic Crohn's disease differing in the frequency of biological therapy use: a historical time-period when biologicals were not used and a more recent period when they were used frequently. The authors found that the proportions of patients having a permanent stoma were respectively 61 and 19%. Univariate and multivariate analysis suggested that biologicals were associated with an increased frequency of rectal preservation. The authors concluded that the risk of permanent stoma in patients with Crohn's colitis and anorectal involvement is significantly reduced with combined surgical and biological treatment. However, these conclusions should be taken with some circumspection, given that the historical surgical approach to Crohn's disease with anorectal involvement was routinely proctocolectomy. It may be that more patients had a staged colectomy and temporary ileostomy in the more recent cohort because there was an option available of additional therapy rather than necessarily because it was effective. Furthermore, it should be noted that the duration of follow-up for the historical group was, by nature, much longer than for the patient cohort treated with biological therapy. It will be of interest to determine if the natural history of anorectal Crohn's unfolds over time. Nonetheless, these results are encouraging and suggest that intensive biological therapy may enable a staged approach, avoiding, or at least delaying, excision of the anorectum. Another time period [858] found that for patients treated more intensively with drug combinations the time interval from initial diagnosis to surgery was greater than patients who did not receive such therapy. However, interestingly, there appeared to be no influence of preoperative medical therapy on the magnitude of surgery, at least using the surrogate measure of bowel length resected.

One recent systematic review [859] failed to find evidence that thiopurine therapy reduced postoperative recurrence rate. However, there was encouraging, though heterogeneous, evidence that anti-TNF therapy reduces postoperative recurrence. Similarly, Carla-Moreau *et al.* [860] conducted a meta-analysis of nine controlled trials incorporating data from 362 randomized patients to assess the efficacy of anti-TNF therapy in preventing or treating postoperative recurrence of luminal Crohn's disease. There was evidence that anti-TNF was effective at preventing endoscopic (OR: 0.05, 95% CI: 0.02–0.13) and clinical recurrence (OR: 0.10, 95% CI: 0.05–0.21). Interestingly, the number needed to treat to prevent one case was only 2.4, quite a remarkable effect size, thereby supporting the expectation that individual patients are highly likely to benefit. Furthermore, if endoscopic postoperative recurrence did arise, anti-TNF therapy was still an effective treatment (OR: 16.64, 95% CI: 2.51–110.27). A more recent meta-analysis incorporating data from 673 patients suggests that complete mucosal healing is a useful surrogate for long-term clinical remission and thus a valuable therapeutic target when considering the timing of surgical intervention [861]. Furthermore, a retrospective comparison between adalimumab and infliximab for a cohort undergoing ileocaecal resection suggests that both anti-TNF agents are of similar efficacy in reducing endoscopic recurrence at least [862].

Ulcerative colitis – beneficial impact of medication on disease control, cancer risk and nature of operation

Medical therapy is aimed at reducing disease activity and avoiding the need for surgical resection. Several trials and systematic reviews have shown a beneficial impact for biological therapy [852,855]. However, it is important to note that, whilst statistically significant, the absolute benefit over placebo is modest and the predominant effect in trials is for patients with relatively restricted disease. For instance, in the ACT trials there was only a modest absolute difference (7%) in favour of infliximab over placebo in the frequency of colectomy in the treated group [854]. Hence, it is essential that surgeons remain an integral part of the team contributing to the coordinated management of patients with IBD. Apart from reducing and/or delaying the need for colectomy, there is no current evidence that modern medical management influences the nature or the magnitude of surgical resection for ulcerative colitis. Nonetheless, it may be feasible that colectomy and ileorectal anastomosis once again have a place in the management of ulcerative colitis (see Section 6).

There is some circumstantial evidence that colorectal cancer risk may be reduced as a consequence of disease-

modifying agents and so this may have an impact on surveillance protocols [863]. Previous evidence has suggested an excess risk of haematological malignancy associated with immunosuppressant therapy in IBD, but concerns about an excess cancer risk with biologicals have not materialized. A recent analysis of SEER data for paediatric IBD patients showed no excess risk of malignancy with infliximab therapy [864]. Furthermore, initial reports suggesting an association between biological therapy and an increased skin cancer risk, especially melanoma, have not been substantiated. A recent meta-analysis suggests that IBD itself is associated with an increased risk of skin cancer and that the effect is independent of treatment with biological therapy [865].

Adverse impact of medical therapy on surgical outcomes in IBD

Crohn's disease – influence of corticosteroids on the risk of postoperative complications

The evidence is well established that corticosteroid therapy is associated with an increased risk of postoperative complications in both Crohn's disease and ulcerative colitis [293,866]. Prednisolone therapy of 20 mg/day (or equivalent) for 6 or more weeks has been conclusively shown to be associated with a substantial increase in the postoperative complication rate. However, given that steroid therapy and higher dose is associated with disease activity, and there are no data from trials of steroid therapy, it is not possible to disentangle the effect of steroid therapy from disease activity itself. In a large systematic review and meta-analysis of all available observational studies, Subramanian *et al.* [295] estimated a 40% excess risk of all complications (OR 1.41) and specifically an increase in risk of infections (OR 1.68) among patients treated with steroids. There is some evidence to suggest a threshold for total dose of steroid-associated complications [867] and other evidence suggests a dose–response effect, with patients on > 40 mg/day having an even greater risk of all complications (OR 2.04). In a recent large observational study, Nguyen and colleagues [868] used the American College of Surgeons National Surgical Quality Improvement Program to explore the effect of preoperative corticosteroid use on postoperative complication risks. They found that steroid therapy was associated with a greater complication frequency in both Crohn's (adjusted OR 1.26) and ulcerative colitis (adjusted OR 1.44). Infectious complications were more frequent with steroid use in IBD overall, but there was also an association with increased risk of venous thromboembolism in both Crohn's disease (OR 1.66) and ulcerative colitis (OR 2.66). Whilst there is insufficient evidence to causally implicate

corticosteroids in the observed association with an excess risk of complications, it is reasonable to recommend reduction in dose wherever possible in the preoperative period. A pragmatic level of 20 mg/day of prednisolone or equivalent has been suggested, but the lower the dose the better and an attempt to reduce to < 10 mg/day for more than 2 weeks prior to surgery seems appropriate (see Sections 3 and 4).

Statement 18.1.

Corticosteroid therapy increases the risk of postoperative complications in patients with Crohn's disease. Wherever possible, dose reduction should be attempted prior to urgent or elective surgery, certainly below 20 mg/day for prednisolone but preferably below 10 mg/day.

Level of evidence: III

Grade of recommendation: C

Consensus: 97.0% (SA 57.6%, A 39.4%)

Biological therapy and risk of postoperative complications in Crohn's disease

Biological therapy (anti-TNF, anti-integrin, anti-IL12/23) is now incorporated as the standard of care for escalation of medical therapy in the management of IBD. However, it is well established that biological therapy, and anti-TNF therapy in particular, is associated with an increased risk of infection in patients with rheumatoid arthritis [869]. These observations provide the rationale for studying the frequency of postoperative infections in IBD patients treated with biological agents over and, in particular, in the perioperative period.

There remains a lack of unanimity over whether biological therapy influences the postoperative complication rate in Crohn's disease. Various observational studies show conflicting results from subgroup analyses of trials of biologicals. However, overall, it does seem as though anti-TNF therapy is associated with an increase in infective complication rates. It should be noted that all of the evidence is observational and so there is no Level 1 and limited Level 2 evidence to support any recommendations.

Waterman *et al.* [870] found no impact of infliximab or adalimumab therapy alone on the overall frequency of postoperative complications or the timing of surgery to treatment cessation. However, in patients treated with combined biological and thiopurine therapy, there was an association with greater overall risk of postoperative infective complications. In contrast, several other studies failed to demonstrate an association between overall postoperative infections or anastomotic leakage rate and up to a 12-week interval between surgery and

the preceding infliximab administration [293,866,871–876]. A more recent systematic review and meta-analysis and the most recent nationwide prospective cohort study conclude that preoperative use of infliximab does increase the risk of early postoperative complications overall, particularly for infection, in patients undergoing surgery for Crohn's disease [877,878], but even these data are contradicted by another contemporaneous meta-analysis showing no effect [874] and a recent large retrospective cohort study [879].

Given the more recent introduction of anti-integrin therapy, data on the effect of these agents on risk of postoperative complications are even more sparse than for anti-TNF agents. One retrospective observational study suggested a higher postoperative infection rate [880], with 37% of IBD patients receiving vedolizumab within 30 days preceding major abdominal surgery developing a postoperative infective complication. This excess risk was significantly higher than for patients receiving anti-TNF or no biological therapy. Further work by the same group suggested that 26% of patients treated with vedolizumab within 12 weeks of major abdominal surgery suffered surgical site infection, with vedolizumab treatment being an independent predictor of infectious complication, although vedolizumab was probably being used in a sicker patient population as significantly more patients in this group had end stomas formed during surgery [881]. However, in contrast, Colombel *et al.* found no significant excess risk of serious infections or overall complication rates for IBD patients treated with vedolizumab compared with placebo in the GEMINI trials [882]. Similarly, use of propensity score matching to analyse cohort data did not demonstrate any excess risk of infectious complications with vedolizumab [879]. There are minimal data on infectious risk with ustekinumab. A small retrospective study has shown that the 30-day infectious complication rate after abdominal surgery for Crohn's disease in patients who received ustekinumab within 12 weeks prior to surgery was 13%, not dissimilar from patients who received anti-TNF therapy [883].

The time interval preceding surgery over which biological agents might exert an effect on risk remains very unclear. However, given a half-life for infliximab of 7–18 days, if clinical circumstances allow, a 14–30-day washout period free of biological agent prior to surgery would seem reasonable and achievable. A similar wash-out period of up to 12 weeks if possible would seem reasonable for patients treated with anti-integrin therapy, but again the available evidence is limited to appraise any effect on perioperative infection risk.

Statement 18.2.

Where clinical circumstances permit, anti-TNF α and anti-integrin therapy should probably not be administered for at least 14–30 days prior to any planned elective surgery for Crohn's disease to minimize the risk of infective complications and perhaps anastomotic leakage, but evidence in this area is poor.

Level of evidence: II

Grade of recommendation: C

Consensus: 83.3% (SA 43.3%, A 40.0%)

Impact of biological therapy on postoperative complications in ulcerative colitis

As discussed for Crohn's disease, the evidence is conflicting as to whether there is an excess risk of postoperative complications for patients treated with biological agents such as infliximab. As with Crohn's, high-quality evidence is lacking due to the fact that disease severity and the need for therapy are highly correlated. One study examined the effect of biological agents on the risk of postoperative complications after restorative proctocolectomy for ulcerative colitis [884]. The authors found a 3.5-fold excess risk of early postoperative complications for patients treated with infliximab, whilst the odds of sepsis were 13.8 times greater. However, it should be noted that again the disease severity is likely to be correlated with the need for biological therapy. Nonetheless, the authors found an excess complication rate even for those patients undergoing a three-stage ileoanal pouch reconstruction. In another large institutional observational study, ulcerative colitis patients treated with infliximab prior to ileoanal pouch reconstruction experienced a substantially increased risk of postoperative pouch-related and infectious complications [885]. A systematic review by Yang *et al.* [886] also suggested that preoperative infliximab therapy was indeed associated with an increased risk of short-term postoperative complications and there was a trend towards increased postoperative infection.

Similarly, a recent meta-analysis [875] found that anti-TNF therapy but not anti-integrin therapy was associated with a greater infection risk than placebo in ulcerative colitis. In contrast, Lightner *et al.* [880] reported an excess of septic complications in patients treated with vedolizumab compared with infliximab or no biological therapy. To add further to this controversy, a recent paper by Yamada *et al.* [879] found no excess risk of 30-day postoperative complications in ulcerative colitis and Crohn's associated with preoperative vedolizumab exposure. In summary, it remains unclear whether anti-integrin therapy has an adverse impact on surgical complications or whether the need for therapy is in itself

merely a biomarker of disease severity, and it is that which imparts the risk of infectious and overall complications.

Statement 18.3.

Where clinical circumstances permit, anti-TNF α and anti-integrin therapy should be discontinued for 14–30 days prior to planned elective surgery for ulcerative colitis, but evidence in this area is poor.

Level of evidence: III

Grade of recommendation: C

Consensus: 86.7% (SA 40.0%, A 46.7%)

Potential adverse effects of other agents

As with all the above agents, there are conflicting data on the role of various other agents used in the standard management of IBD. Whilst some large studies suggest that there is no excess risk of complications with thiopurine therapy [887], other studies contradict these observations [888], particularly when in combination with other immunomodulatory therapy [870]. In clinical practice, it is often not possible to withdraw both therapies and so, along with the imprecise estimation of risk, it is not feasible to offer clear guidance on the withdrawal of combined therapy as a requirement for surgery. However, the above guidance on infliximab alone would seem appropriate. There is no published evidence that the calcineurin antagonists (cyclosporin, tacrolimus) are associated with postsurgical complications. However, the fact these agents are used as second-line salvage therapy for patients with acute severe ulcerative colitis means that it is impossible to disentangle the relative contribution of disease severity from drug-associated risk.

Long term effect of medications

This section has concentrated on short-term complications related to medication. There is also an effect of medication on long-term outcomes after abdominal surgery for IBD, and in particular the risk of development of incisional hernia. Incisional hernias may have a significant impact on a patient's quality of life as well as making reoperative surgery (relatively common in IBD) more complex. Steroids and other immunomodulatory drugs have been shown to be a substantial risk factor for hernia development [889]. Repair may be difficult and further compromised by continued medication. For methods of abdominal surgical incision closure in these patients and the role of prophylactic mesh please refer to the European Hernia Society guidelines [890] and results from the PRImary Mesh Closure of Abdominal Midline Wound (PRIMA) trial [891].

Summary

The revolution in medical therapy for IBD will continue to impact on the surgical management of IBD. The strong correlation between escalating medical therapy and disease severity makes it impossible to disentangle the relative contribution of each to the high complication rates of surgery for IBD in the acute phase. It is also increasingly difficult to define, or even test, which medication is responsible as more and more sequential therapies are introduced and combination therapies are proposed for rescue with anti-TNF induction followed by rapid introduction of anti-integrin therapy. Given all of the above it is important that ongoing careful and comprehensive audit of all IBD patients treated with immunomodulatory therapy is an integral part of the management. There are excellent database resources in the UK (<http://ibdregistry.org.uk/>) [73] and the USA [892] and it is incumbent on all centres to ascertain all instances of treatment and also ensure comprehensive capture of surgical outcomes, including complications.

Statement 18.4

Standard of care for patients treated with immunomodulatory therapy should ideally include registry on a national, searchable database and peri-operative complications should be systematically captured variables in such databases.

Level of evidence: IV

Grade of recommendation: GP

Consensus: 94.3% (SA 62.9%, A 31.4%)

Acknowledgements

The Editorial team express their gratitude to Crohn's and Colitis UK, IA (the ileostomy and internal pouch support group), the Patient Liaison Group of ACPGBI, the British Society of Gastroenterology, and the IBD Clinical Advisory Group, IBD Subcommittee, Executive and Council of ACPGBI for their support in producing the ACPGBI's guidelines in IBD surgery. The Editorial team would also like to acknowledge the support, guidance and contribution throughout from Mr Neil Smart as *Colorectal Disease's* Guest Editor for these guidelines. The lead authors of Section 2 wish to acknowledge the assistance of Mr Rami Fares in the preparation of this section. The lead authors of Section 6 wish to acknowledge the assistance of Miss Ariffa Siddika in carrying out the literature search. The lead authors of Section 16 would like to acknowledge the contribution and insights of Professor D. C. C. Bartolo.

Author contributions

Conception and editorial oversight: SRB, NSF, ODF.

Section leads (section number in brackets): SRB (1,3,9), NSF (1), JFA (14), AGA (6), SKC (13), RJD (15), MMD (5), WJPD (16), MGD (18), JCE (12), MDE (7), BDG (2), RJG (8), RH (17), GWH (16), CAM (6), TDP (3), PMS (7), BS (2), MS (12), JT (5), JHW (11), ABW (10), RGW (4).

Consensus voting (*if selective): JFA, AGA, RGA*, SRB, SKC, SC*, RJD, MMD, WJPD, MGD, JCE, MDE, ODF, NSF, BDG, RJG, RH, ABH*, JH, GWH*, JKL*, CAM, PRO, TDP, JP*, PMS, BS, MS, HT*, JT, AV*, CJW, JHW, ABW, GLW, RGW.

Manuscript preparation: SRB, NSF.

Manuscript review and revision: SRB, NSF, ODF, JFA, AGA, RGA, SKC, SC, RJD, MMD, WJPD, MGD, JCE, MDE, BDG, RJG, RH, ABH, JH, GWH, JKL, CAM, PRO, TDP, JP, PMS, BS, MS, HT, JT, AV, CJW, JHW, ABW, GLW, RGW.

Conflicts of interest

The following have declared that they have received grants, speakers fees, etc., from commercial bodies within the past 2 years. AGA Grant support from Pharmacosmos, Vifor Pharma, honoraria/travel support from Olympus, Vifor Pharma, Pharmacosmos. JCE Speaker fee from Shire. ODF Honoraria from Olympus, Takeda, Shire, Pfizer, UK. NSF speaker fees from Stratagen, Takeda. JKL Speaker fees from Abbvie, Jansenn, MSD, Takeda. Research support from ABBvie, Takeda MS Honoraria from IBD Congress news, Shire. Grant funding from Abbvie, Dansac. JT Speakers fees from Medtronic, consultancy fee from Alessi Surgical CJW Speakers fees from Gore. JHW speakers fees from Frankenmann, Integra, Ferring, Takeda, Jansenn. ABW Chair of Pelvic Floor Society which is supported by Cook Medical, Medtronic, BK Medical, Shire, THD. Consultancy fees from BK Medical.

References

- Oresland T, Bemelman WA, Sampietro GM *et al.* European evidence based consensus on surgery for ulcerative colitis. *J Crohns Colitis* 2015; **9**: 4–25.
- Gionchetti P, Dignass A, Danese S *et al.* 3rd European evidence-based consensus on the diagnosis and management of Crohn's Disease 2016: part 2: surgical management and special situations. *J Crohns Colitis* 2017; **11**: 135–49.
- Bemelman WA, Warusavitarne J, Sampietro GM *et al.* ECCO-ESCP consensus on surgery for Crohn's disease. *J Crohns Colitis* 2018; **12**: 1–16.
- ACPGBI. *Advice on the production of clinical guidelines and consensus statements*. 2016: <http://www.acpgbi.org>.

- uk/content/uploads/2016/06/ACPGBI-guideline-for-Consensus-Statements-for-web.pdf (accessed 15 March 2018)
- 5 Guyatt GH, Oxman AD, Vist GE *et al*. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. *BMJ* 2008; **336**: 924–6.
 - 6 Vind I, Riis L, Jess T *et al*. Increasing incidences of inflammatory bowel disease and decreasing surgery rates in Copenhagen City and County, 2003–2005: a population-based study from the Danish Crohn colitis database. *Am J Gastroenterol* 2006; **101**: 1274–82.
 - 7 Ng SC, Shi HY, Hamidi N *et al*. Worldwide incidence and prevalence of inflammatory bowel disease in the 21st century: a systematic review of population-based studies. *Lancet* 2017; **390**: 2769–78.
 - 8 M'Koma AE. Inflammatory bowel disease: an expanding global health problem. *Clin Med Insights Gastroenterol* 2013; **6**: 33–47.
 - 9 Molodecky NA, Soon IS, Rabi DM *et al*. Increasing incidence and prevalence of the inflammatory bowel diseases with time, based on systematic review. *Gastroenterology* 2012; **142**: 46–54.
 - 10 Morar P, Read J, Arora S *et al*. Defining the optimal design of the inflammatory bowel disease multidisciplinary team: results from a multicentre qualitative expert-based study. *Frontline Gastroenterol* 2015; **6**: 290–7.
 - 11 Morar PS, Sevdalis N, Warusavitarne J *et al*. Establishing the aims, format and function for multidisciplinary team-driven care within an inflammatory bowel disease service: a multicentre qualitative specialist-based consensus study. *Frontline Gastroenterol* 2018; **9**: 29–36.
 - 12 *Standards for the Healthcare of People who have Inflammatory Bowel Disease (IBD)* 2013 Update, in http://s3-eu-west-1.amazonaws.com/files.crohnsandcolitis.org.uk/Publications/PPR/ibd_standards_13.pdf. 2013. (accessed 15 March 2018)
 - 13 *NICE QS81 quality standard for inflammatory bowel disease*, 2015. <https://www.nice.org.uk/guidance/qs81/resources/inflammatory-bowel-disease-pdf-2098903535557>. (accessed 15 March 2018)
 - 14 Greveson K, Woodward S. Exploring the role of the inflammatory bowel disease nurse specialist. *Br J Nurs* 2013; **22**: 952–4, 956–958.
 - 15 Hernandez-Sampelayo P, Seoane M, Oltra L *et al*. Contribution of nurses to the quality of care in management of inflammatory bowel disease: a synthesis of the evidence. *J Crohns Colitis* 2010; **4**: 611–22.
 - 16 Devlen J, Beusterien K, Yen L, Ahmed A, Cheifetz AS, Moss AC. The burden of inflammatory bowel disease: a patient-reported qualitative analysis and development of a conceptual model. *Inflamm Bowel Dis* 2014; **20**: 545–52.
 - 17 Jackson CA, Clatworthy J, Robinson A, Horne R. Factors associated with non-adherence to oral medication for inflammatory bowel disease: a systematic review. *Am J Gastroenterol* 2010; **105**: 525–39.
 - 18 Marin-Jimenez I, Gobbo Montoya M, Panadero A *et al*. Management of the psychological impact of inflammatory bowel disease: perspective of doctors and patients-The ENMENTE Project. *Inflamm Bowel Dis* 2017; **23**: 1492–8.
 - 19 Czuber-Dochan W, Ream E, Norton C. Review article: description and management of fatigue in inflammatory bowel disease. *Aliment Pharmacol Ther* 2013; **37**: 505–16.
 - 20 Sweeney L, Moss-Morris R, Czuber-Dochan W, Meade L, Chumbley G, Norton C. Systematic review: psychosocial factors associated with pain in inflammatory bowel disease. *Aliment Pharmacol Ther* 2018; **47**: 715–29.
 - 21 Gisbert JP, Marin AC, Chaparro M. Systematic review: factors associated with relapse of inflammatory bowel disease after discontinuation of anti-TNF therapy. *Aliment Pharmacol Ther* 2015; **42**: 391–405.
 - 22 Mui M, An V, Lovell J, D'Souza B, Woods R. Patients' perspective on bowel resection for inflammatory bowel disease. *Int J Colorectal Dis* 2018; **33**: 219–22.
 - 23 Casellas F, Herrera-de Guise C, Robles V, Navarro E, Borruel N. Patient preferences for inflammatory bowel disease treatment objectives. *Dig Liver Dis* 2017; **49**: 152–6.
 - 24 Squires SI, Boal Allan J, Lamont S, Naismith GD. Implementing a self-management strategy in inflammatory bowel disease (IBD): patient perceptions, clinical outcomes and the impact on service. *Frontline Gastroenterol* 2017; **8**: 272–8.
 - 25 Zakeri N, Pollok RCG. Diagnostic imaging and radiation exposure in inflammatory bowel disease. *World J Gastroenterol* 2016; **22**: 2165–78.
 - 26 Israeli E, Ying S, Henderson B, Mottola J, Strome T, Bernstein CN. The impact of abdominal computed tomography in a tertiary referral centre emergency department on the management of patients with inflammatory bowel disease. *Aliment Pharmacol Ther* 2013; **38**: 513–21.
 - 27 Chatu S, Subramanian V, Pollok RC. Meta-analysis: diagnostic medical radiation exposure in inflammatory bowel disease. *Aliment Pharmacol Ther* 2012; **35**: 529–39.
 - 28 Park MJ, Lim JS. Computed tomography enterography for evaluation of inflammatory bowel disease. *Clin Endosc* 2013; **46**: 327–66.
 - 29 O'Connor A, Hamlin PJ, Taylor J, Selinger C, Scott N, Ford AC. Postoperative prophylaxis in Crohn's disease after intestinal resection: a retrospective analysis. *Frontline Gastroenterol* 2017; **8**: 203–9.
 - 30 Lee MJ, Heywood N, Sagar PM, Brown SR, Fearnhead NS. Surgical management of fistulating perianal Crohn's disease: a UK survey. *Colorectal Dis* 2017; **19**: 266–73.
 - 31 Brown C, Gibson PR, Hart A *et al*. Long-term outcomes of colectomy surgery among patients with ulcerative colitis. *Springerplus* 2015; **4**: 573.
 - 32 Nguyen GC, Steinhart AH. Nationwide patterns of hospitalizations to centers with high volume of admissions for inflammatory bowel disease and their impact on mortality. *Inflamm Bowel Dis* 2008; **14**: 1688–94.
 - 33 Kaplan GG, McCarthy EP, Ayanian JZ, Korzenik J, Hodin R, Sands BE. Impact of hospital volume on postoperative morbidity and mortality following a colectomy for ulcerative colitis. *Gastroenterology* 2008; **134**: 680–7.
 - 34 Nguyen GC, Steinhart AH. The impact of surgeon volume on postoperative outcomes after surgery for Crohn's disease. *Inflamm Bowel Dis* 2014; **20**: 301–6.

- 35 Tottrup A, Erichsen R, Sværke C, Laurberg S, Srensen HT. Thirty-day mortality after elective and emergency total colectomy in Danish patients with inflammatory bowel disease: a population-based nationwide cohort study. *BMJ Open* 2012; **2**: e000823.
- 36 Burns EM, Bottle A, Aylin P *et al.* Volume analysis of outcome following restorative proctocolectomy. *Br J Surg* 2011; **98**: 408–17.
- 37 Acheson AG, Brown SR, Faiz O, Fearnhead NS. SWORD: a sharp performance and activity tool for inflammatory bowel disease surgeons with a blunt message. *Colorectal Dis* 2017; **19**: 6–7.
- 38 Fearnhead NS, Lee MJ, Acheson AG, Worley G, Faiz OD, Brown SR. Variation in practice of pouch surgery in England – using SWORD data to cut to the chase and justify centralisation. *Colorectal Dis*, 2018; **20**: 597–605.
- 39 Weston-Petrides GK, Lovegrove RE, Tilney HS *et al.* Comparison of outcomes after restorative proctocolectomy with or without defunctioning ileostomy. *Arch Surg* 2008; **143**: 406–12.
- 40 Nordenvall C, Myrelid P, Ekblom A *et al.* Probability, rate and timing of reconstructive surgery following colectomy for inflammatory bowel disease in Sweden: a population-based cohort study. *Colorectal Dis* 2015; **17**: 882–90.
- 41 Perry C, Papachristou I, Ramsay AIG *et al.* Patient experience of centralized acute stroke care pathways. *Health Expect* 2018; **21**: 909–18.
- 42 Vallejo-Torres L, Melnychuk M, Vindrola-Padros C *et al.* Discrete-choice experiment to analyse preferences for centralizing specialist cancer surgery services. *Br J Surg* 2018; **105**: 587–96.
- 43 Faiz O. The volume-outcome relationship in colorectal surgery. *Tech Coloproctol* 2014; **18**: 961–2.
- 44 van der Ploeg VA, Maeda Y, Faiz OD, Hart AL, Clark SK. The prevalence of chronic peri-pouch sepsis in patients treated for antibiotic-dependent or refractory primary idiopathic pouchitis. *Colorectal Dis* 2017; **19**: 827–31.
- 45 Beddy D, Dozois EJ, Pemberton JH. Perioperative complications in inflammatory bowel disease. *Inflamm Bowel Dis* 2011; **17**: 1610–9.
- 46 van Rheenen PF, Aloï M, Biron IA *et al.* European Crohn's and colitis organisation topical review on transitional care in inflammatory bowel disease. *J Crohns Colitis*, 2017; **11**: 1032–8.
- 47 Remzi FH, Aytac E, Ashburn J *et al.* Transabdominal redo ileal pouch surgery for failed restorative proctocolectomy: lessons learned over 500 patients. *Ann Surg* 2015; **262**: 675–82.
- 48 Aytac E, Dietz DW, Ashburn J, Remzi FH. Long-term outcomes after continent ileostomy creation in patients with Crohn's disease. *Dis Colon Rectum* 2017; **60**: 508–13.
- 49 Lee MJ, Heywood N, Sagar PM, Brown SR, Fearnhead NS. Association of Coloproctology of Great Britain and Ireland consensus exercise on surgical management of fistulating perianal Crohn's disease. *Colorectal Dis* 2017; **19**: 418–29.
- 50 Frolkis AD, Dykeman J, Negrón ME *et al.* Risk of surgery for inflammatory bowel diseases has decreased over time: a systematic review and meta-analysis of population-based studies. *Gastroenterology* 2013; **145**: 996–1006.
- 51 Randall J, Singh B, Warren BF, Travis SPL, Mortensen NJ, George BD. Delayed surgery for acute severe colitis is associated with increased risk of postoperative complications. *Br J Surg* 2010; **97**: 404–9.
- 52 Telemi E, Trofyomenko O, Venkat R, Pandit V, Pandian TK, Nfonsam VN. Frailty predicts morbidity after colectomy for ulcerative colitis. *Am Surg* 2018; **84**: 225–9.
- 53 Butter M, Weiler S, Biedermann L *et al.* Clinical manifestations, pathophysiology, treatment and outcome of inflammatory bowel diseases in older people. *Maturitas* 2018; **110**: 71–8.
- 54 Zangenberg MS, Horesh N, Kopylov U, El-Hussuna A. Preoperative optimization of patients with inflammatory bowel disease undergoing gastrointestinal surgery: a systematic review. *Int J Colorectal Dis* 2017; **14**: 652–64.
- 55 Aguilera-Castro L, Ferre-Aracil C, Garcia-Garcia-de-Parades A, Rodriguez-de-Santiago E, Lopez-Sanroman A. Management of complex perianal Crohn's disease. *Ann Gastroenterol* 2017; **30**: 33–44.
- 56 Panes J, Rimola J. Perianal fistulizing Crohn's disease: pathogenesis, diagnosis and therapy. *Nat Rev Gastroenterol Hepatol* 2017; **14**: 652–64.
- 57 Lee MJ, Freer C, Adegbola S *et al.* Patients with perianal Crohn's fistulae experience delays in accessing anti-TNF therapy due to slow recognition, diagnosis and integration of specialist services: lessons learned from three referral centres. *Colorectal Dis* 2018; **20**: 797–803.
- 58 *The National Health Service Commissioning Board and Clinical Commissioning Groups (Responsibilities and Standing Rules) Regulations*, 2012. <http://www.legislation.gov.uk/uksi/2012/2996/contents/made>. (accessed 1 February 2018)
- 59 *House of Lords order paper for 6 September 2017* <http://lordsbusiness.parliament.uk/ItemOfBusiness?itemOfBusinessId=35936§ionId=38&businessPaperDate=2017-09-06>. (accessed 1 February 2018)
- 60 Buskens C, Bemelman W. Waiting time in IBD surgery. *Colorectal Dis* 2017; **19**: 961.
- 61 Grainge MJ, West J, Card TR. Venous thromboembolism during active disease and remission in inflammatory bowel disease: a cohort study. *Lancet* 2010; **375**: 657–63.
- 62 Nguyen GC, Bernstein CN, Bitton A *et al.* Consensus statements on the risk, prevention, and treatment of venous thromboembolism in inflammatory bowel disease: Canadian Association of Gastroenterology. *Gastroenterology* 2014; **146**: 835–48.
- 63 Nguyen GC, Sam J. Rising prevalence of venous thromboembolism and its impact on mortality among hospitalized inflammatory bowel disease patients. *Am J Gastroenterol* 2008; **103**: 2272–80.
- 64 Gross ME, Vogler SA, Mone MC, Sheng X, Sklow B. The importance of extended postoperative venous thromboembolism prophylaxis in IBD: a National Surgical Quality Improvement Program analysis. *Dis Colon Rectum* 2014; **57**: 482–9.

- 65 Brady MT, Patts GJ, Rosen A *et al.* Postoperative venous thromboembolism in patients undergoing abdominal surgery for IBD: a common but rarely addressed problem. *Dis Colon Rectum* 2017; **60**: 61–7.
- 66 Ali F, Al-Kindi SG, Blank JJ, Peterson CY, Ludwig KA, Ridolfi TJ. Elevated venous thromboembolism risk following colectomy for IBD is equal to those for colorectal cancer for ninety days after surgery. *Dis Colon Rectum* 2018; **61**: 375–81.
- 67 McKenna NP, Mathis KL, Khasawneh M *et al.* Thirty-day hospital readmission after restorative proctocolectomy and ileal pouch anal anastomosis for chronic ulcerative colitis at a high-volume center. *J Gastrointest Surg* 2017; **21**: 1859–64.
- 68 Wilson MZ, Connelly TM, Tinsley A, Hollenbeak CS, Koltun WA, Messaris E. Ulcerative colitis is associated with an increased risk of venous thromboembolism in the postoperative period: the results of a matched cohort analysis. *Ann Surg* 2015; **261**: 1160–6.
- 69 McKenna NP, Behm KT, Ubl DS *et al.* Analysis of postoperative venous thromboembolism in patients with chronic ulcerative colitis: is it the disease or the operation? *Dis Colon Rectum* 2017; **60**: 714–22.
- 70 Worley GHT, Fearnhead NS, Brown SR, Acheson AG, Lee MJ, Faiz OD. Review of current practice and outcomes following ileoanal pouch surgery: lessons learned from the Ileoanal Pouch Registry and the 2017 Ileoanal Pouch Report. *Colorectal Dis*, 2018; **20**: 913–22.
- 71 Ponsioen CY, de Groof EJ, Eshuis EJ *et al.* Laparoscopic ileocaecal resection versus infliximab for terminal ileitis in Crohn's disease: a randomised controlled, open-label, multicentre trial. *Lancet Gastroenterol Hepatol* 2017; **2**: 785–92.
- 72 Baker DM, Marshall JH, Lee MJ, Jones GL, Brown SR, Lobo AJ. A systematic review of internet decision-making resources for patients considering surgery for ulcerative colitis. *Inflamm Bowel Dis* 2017; **23**: 1293–300.
- 73 Bardhan KD, Simmonds N, Royston C, Dhar A, Edwards CM. A United Kingdom inflammatory bowel disease database: making the effort worthwhile. *J Crohns Colitis* 2010; **4**: 405–12.
- 74 2015 European Society of Coloproctology Collaborating Group. Risk factors for unfavourable postoperative outcome in patients with Crohn's disease undergoing right hemicolectomy or ileocaecal resection an international audit by ESCP and S-ECCO. *Colorectal Dis*, 2017; epub ahead of print.
- 75 Morar PS, Hollingshead J, Bemelman W *et al.* Establishing key performance indicators [KPIs] and their importance for the surgical management of inflammatory bowel disease—results from a Pan-European, Delphi Consensus Study. *J Crohns Colitis* 2017; **11**: 1362–8.
- 76 Shah R, Hou JK. Approaches to improve quality of care in inflammatory bowel diseases. *World J Gastroenterol* 2014; **20**: 9281–5.
- 77 de Jong MJ, Huijbregtse R, Masclee AAM, Jonkers DMAE, Pierik MJ. Patient-reported outcome measures for use in clinical trials and clinical practice in inflammatory bowel diseases – A systematic review. *Clin Gastroenterol Hepatol* 2018; **16**: 648–63.
- 78 Chung AE, Sandler RS, Long MD *et al.* Harnessing person-generated health data to accelerate patient-centered outcomes research: the Crohn's and Colitis Foundation of America PCORnet Patient Powered Research Network (CCFA Partners). *J Am Med Inform Assoc* 2016; **23**: 485–90.
- 79 Hart AL, Lomer M, Verjee A *et al.* What are the top 10 research questions in the treatment of inflammatory bowel disease? A priority setting partnership with the James Lind alliance. *J Crohns Colitis* 2017; **11**: 204–11.
- 80 Tiernan J, Cook A, Geh I *et al.* Use of a modified Delphi approach to develop research priorities for the association of coloproctology of Great Britain and Ireland. *Colorectal Dis* 2014; **16**: 965–70.
- 81 Gecse KB, Sebastian S, Hertogh G *et al.* Results of the Fifth Scientific Workshop of the ECCO [II]: clinical aspects of perianal fistulising crohn's disease—the unmet needs. *J Crohns Colitis* 2016; **10**: 758–65.
- 82 de Groof EJ, Buskens CJ, Ponsioen CY *et al.* Multimodal treatment of perianal fistulas in Crohn's disease: seton versus anti-TNF versus advancement plasty (PISA): study protocol for a randomized controlled trial. *Trials* 2015; **16**: 366.
- 83 Panes J, García-Olmo D, Van Assche G *et al.* Expanded allogeneic adipose-derived mesenchymal stem cells (Cx601) for complex perianal fistulas in Crohn's disease: a phase 3 randomised, double-blind controlled trial. *Lancet* 2016; **388**: 1281–90.
- 84 Gardenbroek TJ, Eshuis EJ, Ponsioen CIJ, Ubbink DT, D'Haens GR, Bemelman WA. The effect of appendectomy on the course of ulcerative colitis: a systematic review. *Colorectal Dis* 2012; **14**: 545–53.
- 85 Gardenbroek TJ, Pinkney TD, Sahami S *et al.* The ACCURE-trial: the effect of appendectomy on the clinical course of ulcerative colitis, a randomised international multicenter trial (NTR2883) and the ACCURE-UK trial: a randomised external pilot trial (ISRCTN56523019). *BMC Surg* 2015; **15**: 30.
- 86 Worley G, Nordenvall C, Askari A *et al.* Restorative surgery after colectomy for ulcerative colitis in England and Sweden: observations from a comparison of nationwide cohorts. *Colorectal Dis*, 2018; **20**: 804–12.
- 87 Leo CA, Samaranyake S, Perry-Woodford ZI *et al.* Initial experience of restorative proctocolectomy for ulcerative colitis by transanal total mesorectal excision and single-incision abdominal laparoscopic surgery. *Colorectal Dis*, 2016; **18**: 1162–6.
- 88 Hirst NA, Tiernan JP, Millner PA, Jayne DG. Systematic review of methods to predict and detect anastomotic leakage in colorectal surgery. *Colorectal Dis* 2014; **16**: 95–109.
- 89 Kono T, Fichera A, Maeda K *et al.* Kono-S anastomosis for surgical prophylaxis of anastomotic recurrence in Crohn's disease: an international multicenter study. *J Gastrointest Surg* 2016; **20**: 783–90.

- 90 Chapman SJ, Wood B, Drake TM, Young N, Jayne DG. Systematic review and meta-analysis of prophylactic mesh during primary stoma formation to prevent parastomal hernia. *Dis Colon Rectum* 2017; **60**: 107–15.
- 91 Landy J, Walker AW, Li JV *et al.* Variable alterations of the microbiota, without metabolic or immunological change, following faecal microbiota transplantation in patients with chronic pouchitis. *Sci Rep*, 2015; **5**: 12955.
- 92 Kim AH, Roberts C, Feagan BG *et al.* Developing a standard set of patient-centred outcomes for inflammatory bowel disease – an International, Cross-disciplinary Consensus. *J Crohns Colitis*, 2018; **12**: 408–18.
- 93 Sahnun K, Tozer PJ, Adegbola SO *et al.* Developing a core outcome set for fistulising perianal Crohn's disease. *Gut* 2018; epub ahead of print.
- 94 McNair AG, Heywood N, Tiernan J, Verjee A, Bach SP, Fearnhead NS. A national patient and public colorectal research agenda: integration of consumer perspectives in bowel disease through early consultation. *Colorectal Dis* 2017; **19**: O75–85.
- 95 Munkholm P, Langholz E, Davidsen M, Binder V. Intestinal cancer risk and mortality in patients with Crohn's disease. *Gastroenterology* 1993; **105**: 1716–23.
- 96 Seifarth C, Kreis ME, Grone J. Indications and specific surgical techniques in crohn's disease. *Viszeralmedizin* 2015; **31**: 273–9.
- 97 Schluskel AT, Steele SR, Alavi K. Current challenges in the surgical management of Crohn's disease: a systematic review. *Am J Surg* 2016; **212**: 345–51.
- 98 Ford AC, Sandborn WJ, Khan KJ, Hanauer SB, Talley NJ, Moayyedi P. Efficacy of biological therapies in inflammatory bowel disease: systematic review and meta-analysis. *Am J Gastroenterol*, 2011; **106**: 644–59.
- 99 Yamamoto T, Watanabe T. Surgery for luminal Crohn's disease. *World J Gastroenterol* 2014; **20**: 78–90.
- 100 Azzopardi N, Ellul P. Risk factors for osteoporosis in Crohn's disease: infliximab, corticosteroids, body mass index, and age of onset. *Inflamm Bowel Dis* 2013; **19**: 1173–8.
- 101 Strong S, Steele SR, Boutrous M *et al.* Clinical practice guideline for the surgical management of Crohn's disease. *Dis Colon Rectum* 2015; **58**: 1021–36.
- 102 Teitelbaum J. *Growth failure and poor weight gain in children with inflammatory bowel disease*. UpToDate, 2017.
- 103 Heuschkel R, Salvestrini C, Beattie MR, Hildebrand H, Walters T, Griffiths A. Guidelines for the management of growth failure in childhood inflammatory bowel disease. *Inflamm Bowel Dis* 2008; **14**: 839–49.
- 104 Lourenco R, Azevedo S, Lopes AI. Surgery in pediatric crohn disease: case series from a single tertiary referral center. *GE Port J Gastroenterol* 2016; **23**: 191–6.
- 105 Vermeire S, Van Assche G, Rutgeerts P. Classification of inflammatory bowel disease: the old and the new. *Curr Opin Gastroenterol* 2012; **28**: 321–6.
- 106 Bettenworth D, Nowacki TM, Cordes F, Buerke B, Lenze F. Assessment of stricturing Crohn's disease: current clinical practice and future avenues. *World J Gastroenterol* 2016; **22**: 1008–16.
- 107 Kilcoyne A, Kaplan JL, Gee MS. Inflammatory bowel disease imaging: current practice and future directions. *World J Gastroenterol* 2016; **22**: 917–32.
- 108 Rieder F, Latella G, Magro F *et al.* European Crohn's and colitis organisation topical review on prediction, diagnosis and management of fibrostenosing crohn's disease. *J Crohns Colitis* 2016; **10**: 873–85.
- 109 Thienpont C, D'Hoore A, Vermeire S *et al.* Long-term outcome of endoscopic dilatation in patients with Crohn's disease is not affected by disease activity or medical therapy. *Gut* 2010; **59**: 320–4.
- 110 Hassan C, Zullo A, De Francesco V *et al.* Systematic review: endoscopic dilatation in Crohn's disease. *Aliment Pharmacol Ther*, 2007; **26**: 1457–64.
- 111 Malgras B, Pautrat K, Dray X *et al.* Multidisciplinary management of gastrointestinal fibrotic stenosis in Crohn's disease. *Dig Dis Sci* 2015; **60**: 1152–68.
- 112 Bettenworth D, Lopez R, Hindryckx P, Levesque BG, Rieder F. Heterogeneity in endoscopic treatment of Crohn's disease-associated strictures: an international inflammatory bowel disease specialist survey. *J Gastroenterol* 2016; **51**: 939–48.
- 113 Reese GE, Purkayastha S, Tilney HS, von Roon A, Yamamoto T, Tekkis PP. Strictureplasty vs resection in small bowel Crohn's disease: an evaluation of short-term outcomes and recurrence. *Colorectal Dis*, 2007; **9**: 686–94.
- 114 Yamamoto T, Fazio VW, Tekkis PP. Safety and efficacy of strictureplasty for Crohn's disease: a systematic review and meta-analysis. *Dis Colon Rectum* 2007; **50**: 1968–86.
- 115 Excellence, N.I.o.C. *Clinical guideline CG152: Crohn's disease: management*. 2012 (revised 2016). 2017.
- 116 Lee H, Kim Y-H, Kim JH *et al.* Nonsurgical treatment of abdominal or pelvic abscess in consecutive patients with Crohn's disease. *Dig Liver Dis* 2006; **38**: 659–64.
- 117 Lorenz JM, Funaki BS, Ray CE *et al.* ACR appropriateness criteria on percutaneous catheter drainage of infected fluid collections. *J Am Coll Radiol* 2009; **6**: 837–43.
- 118 Ananthakrishnan AN, McGinley EL. Treatment of intra-abdominal abscesses in Crohn's disease: a nationwide analysis of patterns and outcomes of care. *Dig Dis Sci* 2013; **58**: 2013–8.
- 119 da Luz Moreira A, Stocchi L, Tan E, Tekkis PP, Fazio VW. Outcomes of Crohn's disease presenting with abdominopelvic abscess. *Dis Colon Rectum* 2009; **52**: 906–12.
- 120 He X, Lin X, Lian L *et al.* Preoperative percutaneous drainage of spontaneous intra-abdominal abscess in patients with Crohn's disease: a meta-analysis. *J Clin Gastroenterol* 2015; **49**: e82–90.
- 121 Clancy C, Boland T, Deasy J, McNamara D, Burke JP. A meta-analysis of percutaneous drainage versus surgery as the initial treatment of Crohn's disease-related intra-abdominal abscess. *J Crohns Colitis* 2016; **10**: 202–8.
- 122 Freeman HJ. Spontaneous free perforation of the small intestine in Crohn's disease. *Can J Gastroenterol* 2002; **16**: 23–7.
- 123 Ikeuchi H, Yamamura T. Free perforation in Crohn's disease: review of the Japanese literature. *J Gastroenterol* 2002; **37**: 1020–7.

- 124 Doh YS, Kim YS, Bae SI *et al.* The clinical characteristics of patients with free perforation in Korean Crohn's disease: results from the CONNECT study. *BMC Gastroenterol* 2015; **15**: 31.
- 125 Amiot A, Setakhr V, Seksik P *et al.* Long-term outcome of enterocutaneous fistula in patients with Crohn's disease treated with anti-TNF therapy: a cohort study from the GETAID. *Am J Gastroenterol* 2014; **109**: 1443–9.
- 126 Taxonera C, Barreiro-de-Acosta M, Bastida G *et al.* Outcomes of medical and surgical therapy for entero-urinary fistulas in Crohn's disease. *J Crohns Colitis* 2016; **10**: 657–62.
- 127 de laPozaG, López-Sanroman A, Taxonera C *et al.* Genital fistulas in female Crohn's disease patients: clinical characteristics and response to therapy. *J Crohns Colitis* 2012; **6**: 276–80.
- 128 Hastings JW, Garg M, Lynn ET, Divino CM. Surgical repair of ileovesical fistulas: long-term complications, quality of life, and patient satisfaction. *Am Surg* 2014; **80**: 1207–11.
- 129 Friedman S. Cancer in Crohn's disease. *Gastroenterol Clin North Am* 2006; **35**: 621–39.
- 130 Cahill C, Gordon PH, Petrucci A, Boutros M. Small bowel adenocarcinoma and Crohn's disease: any further ahead than 50 years ago? *World J Gastroenterol* 2014; **20**: 11486–95.
- 131 Stocchi L, Milsom JW, Fazio VW. Long-term outcomes of laparoscopic versus open ileocolic resection for Crohn's disease: follow-up of a prospective randomized trial. *Surgery*, 2008; **144**: 622–7.
- 132 Eshuis EJ, Slors JF, Stokkers PC. Long-term outcomes following laparoscopically assisted versus open ileocolic resection for Crohn's disease. *Br J Surg* 2010; **97**: 563–8.
- 133 Dasari BV, McKay D, Gardiner K. Laparoscopic versus Open surgery for small bowel Crohn's disease. *Cochrane Database Syst Rev*, 2011: CD006956.
- 134 Huang R, Valerian BT, Lee EC. Laparoscopic approach in patients with recurrent Crohn's disease. *Am Surg* 2012; **78**: 595–9.
- 135 Tavernier M, Lebreton G, Alves A. Laparoscopic surgery for complex Crohn's disease. *J Visc Surg* 2013; **150**: 389–93.
- 136 Moftah M, Nazour F, Cunningham M, Cahill RA. Single port laparoscopic surgery for patients with complex and recurrent Crohn's disease. *J Crohns Colitis* 2014; **8**: 1055–61.
- 137 Wolff BG, Beart RW Jr, Frydenberg HB, Weiland LH, Agrez MV, Ilstrup DM. The importance of disease-free margins in resections for Crohn's disease. *Dis Colon Rectum* 1983; **26**: 239–43.
- 138 Krause U, Ejerblad S, Bergman L. Crohn's disease. A long-term study of the clinical course in 186 patients. *Scand J Gastroenterol*, 1985; **20**: 516–24.
- 139 Fazio VW, Marchetti F, Church JM *et al.* Effect of resection margins on the recurrence of Crohn's disease in the small bowel. A randomized controlled trial. *Ann Surg*, 1996; **224**: 563–71.
- 140 Coffey JC, Kiernan MG, Sahebally SM *et al.* Inclusion of the mesentery in ileocolic resection for Crohn's disease is associated with reduced surgical recurrence. *J Crohns Colitis* 2018; **12**: 1139–50.
- 141 Choy PY, Bissett IP, Docherty JG, Parry BR, Merrie AE. Stapled versus handsewn methods for ileocolic anastomoses. *Cochrane Database Syst Rev*, 2007: CD004320.
- 142 Simillis C, Purkayastha S, Yamamoto T, Strong SA, Darzi AW, Tekkis PP. A meta-analysis comparing conventional end-to-end anastomosis vs. other anastomotic configurations after resection in Crohn's disease. *Dis Colon Rectum* 2007; **50**: 1674–87.
- 143 McLeod RS, Wolff BG, Ross S, Parkes R, McKenzie M, Investigators of the CAST Trial. Recurrence of Crohn's disease after ileocolic resection is not affected by anastomotic type: results of a multicenter, randomized, controlled trial. *Dis Colon Rectum* 2009; **52**: 919–27.
- 144 Guo Z, Li Y, Zhu W, Gong J, Li N, Li J. Comparing outcomes between side-to-side anastomosis and other anastomotic configurations after intestinal resection for patients with Crohn's disease: a meta-analysis. *World J Surg* 2013; **37**: 893–901.
- 145 Zurbuchen U, Kroesen AJ, Knebel P. Complications after end-to-end vs. side-to-side anastomosis in ileocecal Crohn's disease—early postoperative results from a randomized controlled multi-center trial (ISRCTN-45665492). *Langenbecks Arch Surg* 2013; **398**: 467–74.
- 146 Hesham W, Kann BR. Strictureplasty. *Clin Colon Rectal Surg* 2013; **26**: 80–3.
- 147 Michelassi F, Hurst RD, Melis M *et al.* Side-to-side isoperistaltic strictureplasty in extensive Crohn's disease: a prospective longitudinal study. *Ann Surg* 2000; **232**: 401–8.
- 148 Poggioli G, Laureti S, Pierangeli F, Ugolini F. A new model of strictureplasty for multiple and long stenoses in Crohn's ileitis: side-to-side diseased to disease-free anastomosis. *Dis Colon Rectum* 2003; **46**: 127–30.
- 149 Sasaki I, Shibata C, Funayama Y *et al.* New reconstructive procedure after intestinal resection for Crohn's disease: modified side-to-side isoperistaltic anastomosis with double Heineke-Mikulicz procedure. *Dis Colon Rectum* 2004; **47**: 940–3.
- 150 Sampietro GM, Casiraghi S, Foschi D. Perforating Crohn's disease: conservative and surgical treatment. *Dig Dis* 2013; **31**: 218–21.
- 151 Campbell L, Ambe R, Weaver J, Marcus SM, Cagir B. Comparison of conventional and nonconventional strictureplasties in Crohn's disease: a systematic review and meta-analysis. *Dis Colon Rectum* 2012; **55**: 714–26.
- 152 Michelassi F, Taschieri A, Tonelli F *et al.* An international, multicenter, prospective, observational study of the side-to-side isoperistaltic strictureplasty in Crohn's disease. *Dis Colon Rectum* 2007; **50**: 277–84.
- 153 Gomollon F, Dignass A, Annese V *et al.* 3rd European evidence-based consensus on the diagnosis and management of Crohn's Disease 2016: Part 1: diagnosis and medical management. *J Crohns Colitis* 2017; **11**: 3–25.
- 154 Bernell O, Lapidus A, Hellers G. Risk factors for surgery and recurrence in 907 patients with primary ileocaecal Crohn's disease. *Br J Surg* 2000; **87**: 1697–701.

- 155 Thia KT, Sandborn WJ, Harmsen WS, Zinsmeister AR, Loftus EV Jr. Risk factors associated with progression to intestinal complications of Crohn's disease in a population-based cohort. *Gastroenterology* 2010; **139**: 1147–55.
- 156 Nordgren SR, Fasth SB, Öresland TO, Hultén LA. Long-term follow-up in Crohn's disease. Mortality, morbidity, and functional status. *Scand J Gastroenterol* 1994; **29**: 1122–8.
- 157 Weston LA, Roberts PL, Schoetz DJ Jr, Collier JA, Murray JJ, Rusin LC. Ileocolic resection for acute presentation of Crohn's disease of the ileum. *Dis Colon Rectum* 1996; **39**: 841–6.
- 158 Kim NK, Senagore AJ, Luchtefeld MA *et al.* Long-term outcome after ileocecal resection for Crohn's disease. *Am Surg* 1997; **63**: 627–33.
- 159 Scott NA, Hughes LE. Timing of ileocolonic resection for symptomatic Crohn's disease—the patient's view. *Gut* 1994; **35**: 656–7.
- 160 Tromm A, Tromm CD, Hüppe D, Schwegler U, Krieg M, May B. Evaluation of different laboratory tests and activity indices reflecting the inflammatory activity of Crohn's disease. *Scand J Gastroenterol* 1992; **27**: 774–8.
- 161 Vermeire S, Van Assche G, Rutgeerts P. The role of C-reactive protein as an inflammatory marker in gastrointestinal diseases. *Nat Clin Pract Gastroenterol Hepatol* 2005; **2**: 580–6.
- 162 Solem CA, Loftus EV, Tremaine WJ, Harmsen WS, Zinsmeister AR, Sandborn WJ. Correlation of C-reactive protein with clinical, endoscopic, histologic, and radiographic activity in inflammatory bowel disease. *Inflamm Bowel Dis* 2005; **11**: 707–12.
- 163 Saeed M, Hullur H, Salem A, Ali A, Sahib Y, Ashfaq M. Improved biochemical parameters in patients who undergo early resection in isolated ileocaecal Crohn's disease. *Surg Res Pract* 2017; **2017**: 4396573.
- 164 Shariff U, Narula H, Speake W, Brown S. Terminal ileal Crohn's disease: conservative surgeon and aggressive physician? *Colorectal Dis* 2009; **11**: 522–3.
- 165 Tilney HS, Constantinides VA, Heriot AG *et al.* Comparison of laparoscopic and open ileocecal resection for Crohn's disease: a metaanalysis. *Surg Endosc* 2006; **20**: 1036–44.
- 166 Lesperance K, Martin MJ, Lehmann R, Brounts L, Steele SR. National trends and outcomes for the surgical therapy of ileocolonic Crohn's disease: a population-based analysis of laparoscopic vs. open approaches. *J Gastrointest Surg* 2009; **13**: 1251–9.
- 167 <http://content.digital.nhs.uk/hes> (accessed 28th August 2017).
- 168 Goyer P, Alves A, Bretagnol F, Bouhnik Y, Valleur P, Panis Y. Impact of complex Crohn's disease on the outcome of laparoscopic ileocecal resection: a comparative clinical study in 124 patients. *Dis Colon Rectum* 2009; **52**: 205–10.
- 169 Rijcken E, Mennigen R, Argyris I, Senninger N, Bruewer M. Single-incision laparoscopic surgery for ileocolic resection in Crohn's disease. *Dis Colon Rectum* 2012; **55**: 140–6.
- 170 Gardenbroek TJ, Verlaan T, Tanis PJ *et al.* Single-port versus multiport laparoscopic ileocecal resection for Crohn's disease. *J Crohns Colitis* 2013; **7**: e443–8.
- 171 Carvello M, de Groof EJ, de Buck van Overstraeten A *et al.* Single port laparoscopic ileocaecal resection for Crohn's disease: a multicentre comparison with multi-port laparoscopy. *Colorectal Dis* 2017; **20**: 53–8.
- 172 Borley NR, Mortensen NJ, Jewell DP, Warren BF. The relationship between inflammatory and serosal connective tissue changes in ileal Crohn's disease: evidence for a possible causative link. *J Pathol* 2000; **190**: 196–202.
- 173 Behr MA. The path to Crohn's disease: is mucosal pathology a secondary event? *Inflamm Bowel Dis* 2010; **16**: 896–902.
- 174 Shelley-Fraser G, Borley NR, Warren BF, Shepherd NA. The connective tissue changes of Crohn's disease. *Histopathology* 2012; **60**: 1034–44.
- 175 Coffey JC, O'Leary DP, Kiernan MG, Faul P. The mesentery in Crohn's disease: friend or foe? *Curr Opin Gastroenterol* 2016; **32**: 267–73.
- 176 Li Y, Zhu W, Gong J *et al.* Visceral fat area is associated with a high risk for early postoperative recurrence in Crohn's disease. *Colorectal Dis* 2015; **17**: 225–34.
- 177 Michelassi F, Balestracci T, Chappell R, Block GE. Primary and recurrent Crohn's disease. Experience with 1379 patients. *Ann Surg*, 1991; **214**: 230–8.
- 178 He X, Chen Z, Huang J *et al.* Stapled side-to-side anastomosis might be better than handsewn end-to-end anastomosis in ileocolic resection for Crohn's disease: a meta-analysis. *Dig Dis Sci* 2014; **59**: 1544–51.
- 179 Watanabe T, Sasaki I, Sugita A *et al.* Time trend and risk factors for reoperation in Crohn's disease in Japan. *Hepatogastroenterology* 2012; **59**: 1081–6.
- 180 Watanabe K, Sasaki I, Fukushima K *et al.* Long-term incidence and characteristics of intestinal failure in Crohn's disease: a multicenter study. *J Gastroenterol* 2014; **49**: 231–8.
- 181 Michelassi F. Side-to-side isoperistaltic strictureplasty for multiple Crohn's strictures. *Dis Colon Rectum* 1996; **39**: 345–9.
- 182 de Buck van Overstraeten A, Vermeire S, Vanbeckvoort D *et al.* Modified side-to-side isoperistaltic strictureplasty over the ileocaecal valve: an alternative to ileocaecal resection in extensive terminal ileal Crohn's disease. *J Crohns Colitis* 2016; **10**: 437–42.
- 183 Poggioli G, Stocchi L, Laureti S *et al.* Conservative surgical management of terminal ileitis: side-to-side enterocolic anastomosis. *Dis Colon Rectum* 1997; **40**: 234–7.
- 184 de Buck van Overstraeten A, Wolthuis AM, D'Hoore A. Modified side-to-side isoperistaltic strictureplasty over the ileocaecal valve for the surgical treatment of terminal ileal Crohn's disease: the ultimate bowel sparing technique? *Colorectal Dis* 2016; **18**: O311–3.
- 185 Morar PS, Faiz O, Warusavitarne J *et al.* Systematic review with meta-analysis: endoscopic balloon dilatation for Crohn's disease strictures. *Aliment Pharmacol Ther* 2015; **42**: 1137–48.

- 186 Patel KV, Darakhshan AA, Griffin N, Williams AB, Sanderson JD, Irving PM. Patient optimization for surgery relating to Crohn's disease. *Nat Rev Gastroenterol Hepatol* 2016; **13**: 707–19.
- 187 Cullen G, Vaughn B, Ahmed A *et al.* Abdominal phlegmons in Crohn's disease: outcomes following antitumor necrosis factor therapy. *Inflamm Bowel Dis* 2012; **18**: 691–6.
- 188 Nielsen OH, Rogler G, Hahnloser D, Thomsen OØ. Diagnosis and management of fistulizing Crohn's disease. *Nat Clin Pract Gastroenterol Hepatol* 2009; **6**: 92–106.
- 189 Poritz LS, Gagliano G, McLeod RS, MacRae H, Cohen Z. Surgical management of entero and colcutaneous fistulae in Crohn's disease: 17 year's experience. *Int J Colorectal Dis* 2004; **19**: 481–5.
- 190 Gecse K, Khanna R, Stoker J *et al.* Fistulizing Crohn's disease: diagnosis and management. *United European Gastroenterol J* 2013; **1**: 206–13.
- 191 Misteli H, Koh CE, Wang LM, Mortensen NJ, George B, Guy R. Myenteric plexitis at the proximal resection margin is a predictive marker for surgical recurrence of ileocaecal Crohn's disease. *Colorectal Dis* 2015; **17**: 304–10.
- 192 Decousus S, Boucher A-L, Joubert J *et al.* Myenteric plexitis is a risk factor for endoscopic and clinical postoperative recurrence after ileocolonic resection in Crohn's disease. *Dig Liver Dis* 2016; **48**: 753–8.
- 193 Rutgeerts P, Geboes K, Vantrappen G, Beyls J, Kerremans R, Hiele M. Predictability of the postoperative course of Crohn's disease. *Gastroenterology* 1990; **99**: 956–63.
- 194 Olaison G, Smedh K, Sjodahl R. Natural course of Crohn's disease after ileocolic resection: endoscopically visualised ileal ulcers preceding symptoms. *Gut* 1992; **33**: 331–5.
- 195 Kaplan GG, Seow CH, Ghosh S *et al.* Decreasing colectomy rates for ulcerative colitis: a population-based time trend study. *Am J Gastroenterol* 2012; **107**: 1879–87.
- 196 Ronnblom A, Holmström T, Tanghøj H, Karlsson U, Thörn M, Sjöberg D. Low colectomy rate five years after diagnosis of ulcerative colitis. Results from a prospective population-based cohort in Sweden (ICURE) diagnosed during 2005–2009. *Scand J Gastroenterol* 2016; **51**: 1339–44.
- 197 Laharie D, Bourreille A, Branche J *et al.* Cyclosporin versus infliximab in patients with severe ulcerative colitis refractory to intravenous steroids: a parallel, open-label randomised controlled trial. *Lancet* 2012; **380**: 1909–15.
- 198 Williams JG, Alam MF, Alrubaiy L *et al.* Infliximab versus cyclosporin for steroid-resistant acute severe ulcerative colitis (CONSTRUCT): a mixed methods, open-label, pragmatic randomised trial. *Lancet Gastroenterol Hepatol* 2016; **1**: 15–24.
- 199 Narula N, Marshall JK, Colombel JF *et al.* Systematic review and meta-analysis: infliximab or cyclosporine as rescue therapy in patients with severe ulcerative colitis refractory to steroids. *Am J Gastroenterol* 2016; **111**: 477–91.
- 200 National Clinical Audit of Inpatient Care for Adults with Ulcerative Colitis - UK Inflammatory Bowel Disease (IBD) Audit. 2014; <https://data.gov.uk/dataset/uk-inflammatory-bowel-disease-ibd-audit-round-4-2012-2014>. (accessed 1 February 2018)
- 201 Dinesen LC, Walsh AJ, Protic MN *et al.* The pattern and outcome of acute severe colitis. *J Crohns Colitis* 2010; **4**: 431–7.
- 202 Strong SA. Management of acute colitis and toxic megacolon. *Clin Colon Rectal Surg* 2010; **23**: 274–84.
- 203 Bennis M, Turet E. Surgical management of ulcerative colitis. *Langenbecks Arch Surg* 2012; **397**: 11–7.
- 204 Edwards FC, Truelove SC. The course and prognosis of ulcerative colitis. *Gut* 1963; **4**: 299–315.
- 205 Brown SR, Haboubi N, Hampton J, George B, Travis SPL. The management of acute severe colitis: ACPGBI position statement. *Colorectal Dis* 2008; **10**(Suppl. 3): 8–29.
- 206 Rosenberg W, Ireland A, Jewell DP. High-dose methylprednisolone in the treatment of active ulcerative colitis. *J Clin Gastroenterol* 1990; **12**: 40–1.
- 207 Turner D, Walsh CM, Steinhart AH, Griffiths AM. Response to corticosteroids in severe ulcerative colitis: a systematic review of the literature and a meta-regression. *Clin Gastroenterol Hepatol* 2007; **5**: 103–10.
- 208 Issa M, Vijayapal A, Graham MB *et al.* Impact of *Clostridium difficile* on inflammatory bowel disease. *Clin Gastroenterol Hepatol* 2007; **5**: 345–51.
- 209 Travis SP, Schnell D, Krzeski P *et al.* Developing an instrument to assess the endoscopic severity of ulcerative colitis: the Ulcerative Colitis Endoscopic Index of Severity (UCEIS). *Gut* 2012; **61**: 535–42.
- 210 Corte C, Fernandopulle N, Catuneanu AM *et al.* Association between the ulcerative colitis endoscopic index of severity (UCEIS) and outcomes in acute severe ulcerative colitis. *J Crohns Colitis* 2015; **9**: 376–81.
- 211 Surawicz CM, Haggitt RC, Husseman M, McFarland LV. Mucosal biopsy diagnosis of colitis: acute self-limited colitis and idiopathic inflammatory bowel disease. *Gastroenterology* 1994; **107**: 755–63.
- 212 Criscuoli V, Casà A, Orlando A *et al.* Severe acute colitis associated with CMV: a prevalence study. *Dig Liver Dis* 2004; **36**: 818–20.
- 213 Criscuoli V, Rizzuto MR, Gallo E, Orlando A, Cottone M. Toxic megacolon and human Cytomegalovirus in a series of severe ulcerative colitis patients. *J Clin Virol* 2015; **66**: 103–6.
- 214 Magro F, Gionchetti P, Eliakim R *et al.* Third European evidence-based consensus on diagnosis and management of ulcerative colitis. Part 1: definitions, diagnosis, extra-intestinal manifestations, pregnancy, cancer surveillance, surgery, and ileo-anal pouch disorders. *J Crohns Colitis* 2017; **11**: 649–70.
- 215 Chew CN, Nolan DJ, Jewell DP. Small bowel gas in severe ulcerative colitis. *Gut* 1991; **32**: 1535–7.
- 216 Mege D, Monsinjon M, Zappa M *et al.* Is abdominal CT useful for the management of patients with severe acute colitis complicating inflammatory bowel disease? A study in 54 consecutive patients. *Colorectal Dis* 2017; **19**: O97–102.

- 217 Travis SP, Farrant JM, Ricketts C *et al.* Predicting outcome in severe ulcerative colitis. *Gut* 1996; **38**: 905–10.
- 218 Ho GT, Lee HM, Brydon G *et al.* Fecal calprotectin predicts the clinical course of acute severe ulcerative colitis. *Am J Gastroenterol* 2009; **104**: 673–8.
- 219 Lindgren SC, Flood LM, Kilander AF, Löfberg R, Persson TB, Sjö Dahl RI. Early predictors of glucocorticosteroid treatment failure in severe and moderately severe attacks of ulcerative colitis. *Eur J Gastroenterol Hepatol* 1998; **10**: 831–5.
- 220 Ho GT, Mowat C, Goddard CJR *et al.* Predicting the outcome of severe ulcerative colitis: development of a novel risk score to aid early selection of patients for second-line medical therapy or surgery. *Aliment Pharmacol Ther* 2004; **19**: 1079–87.
- 221 Lynch RW, Churchhouse AM, Protheroe A, Arnott ID, UK IBD Audit Steering Group. Predicting outcome in acute severe ulcerative colitis: comparison of the Travis and Ho scores using UK IBD audit data. *Aliment Pharmacol Ther* 2016; **43**: 1132–41.
- 222 Jain S, Kedia S, Bopanna S *et al.* Faecal calprotectin and UCEIS predict short-term outcomes in acute severe colitis: prospective cohort study. *J Crohns Colitis* 2017; **11**: 1309–16.
- 223 Clemente V, Aratari A, Papi C, Vernia P. Short term colectomy rate and mortality for severe ulcerative colitis in the last 40 years. Has something changed?. *Dig Liver Dis* 2016; **48**: 371–5.
- 224 Autenrieth DM, Baumgart DC. Toxic megacolon. *Inflamm Bowel Dis* 2012; **18**: 584–91.
- 225 Tapani MJ, Olavi KH. Surgical management of toxic megacolon. *Hepatogastroenterology* 2014; **61**: 638–41.
- 226 Gan SI, Beck PL. A new look at toxic megacolon: an update and review of incidence, etiology, pathogenesis, and management. *Am J Gastroenterol* 2003; **98**: 2363–71.
- 227 Kedia S, Ahuja V, Tandon R. Management of acute severe ulcerative colitis. *World J Gastrointest Pathophysiol* 2014; **5**: 579–88.
- 228 Fornaro R, Caratto M, Barbruni G *et al.* Surgical and medical treatment in patients with acute severe ulcerative colitis. *J Dig Dis* 2015; **16**: 558–67.
- 229 Podugu A, Tandon K, Castro FJ. Crohn's disease presenting as acute gastrointestinal hemorrhage. *World J Gastroenterol* 2016; **22**: 4073–8.
- 230 Belaiche J, Louis E, D'Haens G *et al.* Acute lower gastrointestinal bleeding in Crohn's disease: characteristics of a unique series of 34 patients. Belgian IBD Research Group. *Am J Gastroenterol* 1999; **94**: 2177–81.
- 231 Papi C, Gili L, Tarquini M, Antonelli G, Capurso L. Infliximab for severe recurrent Crohn's disease presenting with massive gastrointestinal hemorrhage. *J Clin Gastroenterol* 2003; **36**: 238–41.
- 232 Kim KJ, Han BJ, Yang S-K *et al.* Risk factors and outcome of acute severe lower gastrointestinal bleeding in Crohn's disease. *Dig Liver Dis* 2012; **44**: 723–8.
- 233 Li G, Ren J, Wang G *et al.* Prevalence and risk factors of acute lower gastrointestinal bleeding in Crohn disease. *Medicine (Baltimore)* 2015; **94**: e804.
- 234 Bundred NJ, Dixon JM, Lumsden AB, Gilmour HM, Davies GC. Free perforation in Crohn's colitis. A ten-year review. *Dis Colon Rectum* 1985; **28**: 35–7.
- 235 Greenstein AJ, Mann D, Sachar DB, Aufses AH Jr. Free perforation in Crohn's disease: I. A survey of 99 cases. *Am J Gastroenterol* 1985; **80**: 682–9.
- 236 Geltzeiler CB, Lu KC, Diggs BS *et al.* Initial surgical management of ulcerative colitis in the biologic era. *Dis Colon Rectum* 2014; **57**: 1358–63.
- 237 Spinelli A, Allocca M, Jovani M, Danese S. Review article: optimal preparation for surgery in Crohn's disease. *Aliment Pharmacol Ther* 2014; **40**: 1009–22.
- 238 Bartels SA, Gardenbroek TJ, Ubbink DT, Buskens CJ, Tanis PJ, Bemelman WA. Systematic review and meta-analysis of laparoscopic versus open colectomy with end ileostomy for non-toxic colitis. *Br J Surg* 2013; **100**: 726–33.
- 239 Stocchi L. Laparoscopic surgery for ulcerative colitis. *Clin Colon Rectal Surg* 2010; **23**: 248–58.
- 240 Maggiori L, Panis Y. Surgical management of IBD—from an open to a laparoscopic approach. *Nat Rev Gastroenterol Hepatol* 2013; **10**: 297–306.
- 241 Grass F, Pache B, Martin D, Hahnloser D, Demartines N, Hübner M. Preoperative nutritional conditioning of Crohn's patients—systematic review of current evidence and practice. *Nutrients* 2017; **9**: E562.
- 242 McKee RF, Keenan RA, Munro A. Colectomy for acute colitis: is it safe to close the rectal stump? *Int J Colorectal Dis* 1995; **10**: 222–4.
- 243 Brady RR, Collie MH, Ho GT, Bartolo DC, Wilson RG, Dunlop MG. Outcomes of the rectal remnant following colectomy for ulcerative colitis. *Colorectal Dis* 2008; **10**: 144–50.
- 244 Ng RL, Davies AH, Grace RH, Mortensen NJ. Subcutaneous rectal stump closure after emergency subtotal colectomy. *Br J Surg* 1992; **79**: 701–3.
- 245 Trickett JP, Tilney HS, Gudgeon AM, Mellor SG, Edwards DP. Management of the rectal stump after emergency sub-total colectomy: which surgical option is associated with the lowest morbidity? *Colorectal Dis* 2005; **7**: 519–22.
- 246 Gu J, Stocchi L, Remzi F, Kiran RP. Intraperitoneal or subcutaneous: does location of the (colo)rectal stump influence outcomes after laparoscopic total abdominal colectomy for ulcerative colitis? *Dis Colon Rectum* 2013; **56**: 615–21.
- 247 Buchs NC, Bloemendaal AIA, Wood CPJ *et al.* Subtotal colectomy for ulcerative colitis: lessons learned from a tertiary centre. *Colorectal Dis* 2017; **19**: O153–61.
- 248 Forbes A, Escher J, Hébuterne X *et al.* ESPEN guideline: clinical nutrition in inflammatory bowel disease. *Clin Nutr* 2017; **36**: 321–47.
- 249 Gonzalez-Huix F, Fernández-Bañares F, Esteve-Comas M *et al.* Enteral versus parenteral nutrition as adjunct

- therapy in acute ulcerative colitis. *Am J Gastroenterol* 1993; **88**: 227–32.
- 250 Andersen HK, Lewis SJ, Thomas S. Early enteral nutrition within 24h of colorectal surgery versus later commencement of feeding for postoperative complications. *Cochrane Database Syst Rev*, 2006: CD004080.
- 251 Zezos P, Kouklakis G, Saibil F. Inflammatory bowel disease and thromboembolism. *World J Gastroenterol* 2014; **20**: 13863–78.
- 252 Higgins PD, Skup M, Mulani PM, Lin J, Chao J. Increased risk of venous thromboembolic events with corticosteroid vs biologic therapy for inflammatory bowel disease. *Clin Gastroenterol Hepatol* 2015; **13**: 316–21.
- 253 Ananthkrishnan AN, Cagan A, Gainer VS *et al*. Thromboprophylaxis is associated with reduced post-hospitalization venous thromboembolic events in patients with inflammatory bowel diseases. *Clin Gastroenterol Hepatol* 2014; **12**: 1905–10.
- 254 Arumugam PJ, Bevan L, Macdonald L *et al*. A prospective audit of stomas—analysis of risk factors and complications and their management. *Colorectal Dis* 2003; **5**: 49–52.
- 255 Pengelly S, Reader J, Jones A, Roper K, Douie WJ, Lambert AW. Methods for siting emergency stomas in the absence of a stoma therapist. *Ann R Coll Surg Engl* 2014; **96**: 216–8.
- 256 Person B, Ifargan R, Lachter J, Duek SD, Kluger Y, Assalia A. The impact of preoperative stoma site marking on the incidence of complications, quality of life, and patient's independence. *Dis Colon Rectum* 2012; **55**: 783–7.
- 257 Bass EM, Del Pino A, Tan A, Pearl RK, Orsay CP, Abcarian H. Does preoperative stoma marking and education by the enterostomal therapist affect outcome? *Dis Colon Rectum* 1997; **40**: 440–2.
- 258 Beck DE, Opelka FG. Perioperative steroid use in colorectal patients. Results of a survey. *Dis Colon Rectum* 1996; **39**: 995–9.
- 259 Hicks CW, Wick EC, Salvatori R, Ha CY. Perioperative corticosteroid management for patients with inflammatory bowel disease. *Inflamm Bowel Dis* 2015; **21**: 221–8.
- 260 Friedman RJ, Schiff CF, Bromberg JS. Use of supplemental steroids in patients having orthopaedic operations. *J Bone Joint Surg Am* 1995; **77**: 1801–6.
- 261 Zaghiyan KN, Murrell Z, Melmed GY, Fleshner PR. High-dose perioperative corticosteroids in steroid-treated patients undergoing major colorectal surgery: necessary or overkill? *Am J Surg* 2012; **204**: 481–6.
- 262 Zaghiyan K, Melmed GY, Berel D, Ovsepyan G, Murrell Z, Fleshner P. A prospective, randomized, noninferiority trial of steroid dosing after major colorectal surgery. *Ann Surg* 2014; **259**: 32–7.
- 263 Singh S, Al-Darmaki A, Frolkis AD *et al*. Postoperative mortality among patients with inflammatory bowel diseases: a systematic review and meta-analysis of population-based studies. *Gastroenterology* 2015; **149**: 928–37.
- 264 Faiz O, Warusavitarne J, Bottle A *et al*. Nonelective excisional colorectal surgery in English National Health Service Trusts: a study of outcomes from Hospital Episode Statistics Data between 1996 and 2007. *J Am Coll Surg* 2010; **210**: 390–401.
- 265 Nordenvall C, Ekblom A, Bottai M, Smedby KE, Nilsson PJ. Mortality after total colectomy in 3084 patients with inflammatory bowel disease: a population-based cohort study. *Aliment Pharmacol Ther* 2014; **40**: 280–7.
- 266 Bollegala N, Jackson TD, Nguyen GC. Increased postoperative mortality and complications among elderly patients with inflammatory bowel diseases: an analysis of the national surgical quality improvement program cohort. *Clin Gastroenterol Hepatol* 2016; **14**: 1274–81.
- 267 Wojdemann M, Wettergren A, Hartvigsen A, Myrholm T, Svendsen LB, Bülow S. Closure of rectal stump after colectomy for acute colitis. *Int J Colorectal Dis* 1995; **10**: 197–9.
- 268 Munie S, Hyman N, Osler T. Fate of the rectal stump after subtotal colectomy for ulcerative colitis in the era of ileal pouch-anal anastomosis. *JAMA Surg* 2013; **148**: 408–11.
- 269 Bohm G, O'Dwyer ST. The fate of the rectal stump after subtotal colectomy for ulcerative colitis. *Int J Colorectal Dis* 2007; **22**: 277–82.
- 270 Rutgeerts P, D'Haens G, Hiele M, Geboes K, Vantrappen G. Appendectomy protects against ulcerative colitis. *Gastroenterology* 1994; **106**: 1251–3.
- 271 Andersson RE, Olaison G, Tysk C, Ekblom A. Appendectomy and protection against ulcerative colitis. *N Engl J Med* 2001; **344**: 808–14.
- 272 Radford-Smith GL, Edwards JE, Purdie DM *et al*. Protective role of appendectomy on onset and severity of ulcerative colitis and Crohn's disease. *Gut* 2002; **51**: 808–13.
- 273 Harnoy Y, Bouhnik Y, Gault N *et al*. Effect of appendectomy on colonic inflammation and neoplasia in experimental ulcerative colitis. *Br J Surg* 2016; **103**: 1530–8.
- 274 Holubar SD, Privitera A, Cima RR, Dozois EJ, Pemberton JH, Larson DW. Minimally invasive total proctocolectomy with Brooke ileostomy for ulcerative colitis. *Inflamm Bowel Dis* 2009; **15**: 1337–42.
- 275 Steele SR, Kumar R, Feingold DL, Rafferty JL, Buie WD. Practice parameters for the management of perianal abscess and fistula-in-ano. *Dis Colon Rectum* 2011; **54**: 1465–74.
- 276 Ritchie JK, Lockhart-Mummery HE. Non-restorative surgery in the treatment of Crohn's disease of the large bowel. *Gut* 1973; **14**: 263–9.
- 277 Dunker MS, Bemelman WA, Slors JFM, van Hogezaand RA, Ringers J, Gouma DJ. Laparoscopic-assisted vs open colectomy for severe acute colitis in patients with inflammatory bowel disease (IBD): a retrospective study in 42 patients. *Surg Endosc* 2000; **14**: 911–4.
- 278 Carter FM, McLeod RS, Cohen Z. Subtotal colectomy for ulcerative colitis: complications related to the rectal remnant. *Dis Colon Rectum* 1991; **34**: 1005–9.
- 279 Radice E, Nelson H, Devine RM *et al*. Ileal pouch-anal anastomosis in patients with colorectal cancer: long-term

- functional and oncologic outcomes. *Dis Colon Rectum* 1998; **41**: 11–7.
- 280 Murphy PB, Khot Z, Vogt KN, Ott M, Dubois L. Quality of life after total proctocolectomy with ileostomy or IPAA: a systematic review. *Dis Colon Rectum* 2015; **58**: 899–908.
- 281 Maser EA, Sachar DB, Kruse D, Harpaz N, Ullman T, Bauer JJ. High rates of metachronous colon cancer or dysplasia after segmental resection or subtotal colectomy in Crohn's colitis. *Inflamm Bowel Dis* 2013; **19**: 1827–32.
- 282 Kiran RP, Nisar PJ, Goldblum JR *et al*. Dysplasia associated with Crohn's colitis: segmental colectomy or more extended resection? *Ann Surg* 2012; **256**: 221–6.
- 283 de Buck van Overstraeten A, Wolthuis AM, Vermeire S *et al*. Intersphincteric proctectomy with end-colectomy for anorectal Crohn's disease results in early and severe proximal colonic recurrence. *J Crohns Colitis* 2013; **7**: e227–31.
- 284 Tarrant KM, Barclay ML, Frampton CMA, Geary RB. Perianal disease predicts changes in Crohn's disease phenotype—results of a population-based study of inflammatory bowel disease phenotype. *Am J Gastroenterol* 2008; **103**: 3082–93.
- 285 Polle SW, Slors JFM, Weverling GJ, Gouma DJ, Hommes DW, Bemelman WA. Recurrence after segmental resection for colonic Crohn's disease. *Br J Surg* 2005; **92**: 1143–9.
- 286 Bernell O, Lapidus A, Hellers G. Recurrence after colectomy in Crohn's colitis. *Dis Colon Rectum* 2001; **44**: 647–54.
- 287 Angriman I, Pirozzolo G, Bardini R, Cavallin F, Castoro C, Scarpa M. A systematic review of segmental vs subtotal colectomy and subtotal colectomy vs total proctocolectomy for colonic Crohn's disease. *Colorectal Dis* 2017; **19**: e279–87.
- 288 Abdalla M, Landerholm K, Andersson P, Andersson RE, Myrelid P. Risk of rectal cancer after colectomy for patients with ulcerative colitis: a national cohort study. *Clin Gastroenterol Hepatol* 2017; **15**: 1055–60.
- 289 Sigel JE, Petras RE, Lashner BA, Fazio VW, Goldblum JR. Intestinal adenocarcinoma in Crohn's disease: a report of 30 cases with a focus on coexisting dysplasia. *Am J Surg Pathol* 1999; **23**: 651–5.
- 290 Svrcek M, Cosnes J, Beaugerie L *et al*. Colorectal neoplasia in Crohn's colitis: a retrospective comparative study with ulcerative colitis. *Histopathology* 2007; **50**: 574–83.
- 291 Harling H, Hegnhøj J, Rasmussen TN, Jarnum S. Fate of the rectum after colectomy and ileostomy for Crohn's colitis. *Dis Colon Rectum* 1991; **34**: 931–5.
- 292 Cattan P, Bonhomme N, Panis Y *et al*. Fate of the rectum in patients undergoing total colectomy for Crohn's disease. *Br J Surg* 2002; **89**: 454–9.
- 293 Ferrante M, D'Hoore A, Vermeire S *et al*. Corticosteroids but not infliximab increase short-term postoperative infectious complications in patients with ulcerative colitis. *Inflamm Bowel Dis* 2009; **15**: 1062–70.
- 294 Bartels SA, Vlug MS, Henneman D, Ponsioen CY, Tanis PJ, Bemelman WA. Less adhesiolysis and hernia repair during completion proctocolectomy after laparoscopic emergency colectomy for ulcerative colitis. *Surg Endosc* 2012; **26**: 368–73.
- 295 Subramanian V, Saxena S, Kang J-Y, Pollok RCG. Preoperative steroid use and risk of postoperative complications in patients with inflammatory bowel disease undergoing abdominal surgery. *Am J Gastroenterol* 2008; **103**: 2373–81.
- 296 Oresland T, Palmblad S, Ellström M, Berndtsson I, Crona N, Hultén L. Gynaecological and sexual function related to anatomical changes in the female pelvis after restorative proctocolectomy. *Int J Colorectal Dis* 1994; **9**: 77–81.
- 297 Ørding OK, Juul S, Berndtsson I, Oresland T, Laurberg S. Ulcerative colitis: female fecundity before diagnosis, during disease, and after surgery compared with a population sample. *Gastroenterology* 2002; **122**: 15–9.
- 298 Beyer-Berjot L, Maggiori L, Birnbaum D, Lefevre JH, Berdah S, Panis Y. A total laparoscopic approach reduces the infertility rate after ileal pouch-anal anastomosis: a 2-center study. *Ann Surg* 2013; **258**: 275–82.
- 299 Leicester RJ, Ritchie JK, Wadsworth J, Thomson JPS, Hawley PR. Sexual function and perineal wound healing after intersphincteric excision of the rectum for inflammatory bowel disease. *Dis Colon Rectum* 1984; **27**: 244–8.
- 300 Berry AR, de Campos R, Lee EC. Perineal and pelvic morbidity following perimuscular excision of the rectum for inflammatory bowel disease. *Br J Surg* 1986; **73**: 675–7.
- 301 Hurst RD, Gottlieb LJ, Crucitti P, Melis M, Rubin M, Michelassi F. Primary closure of complicated perineal wounds with myocutaneous and fasciocutaneous flaps after proctectomy for Crohn's disease. *Surgery* 2001; **130**: 767–72.
- 302 Schaden D, Schauer G, Haas F, Berger A. Myocutaneous flaps and proctocolectomy in severe perianal Crohn's disease—a single stage procedure. *Int J Colorectal Dis* 2007; **22**: 1453–7.
- 303 ACPGBI Parastomal Hernia Group. Prevention and treatment of parastomal hernia: a position statement on behalf of the Association of Coloproctology of Great Britain and Ireland. *Colorectal Dis* 2018; **20**(Suppl. 2): 5–19.
- 304 Rencuzogullari A, Gorgun E, Costedio M *et al*. Case-matched comparison of robotic versus laparoscopic proctectomy for inflammatory bowel disease. *Surg Laparosc Endosc Percutan Tech* 2016; **26**: e37–40.
- 305 Yamaguchi T, Kinugasa Y, Shiomi A, Tomioka H, Kagawa H, Yamakawa Y. Robotic-assisted vs. conventional laparoscopic surgery for rectal cancer: short-term outcomes at a single center. *Surg Today* 2016; **46**: 957–62.
- 306 Gardenbroek TJ, Tanis PJ, Buskens CJ, Bemelman WA. Surgery for Crohn's disease: new developments. *Dig Surg* 2012; **29**: 275–80.
- 307 Buchs NC, Wynn G, Austin R *et al*. A two-centre experience of transanal total mesorectal excision. *Colorectal Dis* 2016; **18**: 1154–61.
- 308 Camilleri-Brennan J, Munro A, Steele RJ. Does an ileoanal pouch offer a better quality of life than a permanent

- ileostomy for patients with ulcerative colitis? *J Gastrointest Surg* 2003; **7**: 814–9.
- 309 Poylin V, Curran T, Alvarez D, Nagle D, Cataldo T. Primary vs. delayed perineal proctectomy—there is no free lunch. *Int J Colorectal Dis* 2017; **32**: 1207–12.
- 310 Corman ML, Veidenheimer MC, Collier JA, Ross VH. Perineal wound healing after proctectomy for inflammatory bowel disease. *Dis Colon Rectum* 1978; **21**: 155–9.
- 311 Oakley JR, Fazio VW, Jagelman DG, Lavery IC, Weakley FL, Easley K. Management of the perineal wound after rectal excision for ulcerative colitis. *Dis Colon Rectum* 1985; **28**: 885–8.
- 312 Baudot P, Keighley MR, Alexander-Williams J. Perineal wound healing after proctectomy for carcinoma and inflammatory disease. *Br J Surg* 1980; **67**: 275–6.
- 313 Killeen S, Devaney A, Mannion M, Martin ST, Winter DC. Omental pedicle flaps following proctectomy: a systematic review. *Colorectal Dis* 2013; **15**: e634–45.
- 314 Yamamoto T, Bain IM, Allan RN, Keighley MR. Persistent perineal sinus after proctocolectomy for Crohn's disease. *Dis Colon Rectum* 1999; **42**: 96–101.
- 315 Collie MH, Potter MA, Bartolo DC. Myocutaneous flaps promote perineal healing in inflammatory bowel disease. *Br J Surg* 2005; **92**: 740–1.
- 316 Schaffzin DM, Douglas JM, Stahl TJ, Smith LE. Vacuum-assisted closure of complex perineal wounds. *Dis Colon Rectum* 2004; **47**: 1745–8.
- 317 Menon A, Clark MA, Shatari T, Keh C, Keighley MR. Pedicled flaps in the treatment of nonhealing perineal wounds. *Colorectal Dis* 2005; **7**: 441–4.
- 318 Maeda Y, Heyckendorff-Diebold T, Tei TM, Lundby L, Buntzen S. Gracilis muscle transposition for complex fistula and persistent nonhealing sinus in perianal Crohn's disease. *Inflamm Bowel Dis* 2011; **17**: 583–9.
- 319 Chan XH, Koh CE, Glover M, Bryson P, Travis SP, Mortensen NJ. Healing under pressure: hyperbaric oxygen and myocutaneous flap repair for extreme persistent perineal sinus after proctectomy for inflammatory bowel disease. *Colorectal Dis* 2014; **16**: 186–90.
- 320 Buskens CJ, de Groof EJ, Bemelman WA, Wildenberg ME. The role of the mesentery in Crohn's disease. *Lancet Gastroenterol Hepatol* 2017; **2**: 245–6.
- 321 Bauer JJ, Gelernt IM, Salky B, KreeI I. Sexual dysfunction following proctocolectomy for benign disease of the colon and rectum. *Ann Surg* 1983; **197**: 363–7.
- 322 Jones OM, Stevenson AR, Stitz RW, Lumley JW. Preservation of sexual and bladder function after laparoscopic rectal surgery. *Colorectal Dis* 2009; **11**: 489–95.
- 323 Wikland M, Jansson I, Asztély M *et al.* Gynaecological problems related to anatomical changes after conventional proctocolectomy and ileostomy. *Int J Colorectal Dis* 1990; **5**: 49–52.
- 324 Metzger PP, Slappy AL, Chua HK, Menke DM. Adenocarcinoma developing at an ileostomy: report of a case and review of the literature. *Dis Colon Rectum* 2008; **51**: 604–9.
- 325 Nicholls RJ, Belliveau P, Neill M, Wilks M, Tabaqchali S. Restorative proctocolectomy with ileal reservoir: a pathophysiological assessment. *Gut* 1981; **22**: 462–8.
- 326 Hueting WE, Buskens E, van der Tweel I, Gooszen HG, van Laarhoven CJ. Results and complications after ileal pouch anal anastomosis: a meta-analysis of 43 observational studies comprising 9,317 patients. *Dig Surg* 2005; **22**: 69–79.
- 327 Chang S, Shen B, Remzi F. When not to pouch: important considerations for patient selection for ileal pouch-anal anastomosis. *Gastroenterol Hepatol (N Y)* 2017; **13**: 466–75.
- 328 Parks AG, Nicholls RJ. Proctocolectomy without ileostomy for ulcerative colitis. *Br Med J* 1978; **2**: 85–8.
- 329 Parks AG, Nicholls RJ, Belliveau P. Proctocolectomy with ileal reservoir and anal anastomosis. *Br J Surg* 1980; **67**: 533–8.
- 330 Nicholls J, Pescatori M, Motson RW, Pezim ME. Restorative proctocolectomy with a three-loop ileal reservoir for ulcerative colitis and familial adenomatous polyposis. Clinical results in 66 patients followed for up to 6 years. *Ann Surg*, 1984; **199**: 383–8.
- 331 Keighley MR, Yoshioka K, Kmiet W. Prospective randomized trial to compare the stapled double lumen pouch and the sutured quadruple pouch for restorative proctocolectomy. *Br J Surg* 1988; **75**: 1008–11.
- 332 Johnston D, Williamson ME, Lewis WG, Miller AS, Sagar PM, Holdsworth PJ. Prospective controlled trial of duplicated (J) versus quadruplicated (W) pelvic ileal reservoirs in restorative proctocolectomy for ulcerative colitis. *Gut* 1996; **39**: 242–7.
- 333 Selvaggi F, Giuliani A, Gallo C, Signoriello G, Riegler G, Canonico S. Randomized, controlled trial to compare the J-pouch and W-pouch configurations for ulcerative colitis in the maturation period. *Dis Colon Rectum* 2000; **43**: 615–20.
- 334 Lovegrove RE, Heriot AG, Constantinides V *et al.* Meta-analysis of short-term and long-term outcomes of J, W and S ileal reservoirs for restorative proctocolectomy. *Colorectal Dis* 2007; **9**: 310–20.
- 335 Lovegrove RE, Constantinides VA, Heriot AG *et al.* A comparison of hand-sewn versus stapled ileal pouch anal anastomosis (IPAA) following proctocolectomy: a meta-analysis of 4183 patients. *Ann Surg* 2006; **244**: 18–26.
- 336 Kirat HT, Remzi FH, Kiran RP, Fazio VW. Comparison of outcomes after hand-sewn versus stapled ileal pouch-anal anastomosis in 3,109 patients. *Surgery* 2009; **146**: 723–9.
- 337 Schluender SJ, Mei L, Yang H, Fleshner PR. Can a meta-analysis answer the question: is mucosectomy and hand-sewn or double-stapled anastomosis better in ileal pouch-anal anastomosis? *Am Surg* 2006; **72**: 912–6.
- 338 Remzi FH, Fazio VW, Delaney CP *et al.* Dysplasia of the anal transitional zone after ileal pouch-anal anastomosis: results of prospective evaluation after a minimum of ten years. *Dis Colon Rectum* 2003; **46**: 6–13.
- 339 Ziv Y, Fazio VW, Sirimarco MT, Lavery IC, Goldblum JR, Petras RE. Incidence, risk factors, and treatment of

- dysplasia in the anal transitional zone after ileal pouch-anal anastomosis. *Dis Colon Rectum* 1994; **37**: 1281–5.
- 340 Heppell J, Weiland LH, Perrault J, Pemberton JH, Telander RL, Beart RW Jr. Fate of the rectal mucosa after rectal mucosectomy and ileoanal anastomosis. *Dis Colon Rectum* 1983; **26**: 768–71.
- 341 Farouk R, Dozois RR, Pemberton JH, Larson D. Incidence and subsequent impact of pelvic abscess after ileal pouch-anal anastomosis for chronic ulcerative colitis. *Dis Colon Rectum* 1998; **41**: 1239–43.
- 342 Saha AK, Tapping CR, Foley GT *et al.* Morbidity and mortality after closure of loop ileostomy. *Colorectal Dis* 2009; **11**: 866–71.
- 343 Wong KS, Remzi FH, Gorgun E *et al.* Loop ileostomy closure after restorative proctocolectomy: outcome in 1,504 patients. *Dis Colon Rectum* 2005; **48**: 243–50.
- 344 ACPGBI. *Ileo-anal pouch report*. 2017; <https://www.acpgbi.org.uk/content/uploads/2016/07/Ileoanal-Pouch-Report-2017-FINAL.compressed.pdf> (accessed 1 November 2017).
- 345 Fazio VW, Ziv Y, Church JM *et al.* Ileal pouch-anal anastomoses complications and function in 1005 patients. *Ann Surg* 1995; **222**: 120–7.
- 346 Erkek AB, Remzi FH, Hammel JP, Akyuz M, Fazio VW. Effect of small bowel obstruction on functional outcome and quality of life in patients with ileal pouch-anal anastomosis: 10-year follow-up study. *J Gastroenterol Hepatol* 2008; **23**: 119–25.
- 347 Ahmed AliU, Keus F, Heikens JT *et al.* Open versus laparoscopic (assisted) ileo pouch anal anastomosis for ulcerative colitis and familial adenomatous polyposis. *Cochrane Database Syst Rev* 2009; CD006267.
- 348 Singh P, Bhangu A, Nicholls RJ, Tekkis P. A systematic review and meta-analysis of laparoscopic vs open restorative proctocolectomy. *Colorectal Dis* 2013; **15**: e340–51.
- 349 Sofo L, Caprino P, Sacchetti F, Bossola M. Restorative proctocolectomy with ileal pouch-anal anastomosis for ulcerative colitis: a narrative review. *World J Gastrointest Surg* 2016; **8**: 556–63.
- 350 Mark-Christensen A, Pachler FR, Nørager CB, Jepsen P, Laurberg S, Tøttrup A. Short-term outcome of robot-assisted and open IPAA: an observational single-center study. *Dis Colon Rectum* 2016; **59**: 201–7.
- 351 Gash KJ, Goede AC, Kaldowski B, Vestweber B, Dixon AR. Single incision laparoscopic (SILS) restorative proctocolectomy with ileal pouch-anal anastomosis. *Surg Endosc* 2011; **25**: 3877–80.
- 352 Tasende MM, Delgado S, Jimenez M *et al.* Minimal invasive surgery: NOSE and NOTES in ulcerative colitis. *Surg Endosc* 2015; **29**: 3313–8.
- 353 Smith L, Friend WG, Medwell SJ. The superior mesenteric artery. The critical factor in the pouch pull-through procedure. *Dis Colon Rectum* 1984; **27**: 741–4.
- 354 Murrell Z, Fleshner P. Ulcerative colitis: surgical management. In: *The ASCRS Textbook of Colon and Rectal Surgery*, 2nd edition (eds Steele SR, Hull TL, Read TE, Saclarides TJ, Senagore AJ, Whitlow CB). New York, NY: Springer, 2011. pp. 479–98.
- 355 Keighley MRB, Williams NS. *Surgery of the Anus, Colon and Rectum*, 1st edition. London: WB Saunders, 1999.
- 356 Cherqui D, Valleur P, Perniceni T, Hautefeuille P. Inferior reach of ileal reservoir in ileoanal anastomosis. Experimental anatomic and angiographic study. *Dis Colon Rectum*, 1987; **30**: 365–71.
- 357 Metcalf DR, Nivatvongs S, Sullivan TM, Suwanthanma W. A technique of extending small-bowel mesentery for ileal pouch-anal anastomosis: report of a case. *Dis Colon Rectum* 2008; **51**: 363–4.
- 358 Sagar PM, Pemberton JH. Intraoperative, postoperative and reoperative problems with ileoanal pouches. *Br J Surg* 2012; **99**: 454–68.
- 359 Coffey JC, Dillon MF, O'Driscoll JS, Faul E. Transanal total mesocolic excision (taTME) as part of ileoanal pouch formation in ulcerative colitis—first report of a case. *Int J Colorectal Dis* 2016; **31**: 735–6.
- 360 Duff SE, Sagar PM, Rao M, Macafee D, El-Khoury T. Laparoscopic restorative proctocolectomy: safety and critical level of the ileal pouch anal anastomosis. *Colorectal Dis* 2012; **14**: 883–6.
- 361 Verlaan T, van Berge Henegouwen MI, Tanis PJ, Fockens P, Bemelman WA. Early, minimally invasive closure of anastomotic leaks: a new concept. *Colorectal Dis* 2011; **13**(Suppl. 7): 18–22.
- 362 Scott NA, Dozois RR, Beart RW, Pemberton JH, Wolff BG, Ilstrup DM. Postoperative intra-abdominal and pelvic sepsis complicating ileal pouch-anal anastomosis. *Int J Colorectal Dis* 1988; **3**: 149–52.
- 363 Nyam DC, Wolff BG, Dozois RR, Pemberton JH, Mathison SM. Does the presence of a pre-ileostomy closure asymptomatic pouch-anastomotic sinus tract affect the success of ileal pouch-anal anastomosis? *J Gastrointest Surg* 1997; **1**: 274–7.
- 364 Whitlow CB, Opelka FG, Gathright BJ, Beck DE. Treatment of colorectal and ileoanal anastomotic sinuses. *Dis Colon Rectum* 1997; **40**: 760–3.
- 365 Akbari RP, Madoff RD, Parker SC *et al.* Anastomotic sinuses after ileoanal pouch construction: incidence, management, and outcome. *Dis Colon Rectum* 2009; **52**: 452–5.
- 366 de Silva HJ, de Angelis CP, Soper N, Kettlewell MG, Mortensen NJ, Jewell DP. Clinical and functional outcome after restorative proctocolectomy. *Br J Surg* 1991; **78**: 1039–44.
- 367 McIntyre PB, Pemberton JH, Wolff BG, Beart RW, Dozois RR. Comparing functional results one year and ten years after ileal pouch-anal anastomosis for chronic ulcerative colitis. *Dis Colon Rectum* 1994; **37**: 303–7.
- 368 Williams NS, Johnston D. The current status of mucosal proctectomy and ileo-anal anastomosis in the surgical treatment of ulcerative colitis and adenomatous polyposis. *Br J Surg* 1985; **72**: 159–68.
- 369 Levitt MD, Lewis AA. Determinants of ileoanal pouch function. *Gut* 1991; **32**: 126–7.

- 370 Reddy SN, Bazzocchi G, Chan S *et al.* Colonic motility and transit in health and ulcerative colitis. *Gastroenterology* 1991; **101**: 1289–97.
- 371 Wexner SD, Jensen L, Rothenberger DA, Wong WD, Goldberg SM. Long-term functional analysis of the ileoanal reservoir. *Dis Colon Rectum* 1989; **32**: 275–81.
- 372 Lewis WG, Williamson ME, Miller AS, Sagar PM, Holdsworth PJ, Johnston D. Preservation of complete anal sphincteric proprioception in restorative proctocolectomy: the inhibitory reflex and fine control of continence need not be impaired. *Gut* 1995; **36**: 902–6.
- 373 Pescatori M, Mattana C, Castagneto M. Clinical and functional results after restorative proctocolectomy. *Br J Surg* 1988; **75**: 321–4.
- 374 Pescatori M, Mattana C. Factors affecting anal continence after restorative proctocolectomy. *Int J Colorectal Dis* 1990; **5**: 213–8.
- 375 Oresland T, Fasth S, Nordgren S, Hultén L. The clinical and functional outcome after restorative proctocolectomy. A prospective study in 100 patients. *Int J Colorectal Dis*, 1989; **4**: 50–6.
- 376 Becker JM, LaMorte W, Marie G, Ferzoco S. Extent of smooth muscle resection during mucosectomy and ileal pouch-anal anastomosis affects anorectal physiology and functional outcome. *Dis Colon Rectum* 1997; **40**: 653–60.
- 377 Lewis WG, Miller AS, Williamson ME *et al.* The perfect pelvic pouch—what makes the difference? *Gut* 1995; **37**: 552–6.
- 378 Pricolo VE, Potenti FM, Luks FI. Selective preservation of the anal transition zone in ileoanal pouch procedures. *Dis Colon Rectum* 1996; **39**: 871–7.
- 379 Keighley MR, Ogunbiyi OA, Korsgen S. Pitfalls and outcome in ileo-anal pouch surgery for ulcerative colitis. *Neth J Med* 1997; **50**: S23–7.
- 380 Cohen Z, McLeod RS, Stern H, Grant D, Nordgren S. The pelvic pouch and ileoanal anastomosis procedure. Surgical technique and initial results. *Am J Surg* 1985; **150**: 601–7.
- 381 Goldberg PA, Kamm MA, Nicholls RJ, Morris G, Britton KE. Contribution of gastrointestinal transit and pouch characteristics in determining pouch function. *Gut* 1997; **40**: 790–3.
- 382 Heikens JT, de Vries J, van Laarhoven CJ. Quality of life, health-related quality of life and health status in patients having restorative proctocolectomy with ileal pouch-anal anastomosis for ulcerative colitis: a systematic review. *Colorectal Dis* 2012; **14**: 536–44.
- 383 Pemberton JH, Kelly KA, Beart RW, Dozois RR, Wolff BG, Ilstrup DM. Ileal pouch-anal anastomosis for chronic ulcerative colitis. Long-term results. *Ann Surg* 1987; **206**: 504–13.
- 384 Remzi FH, Fazio ViW, Oncel M *et al.* Portal vein thrombi after restorative proctocolectomy. *Surgery*, 2002; **132**: 655–61.
- 385 Fichera A, Cicchiello LA, Mendelson DS, Greenstein AJ, Heimann TM. Superior mesenteric vein thrombosis after colectomy for inflammatory bowel disease: a not uncommon cause of postoperative acute abdominal pain. *Dis Colon Rectum* 2003; **46**: 643–8.
- 386 Ball CG, MacLean AR, Buie WD, Smith DF, Raber EL. Portal vein thrombi after ileal pouch-anal anastomosis: its incidence and association with pouchitis. *Surg Today* 2007; **37**: 552–7.
- 387 Millan M, Hull TL, Hammel J, Remzi F. Portal vein thrombi after restorative proctocolectomy: serious complication without long-term sequelae. *Dis Colon Rectum* 2007; **50**: 1540–4.
- 388 Ehsan M, Isler JT, Kimmins MH, Billingham RP. Prevalence and management of prolapse of the ileoanal pouch. *Dis Colon Rectum* 2004; **47**: 885–8.
- 389 Joyce MR, Fazio VW, Hull TT *et al.* Ileal pouch prolapse: prevalence, management, and outcomes. *J Gastrointest Surg* 2010; **14**: 993–7.
- 390 Shen B, Lashner BA, Bennett AE *et al.* Treatment of rectal cuff inflammation (cuffitis) in patients with ulcerative colitis following restorative proctocolectomy and ileal pouch-anal anastomosis. *Am J Gastroenterol* 2004; **99**: 1527–31.
- 391 Wu B, Lian L, Li Y *et al.* Clinical course of cuffitis in ulcerative colitis patients with restorative proctocolectomy and ileal pouch-anal anastomoses. *Inflamm Bowel Dis* 2013; **19**: 404–10.
- 392 O'Mahoney PR, Scherl EJ, Lee SW, Milsom JW. Adenocarcinoma of the ileal pouch mucosa: case report and literature review. *Int J Colorectal Dis* 2015; **30**: 11–8.
- 393 Kock NG, Darle N, Hultén L, Kewenter J, Myrvold H, Philipson B. Ileostomy. *Curr Probl Surg* 1977; **14**: 1–52.
- 394 Handelsman JC, Fishbein RH, Hoover HC Jr, Smith GW, Haller JA Jr. Endorectal pull-through operation in adults after colectomy and excision of rectal mucosa. *Surgery* 1983; **93**: 247–53.
- 395 Lightner AL, Mathis KL, Dozois EJ *et al.* Results at up to 30 years after ileal pouch-anal anastomosis for chronic ulcerative colitis. *Inflamm Bowel Dis* 2017; **23**: 781–90.
- 396 Lohmuller JL, Pemberton JH, Dozois RR, Ilstrup D, van Heerden J. Pouchitis and extraintestinal manifestations of inflammatory bowel disease after ileal pouch-anal anastomosis. *Ann Surg*, 1990; **211**: 622–7.
- 397 Moskowitz RL, Shepherd NA, Nicholls RJ. An assessment of inflammation in the reservoir after restorative proctocolectomy with ileoanal ileal reservoir. *Int J Colorectal Dis* 1986; **1**: 167–74.
- 398 Di Febo G, Miglioli M, Lauri A *et al.* Endoscopic assessment of acute inflammation of the ileal reservoir after restorative ileo-anal anastomosis. *Gastrointest Endosc* 1990; **36**: 6–9.
- 399 Sandborn WJ, Tremaine WJ, Batts KP, Pemberton JH, Phillips SF. Pouchitis after ileal pouch-anal anastomosis: a Pouchitis Disease Activity Index. *Mayo Clin Proc* 1994; **69**: 409–15.
- 400 Shepherd NA, Jass JR, Duval I, Moskowitz RL, Nicholls RJ, Morson BC. Restorative proctocolectomy with ileal reservoir: pathological and histochemical study of mucosal biopsy specimens. *J Clin Pathol* 1987; **40**: 601–7.

- 401 Stallmach A, Moser C, Hero-Gross R *et al.* Pattern of mucosal adaptation in acute and chronic pouchitis. *Dis Colon Rectum* 1999; **42**: 1311–7.
- 402 Shepherd NA, Hultén L, Tytgat GN *et al.* Pouchitis. *Int J Colorectal Dis* 1989; **4**: 205–29.
- 403 Madden MV, McIntyre AS, Nicholls RJ. Double-blind crossover trial of metronidazole versus placebo in chronic unremitting pouchitis. *Dig Dis Sci* 1994; **39**: 1193–6.
- 404 Mimura T, Rizzello F, Helwig U *et al.* Four-week open-label trial of metronidazole and ciprofloxacin for the treatment of recurrent or refractory pouchitis. *Aliment Pharmacol Ther* 2002; **16**: 909–17.
- 405 Ruseler-van Embden JG, Schouten WR, van Lieshout LM. Pouchitis: result of microbial imbalance? *Gut*, 1994; **35**: 658–64.
- 406 Gionchetti P, Rizzello F, Venturi A *et al.* Oral bacteriotherapy as maintenance treatment in patients with chronic pouchitis: a double-blind, placebo-controlled trial. *Gastroenterology* 2000; **119**: 305–9.
- 407 Kelly OB, Rosenberg M, Tyler AD *et al.* Infliximab to treat refractory inflammation after pelvic pouch surgery for ulcerative colitis. *J Crohns Colitis* 2016; **10**: 410–7.
- 408 Mir F, Yousef MH, Partyka EK, Tahan V. Successful treatment of chronic refractory pouchitis with vedolizumab. *Int J Colorectal Dis* 2017; **32**: 1517–8.
- 409 Tran-Minh ML, Allez M, Gornet JM. Successful treatment with ustekinumab for chronic refractory pouchitis. *J Crohns Colitis* 2017; **11**: 1156.
- 410 Yamamoto T, Tanaka T, Yokoyama T *et al.* Efficacy of granulocyte and monocyte apheresis for antibiotic-refractory pouchitis after proctocolectomy for ulcerative colitis: an open-label, prospective, multicentre study. *Therap Adv Gastroenterol* 2017; **10**: 199–206.
- 411 Jairath V, Khanna R, Feagan BG, Alicaforsen for the treatment of inflammatory bowel disease. *Expert Opin Investig Drugs* 2017; **26**: 991–7.
- 412 Berndtsson I, Oresland T, Hultén L. Sexuality in patients with ulcerative colitis before and after restorative proctocolectomy: a prospective study. *Scand J Gastroenterol* 2004; **39**: 374–9.
- 413 Davies RJ, O'Connor BI, Victor C, MacRae HM, Cohen Z, McLeod RS. A prospective evaluation of sexual function and quality of life after ileal pouch-anal anastomosis. *Dis Colon Rectum* 2008; **51**: 1032–5.
- 414 Ørding OK, Juul S, Berndtsson I, Oresland T, Laurberg S. Ulcerative colitis: female fecundity before diagnosis, during disease and after surgery compared with a population sample. *Gastroenterology* 2002; **122**: 15–9.
- 415 Johnson P, Richard C, Ravid A *et al.* Female infertility after ileal pouch-anal anastomosis for ulcerative colitis. *Dis Colon Rectum* 2004; **47**: 1119–26.
- 416 Lepistö A, Sarna S, Tiitinen A, Järvinen HJ. Female fertility and childbirth after ileal pouch-anal anastomosis for ulcerative colitis. *Br J Surg* 2007; **94**: 478–82.
- 417 Bartels SA, D'Hoore A, Cuesta MA, Bendsorp AJ, Lucas C, Bemelman WA. Significantly increased pregnancy rates after laparoscopic restorative proctocolectomy: a cross-sectional study. *Ann Surg* 2012; **256**: 1045–8.
- 418 McLaughlin SD, Clark SK, Thomas-Gibson S, Tekkis PP, Ciclitira PJ, Nicholls RJ. Guide to endoscopy of the ileo-anal pouch following restorative proctocolectomy with ileal pouch-anal anastomosis; indications, technique, and management of common findings. *Inflamm Bowel Dis* 2009; **15**: 1256–63.
- 419 Das P, Johnson MW, Tekkis PP, Nicholls RJ. Risk of dysplasia and adenocarcinoma following restorative proctocolectomy for ulcerative colitis. *Colorectal Dis* 2007; **9**: 15–27.
- 420 Kariv R, Remzi FH, Lian L *et al.* Preoperative colorectal neoplasia increases risk for pouch neoplasia in patients with restorative proctocolectomy. *Gastroenterology*, 2010; **139**: 806–12.
- 421 Birkmeyer JD, Siewers AE, Finlayson EV *et al.* Hospital volume and surgical mortality in the United States. *N Engl J Med* 2002; **346**: 1128–37.
- 422 Raval MJ, Schnitzler M, O'Connor BI, Cohen Z, McLeod RS. Improved outcome due to increased experience and individualized management of leaks after ileal pouch-anal anastomosis. *Ann Surg* 2007; **246**: 763–70.
- 423 Faiz O, Fearnhead N, Brown S. Improving quality in surgery for Inflammatory Bowel Disease (IBD). *Colorectal Dis* 2017; **19**: 615–6.
- 424 Aylett SO. Conservative surgery in the treatment of ulcerative colitis. *Br Med J* 1953; **2**: 1348–51.
- 425 Gallone L, Olmi L, Marchetti V. Use of topical rectal therapy to preserve the rectum in surgery of ulcerative colitis. *World J Surg* 1980; **4**: 609–13.
- 426 Mann CV. Total colectomy and ileorectal anastomosis for ulcerative colitis. *World J Surg* 1988; **12**: 155–9.
- 427 Pastore RL, Wolff BG, Hodge D. Total abdominal colectomy and ileorectal anastomosis for inflammatory bowel disease. *Dis Colon Rectum* 1997; **40**: 1455–64.
- 428 Borjesson L, Lundstam U, Oresland T, Brevinge H, Hultén L. The place for colectomy and ileorectal anastomosis: a valid surgical option for ulcerative colitis? *Tech Coloproctol*, 2006; **10**: 237–41; discussion 241.
- 429 Andersson P, Norblad R, Söderholm JD, Myrelid P. Ileorectal anastomosis in comparison with ileal pouch anal anastomosis in reconstructive surgery for ulcerative colitis—a single institution experience. *J Crohns Colitis* 2014; **8**: 582–9.
- 430 Myrelid P, Oresland T. A reappraisal of the ileo-rectal anastomosis in ulcerative colitis. *J Crohns Colitis* 2015; **9**: 433–8.
- 431 Roda G, Narula N, Pinotti R *et al.* Systematic review with meta-analysis: proximal disease extension in limited ulcerative colitis. *Aliment Pharmacol Ther* 2017; **45**: 1481–92.
- 432 Larson DW, Davies MM, Dozois EJ *et al.* Sexual function, body image, and quality of life after laparoscopic and open ileal pouch-anal anastomosis. *Dis Colon Rectum* 2008; **51**: 392–6.

- 433 Ogilvie JW Jr, Goetz L, Baxter NN, Park J, Minami S, Madoff RD. Female sexual dysfunction after ileal pouch-anal anastomosis. *Br J Surg* 2008; **95**: 887–92.
- 434 van Balkom KA, Beld MP, Visschers RGJ, van Gemert WG, Breukink SO. Long-term results after restorative proctocolectomy with ileal pouch-anal anastomosis at a young age. *Dis Colon Rectum* 2012; **55**: 939–47.
- 435 Olsen KO, Juul S, Bülow S *et al*. Female fecundity before and after operation for familial adenomatous polyposis. *Br J Surg* 2003; **90**: 227–31.
- 436 Rajaratnam SG, Eglinton TW, Hider P, Fearnhead NS. Impact of ileal pouch-anal anastomosis on female fertility: meta-analysis and systematic review. *Int J Colorectal Dis* 2011; **26**: 1365–74.
- 437 Scoglio D, Ahmed Ali U, Fichera A. Surgical treatment of ulcerative colitis: ileorectal vs ileal pouch-anal anastomosis. *World J Gastroenterol* 2014; **20**: 13211–8.
- 438 da Luz Moreira A, Kiran RP, Lavery I. Clinical outcomes of ileorectal anastomosis for ulcerative colitis. *Br J Surg* 2010; **97**: 65–9.
- 439 Elton C, Makin G, Hitos K, Cohen CR. Mortality, morbidity and functional outcome after ileorectal anastomosis. *Br J Surg* 2003; **90**: 59–65.
- 440 Pinczowski D, Ekblom A, Baron J, Yuen J, Adami HO. Risk factors for colorectal cancer in patients with ulcerative colitis: a case-control study. *Gastroenterology* 1994; **107**: 117–20.
- 441 Bernstein CN, Eaden J, Steinhart AH, Munkholm P, Gordon PH. Cancer prevention in inflammatory bowel disease and the chemoprophylactic potential of 5-aminosalicylic acid. *Inflamm Bowel Dis* 2002; **8**: 356–61.
- 442 Bülow S, Højen H, Buntzen S, Larsen KL, Preisler L, Qvist N. Primary and secondary restorative proctocolectomy for familial adenomatous polyposis: complications and long-term bowel function. *Colorectal Dis* 2013; **15**: 436–41.
- 443 Ko CY, Rusin LC, Schoetz DJ Jr *et al*. Does better functional result equate with better quality of life? Implications for surgical treatment in familial adenomatous polyposis. *Dis Colon Rectum* 2000; **43**: 829–35; discussion 835–7.
- 444 Baker WN, Glass RE, Ritchie JK, Aylett SO. Cancer of the rectum following colectomy and ileorectal anastomosis for ulcerative colitis. *Br J Surg* 1978; **65**: 862–8.
- 445 Kiran RP, Ahmed Ali U, Nisar PJ *et al*. Risk and location of cancer in patients with preoperative colitis-associated dysplasia undergoing proctocolectomy. *Ann Surg* 2014; **259**: 302–9.
- 446 Kiran RP, Nisar PJ, Church JM, Fazio VW. The role of primary surgical procedure in maintaining intestinal continuity for patients with Crohn's colitis. *Ann Surg* 2011; **253**: 1130–5.
- 447 Chevalier JM, Jones DJ, Ratelle R, Frileux P, Turet E, Parc R. Colectomy and ileorectal anastomosis in patients with Crohn's disease. *Br J Surg* 1994; **81**: 1379–81.
- 448 Farouk R, Pemberton JH, Wolff BG, Dozois RR, Browning S, Larson D. Functional outcomes after ileal pouch-anal anastomosis for chronic ulcerative colitis. *Ann Surg* 2000; **231**: 919–26.
- 449 Fazio VW, Kiran RP, Remzi FH *et al*. Ileal pouch anal anastomosis: analysis of outcome and quality of life in 3707 patients. *Ann Surg* 2013; **257**: 679–85.
- 450 MacRae HM, McLeod RS, Cohen Z, O'Connor BI, Ton EN. Risk factors for pelvic pouch failure. *Dis Colon Rectum* 1997; **40**: 257–62.
- 451 Bullard KM, Madoff RD, Gemlo BT. Is ileoanal pouch function stable with time? Results of a prospective audit. *Dis Colon Rectum* 2002; **45**: 299–304.
- 452 Heuschen UA, Allemeyer EH, Hinz U, Lucas M, Herfarth C, Heuschen G. Outcome after septic complications in J pouch procedures. *Br J Surg* 2002; **89**: 194–200.
- 453 Tulchinsky H, Hawley PR, Nicholls J. Long-term failure after restorative proctocolectomy for ulcerative colitis. *Ann Surg* 2003; **238**: 229–34.
- 454 Karoui M, Cohen R, Nicholls J. Results of surgical removal of the pouch after failed restorative proctocolectomy. *Dis Colon Rectum* 2004; **47**: 869–75.
- 455 Wasmuth HH, Tranø G, Endreseth B, Rydning A, Wibe A, Myrvold HE. Long-term surgical load in patients with ileal pouch-anal anastomosis. *Colorectal Dis* 2009; **11**: 711–8.
- 456 Fazio VW, Wu JS, Lavery IC. Repeat ileal pouch-anal anastomosis to salvage septic complications of pelvic pouches: clinical outcome and quality of life assessment. *Ann Surg* 1998; **228**: 588–97.
- 457 Tekkis PP, Heriot AG, Smith JJ, Das P, Canero A, Nicholls RJ. Long-term results of abdominal salvage surgery following restorative proctocolectomy. *Br J Surg* 2006; **93**: 231–7.
- 458 Remzi FH, Fazio VW, Kirat HT, Wu JS, Lavery IC, Kiran RP. Repeat pouch surgery by the abdominal approach safely salvages failed ileal pelvic pouch. *Dis Colon Rectum* 2009; **52**: 198–204.
- 459 Shawki S, Belizon A, Person B, Weiss EG, Sands DR, Wexner SD. What are the outcomes of reoperative restorative proctocolectomy and ileal pouch-anal anastomosis surgery? *Dis Colon Rectum* 2009; **52**: 884–90.
- 460 Das P, Smith JJ, Tekkis PP, Heriot AG, Antropoli M, John Nicholls R. Quality of life after indefinite diversion/pouch excision in ileal pouch failure patients. *Colorectal Dis* 2007; **9**: 718–24.
- 461 Kock NG. Intra-abdominal “reservoir” in patients with permanent ileostomy. Preliminary observations on a procedure resulting in fecal “continence” in five ileostomy patients. *Arch Surg* 1969; **99**: 223–31.
- 462 Kock NG. Ileostomy without external appliances: a survey of 25 patients provided with intra-abdominal intestinal reservoir. *Ann Surg* 1971; **173**: 545–50.
- 463 Goligher JC. Present status of the continent ileostomy: experience at the General Infirmary, Leeds. *Dis Colon Rectum* 1976; **19**: 195–9.
- 464 Cohen Z. Evolution of the Kock continent reservoir ileostomy. *Can J Surg* 1982; **25**: 509–14.
- 465 Aytac E, Ashburn J, Dietz DW. Is there still a role for continent ileostomy in the surgical treatment of inflammatory bowel disease? *Inflamm Bowel Dis* 2014; **20**: 2519–25.

- 466 Lepisto AH, Jarvinen HJ. Durability of Kock continent ileostomy. *Dis Colon Rectum* 2003; **46**: 925–8.
- 467 Nessar G, Fazio VW, Tekkis P *et al*. Long-term outcome and quality of life after continent ileostomy. *Dis Colon Rectum* 2006; **49**: 336–44.
- 468 Wasmuth HH, Svinsås M, Tranø G *et al*. Surgical load and long-term outcome for patients with Kock continent ileostomy. *Colorectal Dis* 2007; **9**: 713–7.
- 469 Barnett WO. The continent jejunal reservoir in Crohn's colitis. *J Miss State Med Assoc* 1986; **27**: 119–21.
- 470 Bloom RJ, Larsen CP, Watt R, Oberhelman HA Jr. A reappraisal of the Kock continent ileostomy in patients with Crohn's disease. *Surg Gynecol Obstet* 1986; **162**: 105–8.
- 471 Handelsman JC, Gottlieb LM, Hamilton SR. Crohn's disease as a contraindication to Kock pouch (continent ileostomy). *Dis Colon Rectum* 1993; **36**: 840–3.
- 472 Kock NG, Myrvold HE, Nilsson LO. Progress report on the continent ileostomy. *World J Surg* 1980; **4**: 143–8.
- 473 Nessar G, Wu JS. Evolution of continent ileostomy. *World J Gastroenterol* 2012; **18**: 3479–82.
- 474 Kock NG. Continent ileostomy. *Prog Surg* 1973; **12**: 180–201.
- 475 Kock NG. Present status of the continent ileostomy: surgical revision of the malfunctioning ileostomy. *Dis Colon Rectum* 1976; **19**: 200–6.
- 476 Kock NG, Brevinge H, Philipson BM, Ojerskog B. Continent ileostomy. The present technique and long term results. *Ann Chir Gynaecol* 1986; **75**: 63–70.
- 477 Dozois RR, Kelly KA, Beart RW Jr, Behrs OH. Improved results with continent ileostomy. *Ann Surg* 1980; **192**: 319–24.
- 478 Kock NG, Myrvold HE, Nilsson LO, Ahrén C. Construction of a stable nipple valve for the continent ileostomy. *Ann Chir Gynaecol* 1980; **69**: 132–43.
- 479 Weinstein M, Rubin RJ, Salvati EP. Detachment of the continent ileostomy pouch from the anterior abdominal wall: report of two unusual cases. *Dis Colon Rectum* 1976; **19**: 705–6.
- 480 Cranley B, McKelvey ST. The Kock ileostomy reservoir: an experimental study of methods of improving valve stability and competence. *Br J Surg* 1981; **68**: 545–50.
- 481 Lycke KG, Göthlin JH, Jensen JK, Philipson BM, Kock NG. Radiology of the continent ileostomy reservoir: I. Method of examination and normal findings. *Abdom Imaging*, 1994; **19**: 116–23.
- 482 Goligher JC, Lintott D. Experience with 26 reservoir ileostomies. *Br J Surg* 1975; **62**: 893–900.
- 483 Ecker KW, Haberer M, Feifel G. Conversion of the failing ileoanal pouch to reservoir-ileostomy rather than to ileostomy alone. *Dis Colon Rectum* 1996; **39**: 977–80.
- 484 Behrens DT, Paris M, Luttrell JN. Conversion of failed ileal pouch-anal anastomosis to continent ileostomy. *Dis Colon Rectum* 1999; **42**: 490–5; discussion 495–6.
- 485 Lian L, Fazio VW, Remzi FH, Shen B, Dietz D, Kiran RP. Outcomes for patients undergoing continent ileostomy after a failed ileal pouch-anal anastomosis. *Dis Colon Rectum*, 2009; **52**: 1409–14; discussion 4414–6.
- 486 Wasmuth HH, Tranø G, Wibe A, Endreseth BH, Rydning A, Myrvold HE. Failed pelvic pouch substituted by continent ileostomy. *Colorectal Dis* 2010; **12**: e109–13.
- 487 Borjesson L, Oresland T, Hulten L. The failed pelvic pouch: conversion to a continent ileostomy. *Tech Colo-proctol* 2004; **8**: 102–5.
- 488 Wasmuth HH, Myrvold HE. Durability of ileal pouch-anal anastomosis and continent ileostomy. *Dis Colon Rectum* 2009; **52**: 1285–9.
- 489 Wasmuth HH, Tranø G, Myrvold HE, Aabakken L, Bakka A. Adenoma formation and malignancy after restorative proctocolectomy with or without mucosectomy in patients with familial adenomatous polyposis. *Dis Colon Rectum* 2013; **56**: 288–94.
- 490 Beck DE. Clinical aspects of continent ileostomies. *Clin Colon Rectal Surg* 2004; **17**: 57–63.
- 491 Fasth S, Hulten L, Svaninger G. The Kock continent ileostomy: influence of a defunctioning ileostomy and nipple valve stapling on early and late morbidity. *Int J Colorectal Dis* 1987; **2**: 82–6.
- 492 Klingler PJ, Neuhauser B, Peer R, Klingler CH, Bodner E. Nipple complication caused by a mesenteric GORE-TEX sling reinforcement in a Kock ileal reservoir: report of a case. *Dis Colon Rectum* 2001; **44**: 128–30.
- 493 Hulten L, Fasth S. Loop ileostomy for protection of the newly constructed ileostomy reservoir. *Br J Surg* 1981; **68**: 11–3.
- 494 Palselius I. Stoma care in continent ileostomy. *Clin Gastroenterol* 1982; **11**: 278–84.
- 495 Gelernt IM, Bauer JJ, Kreel I. The reservoir ileostomy: early experience with 54 patients. *Ann Surg* 1977; **185**: 179–84.
- 496 Barnett WO. Continent intestinal reservoir. *South Med J* 1987; **80**: 1262–5.
- 497 Barnett WO. Current experiences with the continent intestinal reservoir. *Surg Gynecol Obstet* 1989; **168**: 1–5.
- 498 Mullen P, Behrens D, Chalmers T *et al*. Barnett continent intestinal reservoir. Multicenter experience with an alternative to the Brooke ileostomy. *Dis Colon Rectum* 1995; **38**: 573–82.
- 499 Parc Y, Klouche M, Bennis M, Lefèvre JH, Shields C, Turet E. The continent ileostomy: an alternative to end ileostomy? Short and long-term results of a single institution series. *Dig Liver Dis* 2011; **43**: 779–83.
- 500 Stein JP, Lieskovsky G, Ginsberg DA, Bochner BH, Skinner DG. The T pouch: an orthotopic ileal neobladder incorporating a serosal lined ileal antireflux technique. *J Urol* 1998; **159**: 1836–42.
- 501 Kaiser AM, Stein JP, Beart RW Jr. T-pouch: a new valve design for a continent ileostomy. *Dis Colon Rectum* 2002; **45**: 411–5.
- 502 Kaiser AM. T-pouch: results of the first 10 years with a nonintussuscepting continent ileostomy. *Dis Colon Rectum* 2012; **55**: 155–62.

- 503 Cranley B. The Kock reservoir ileostomy: a review of its development, problems and role in modern surgical practice. *Br J Surg* 1983; **70**: 94–9.
- 504 Denoya PI, Schluender SJ, Bub DS, Gorfine SR, Bauer JJ. Delayed Kock pouch nipple valve failure: is revision indicated? *Dis Colon Rectum* 2008; **51**: 1544–7.
- 505 Halvorsen JF, Heimann P, Hoel R, Nygaard K. The continent reservoir ileostomy: review of a collective series of thirty-six patients from three surgical departments. *Surgery* 1978; **83**: 252–8.
- 506 Gerber A, Apt MK, Craig PH. The Kock continent ileostomy. *Surg Gynecol Obstet* 1983; **156**: 345–50.
- 507 Flake WK, Altman MS, Cartmill AM, Gilsdorf RB. Problems encountered with the Kock ileostomy. *Am J Surg* 1979; **138**: 851–5.
- 508 Thompson JS, Williams SM. Fistula following continent ileostomy. *Dis Colon Rectum* 1984; **27**: 193–5.
- 509 Chen M, Shen B. Endoscopic needle-knife stricturotomy for nipple valve stricture of continent ileostomy (with video). *Gastrointest Endosc* 2015; **81**: 1287–8; discussion 1288–9.
- 510 Svaninger G, Nordgren S, Oresland T, Hultén L. Incidence and characteristics of pouchitis in the Kock continent ileostomy and the pelvic pouch. *Scand J Gastroenterol* 1993; **28**: 695–700.
- 511 Bonello JC, Thow GB, Manson RR. Mucosal enteritis: a complication of the continent ileostomy. *Dis Colon Rectum* 1981; **24**: 37–41.
- 512 Jarvinen HJ, Makitie A, Sivula A. Long-term results of continent ileostomy. *Int J Colorectal Dis* 1986; **1**: 40–3.
- 513 Schjonsby H, Halvorsen JF, Hofstad T, Hovdenak N. Stagnant loop syndrome in patients with continent ileostomy (intra-abdominal ileal reservoir). *Gut* 1977; **18**: 795–9.
- 514 Kelly DG, Phillips SF, Kelly KA, Weinstein WM, Gilchrist MJ. Dysfunction of the continent ileostomy: clinical features and bacteriology. *Gut* 1983; **24**: 193–201.
- 515 Go PM, van Dieijen-Visser MP, Davies BI, Lens J, Brombacher PJ. Microbial flora and bile acid metabolism in patients with an ileal reservoir. *Scand J Gastroenterol* 1988; **23**: 229–36.
- 516 Fox ER, Chung T, Laufer I. Enteroliths in a continent ileostomy. *AJR Am J Roentgenol* 1988; **150**: 105–6.
- 517 Geller A, Clain JE, Lewis BS, Gostout CJ. Enteroliths in a Kock continent ileostomy: endoscopic diagnosis and management. *Gastrointest Endosc* 1998; **48**: 306–8.
- 518 Moattar H, Begun J, Florin T. Enteroliths in a Kock continent ileostomy: case report and review of the literature. *Endoscopy* 2015; **47**(Suppl. 1 UCTN): E200–1.
- 519 Baig MK, Valerian B, Hakim L, Ghoniem G, Wexner SD. Holmium: yttrium aluminium garnet laser lithotripsy for symptomatic Kock pouch calculi. *Surg Innov* 2006; **13**: 193–7.
- 520 McLeod RS, Taylor DW, Cohen Z, Cullen JB. Single-patient randomised clinical trial. Use in determining optimum treatment for patient with inflammation of Kock continent ileostomy reservoir. *Lancet* 1986; **1**: 726–8.
- 521 Nilsson LO, Kock NG, Lindgren I, Myrvold HE, Philipson BM, Ahrén C. Morphological and histochemical changes in the mucosa of the continent ileostomy reservoir 6–10 years after its construction. *Scand J Gastroenterol* 1980; **15**: 737–47.
- 522 Thompson JS, Gilroy R, Sudan D. Short bowel syndrome after continence-preserving procedures. *J Gastrointest Surg* 2008; **12**: 73–6.
- 523 Ojerskog B, Kock NG, Nilsson LO, Philipson BM, Ahrén C. Long-term follow-up of patients with continent ileostomies. *Dis Colon Rectum* 1990; **33**: 184–9.
- 524 Lycke KG, Göthlin JH, Jensen JK, Philipson BM, Kock NG. Comparison between radiologic and endoscopic evaluation of the continent ileostomy reservoir. *Scand J Gastroenterol* 1993; **28**: 1115–20.
- 525 Lycke KG, Göthlin JH, Jensen JK, Philipson BM, Kock NG. Radiology of the continent ileostomy reservoir: II. Findings in patients with late complications. *Abdom Imaging* 1994; **19**: 124–31.
- 526 Litle VR, Barbour S, Schrock TR, Welton ML. The continent ileostomy: long-term durability and patient satisfaction. *J Gastrointest Surg* 1999; **3**: 625–32.
- 527 Berndtsson IE, Lindholm E, Oresland T, Hultén L. Health-related quality of life and pouch function in continent ileostomy patients: a 30-year perspective. *Dis Colon Rectum* 2004; **47**: 2131–7.
- 528 Hultén L, Willén R, Nilsson O, Safarani N, Haboubi N. Mucosal assessment for dysplasia and cancer in the ileal pouch mucosa in patients operated on for ulcerative colitis—a 30-year follow-up study. *Dis Colon Rectum* 2002; **45**: 448–52.
- 529 Singh B, McC Mortensen NJ, Jewell DP, George B. Perianal Crohn's disease. *Br J Surg* 2004; **91**: 801–14.
- 530 Safar B, Sands D. Perianal Crohn's disease. *Clin Colon Rectal Surg* 2007; **20**: 282–93.
- 531 American Gastroenterological Association Clinical Practice Committee. American Gastroenterological Association medical position statement: perianal Crohn's disease. *Gastroenterology* 2003; **125**: 1503–7.
- 532 Van Assche G, Dignass A, Reinisch W *et al*. The second European evidence-based Consensus on the diagnosis and management of Crohn's disease: special situations. *J Crohns Colitis* 2010; **4**: 63–101.
- 533 Gecse KB, Bemelman W, Kamm MA *et al*. A global consensus on the classification, diagnosis and multidisciplinary treatment of perianal fistulising Crohn's disease. *Gut* 2014; **63**: 1381–92.
- 534 Chaparro M, Zanotti C, Burgueño P *et al*. Health care costs of complex perianal fistula in Crohn's disease. *Dig Dis Sci* 2013; **58**: 3400–6.
- 535 Buchmann P, Keighley MR, Allan RN, Thompson H, Alexander-Williams J. Natural history of perianal Crohn's disease. Ten year follow-up: a plea for conservatism. *Am J Surg* 1980; **140**: 642–4.
- 536 van Dongen LM, Lubbers EJ. Perianal fistulas in patients with Crohn's disease. *Arch Surg* 1986; **121**: 1187–90.

- 537 Williams JG, MacLeod CA, Rothenberger DA, Goldberg SM. Seton treatment of high anal fistulae. *Br J Surg* 1991; **78**: 1159–61.
- 538 Taxonera C, Schwartz DA, Garcia-Olmo D. Emerging treatments for complex perianal fistula in Crohn's disease. *World J Gastroenterol* 2009; **15**: 4263–72.
- 539 Haennig A, Staumont G, Lepage B *et al.* The results of seton drainage combined with anti-TNF α therapy for anal fistula in Crohn's disease. *Colorectal Dis* 2015; **17**: 311–9.
- 540 de Groof EJ, Sahami S, Lucas C, Ponsioen CY, Bemelman WA, Buskens CJ. Treatment of perianal fistulas in Crohn's disease: a systematic review and meta-analysis comparing seton drainage and anti-TNF treatment. *Colorectal Dis* 2016; **8**: 667–75.
- 541 Yassin NA, Askari A, Warusavitarnae J *et al.* Systematic review: the combined surgical and medical treatment of fistulising perianal Crohn's disease. *Aliment Pharmacol Ther* 2014; **40**: 741–9.
- 542 Talbot C, Sagar PM, Johnston MJ, Finan PJ, Burke D. Infliximab in the surgical management of complex fistulating anal Crohn's disease. *Colorectal Dis* 2005; **7**: 164–8.
- 543 Tozer P, Ng SC, Siddiqui MR. Long-term MRI-guided combined anti-TNF- α and thiopurine therapy for Crohn's perianal fistulas. *Inflamm Bowel Dis* 2012; **18**: 1825–34.
- 544 Régimbeau JM, Panis Y, Marteau P, Benoist S, Valleur P. Surgical treatment of anoperineal Crohn's disease: can abdominoperineal resection be predicted? *J Am Coll Surg* 1999; **189**: 171–6.
- 545 Tougeron D, Savoye G, Savoye-Collet C, Koning E, Michot F, Lerebours E. Predicting factors of fistula healing and clinical remission after infliximab-based combined therapy for perianal fistulizing Crohn's disease. *Dig Dis Sci* 2009; **54**: 1746–52.
- 546 Lunniss PJ, Kamm MA, Phillips RK. Factors affecting continence after surgery for anal fistula. *Br J Surg* 1994; **81**: 1382–5.
- 547 Hamalainen KP, Sainio AP. Cutting seton for anal fistulas: high risk of minor control defects. *Dis Colon Rectum* 1997; **40**: 1443–6; discussion 1447.
- 548 Thornton M, Solomon MJ. Long-term indwelling seton for complex anal fistulas in Crohn's disease. *Dis Colon Rectum* 2005; **48**: 459–63.
- 549 Nasserri Y, Cassella L, Berns M, Zaghiyan K, Cohen J. The anal fistula plug in Crohn's disease patients with fistula-in-ano: a systematic review. *Colorectal Dis* 2016; **18**: 351–6.
- 550 Senejoux A, Siproudhis L, Abramowitz L *et al.* Fistula plug in fistulising ano-perineal Crohn's disease: a randomised controlled trial. *J Crohns Colitis* 2016; **10**: 141–8.
- 551 Gingold DS, Murrell ZA, Fleshner PR. A prospective evaluation of the ligation of the intersphincteric tract procedure for complex anal fistula in patients with Crohn's disease. *Ann Surg* 2014; **260**: 1057–61.
- 552 Ellis CN. Outcomes with the use of bioprosthetic grafts to reinforce the ligation of the intersphincteric fistula tract (BioLIFT procedure) for the management of complex anal fistulas. *Dis Colon Rectum* 2010; **53**: 1361–4.
- 553 Soltani A, Kaiser AM. Endorectal advancement flap for cryptoglandular or Crohn's fistula-in-ano. *Dis Colon Rectum* 2010; **53**: 486–95.
- 554 Levy C, Tremaine WJ. Management of internal fistulas in Crohn's disease. *Inflamm Bowel Dis* 2002; **8**: 106–11.
- 555 Grimaud JC, Munoz-Bongrand N, Siproudhis L *et al.* Fibrin glue is effective healing perianal fistulas in patients with Crohn's disease. *Gastroenterology* 2010; **138**: 2275–81, 2281 e1.
- 556 Vitton V, Gasmi M, Barthet M, Desjeux A, Orsoni P, Grimaud JC. Long-term healing of Crohn's anal fistulas with fibrin glue injection. *Aliment Pharmacol Ther* 2005; **21**: 1453–7.
- 557 Buchanan GN, Bartram CI, Phillips Robin KS *et al.* Efficacy of fibrin sealant in the management of complex anal fistula: a prospective trial. *Dis Colon Rectum* 2003; **46**: 1167–74.
- 558 Patrlj L, Kocman B, Martinac M *et al.* Fibrin glue-antibiotic mixture in the treatment of anal fistulae: experience with 69 cases. *Dig Surg* 2000; **17**: 77–80.
- 559 Singer M, Cintron J, Nelson R *et al.* Treatment of fistulas-in-ano with fibrin sealant in combination with intra-adhesive antibiotics and/or surgical closure of the internal fistula opening. *Dis Colon Rectum* 2005; **48**: 799–808.
- 560 Sileri P, Boehm G, Franceschilli L *et al.* Collagen matrix injection combined with flap repair for complex anal fistula. *Colorectal Dis* 2012; **14**(Suppl. 3): 24–8.
- 561 Narang SK, Keogh K, Alam NN, Pathak S, Daniels IR, Smart NJ. A systematic review of new treatments for cryptoglandular fistula in ano. *Surgeon* 2017; **15**: 30–9.
- 562 Mennigen R, Laukötter M, Senninger N, Rijcken E. The OTSC((R)) proctology clip system for the closure of refractory anal fistulas. *Tech Coloproctol* 2015; **19**: 241–6.
- 563 Giamundo P, Esercizio L, Geraci M, Tibaldi L, Valente M. Fistula-tract Laser Closure (FiLaC): long-term results and new operative strategies. *Tech Coloproctol* 2015; **19**: 449–53.
- 564 Meinerio P, Mori L. Video-assisted anal fistula treatment (VAAFT): a novel sphincter-saving procedure for treating complex anal fistulas. *Tech Coloproctol* 2011; **15**: 417–22.
- 565 Kasperek MS, Glatzle J, Temeltcheva T, Mueller MH, Koenigsrainer A, Kreis ME. Long-term quality of life in patients with Crohn's disease and perianal fistulas: influence of fecal diversion. *Dis Colon Rectum* 2007; **50**: 2067–74.
- 566 Gu J, Valente MA, Remzi FH, Stocchi L. Factors affecting the fate of faecal diversion in patients with perianal Crohn's disease. *Colorectal Dis* 2015; **17**: 66–72.
- 567 Sauk J, Nguyen D, Yajnik V *et al.* Natural history of perianal Crohn's disease after fecal diversion. *Inflamm Bowel Dis* 2014; **20**: 2260–5.
- 568 Yamamoto T, Allan RN, Keighley MR. Audit of single-stage proctocolectomy for Crohn's disease: postoperative complications and recurrence. *Dis Colon Rectum* 2000; **43**: 249–56.

- 569 Brough WA, Schofield PF. The value of the rectus abdominis myocutaneous flap in the treatment of complex perineal fistula. *Dis Colon Rectum* 1991; **34**: 148–50.
- 570 Shahzad F, Wong KY, Di Candia M, Menon M, Malata CM. Gluteal fold flap in perineal reconstruction for Crohn's disease-associated fistulae. *J Plast Reconstr Aesthet Surg* 2014; **67**: 1587–90.
- 571 Rius J, Nessim A, Noguera JJ, Wexner SD. Gracilis transposition in complicated perianal fistula and unhealed perineal wounds in Crohn's disease. *Eur J Surg* 2000; **166**: 218–22.
- 572 Ingle SB, Loftus EV Jr. The natural history of perianal Crohn's disease. *Dig Liver Dis* 2007; **39**: 963–9.
- 573 Keighley MR, Allan RN. Current status and influence of operation on perianal Crohn's disease. *Int J Colorectal Dis* 1986; **1**: 104–7.
- 574 Alexander-Williams J, Allan A, Morel P, Hawker PC, Dykes PW, O'Connor H. The therapeutic dilatation of enteric strictures due to Crohn's disease. *Ann R Coll Surg Engl* 1986; **68**: 95–7.
- 575 Wolkomir AF, Luchtefeld MA. Surgery for symptomatic hemorrhoids and anal fissures in Crohn's disease. *Dis Colon Rectum* 1993; **36**: 545–7.
- 576 Sandborn WJ, Fazio VW, Feagan BG, Hanauer SB. American Gastroenterological Association Clinical Practice Committee. AGA technical review on perianal Crohn's disease. *Gastroenterology* 2003; **125**: 1508–30.
- 577 Karin E, Avital S, Dotan I, Skornick Y, Greenberg R. Doppler-guided haemorrhoidal artery ligation in patients with Crohn's disease. *Colorectal Dis* 2012; **14**: 111–4.
- 578 Hughes LE, Donaldson DR, Williams JG, Taylor BA, Young HL. Local depot methylprednisolone injection for painful anal Crohn's disease. *Gastroenterology* 1988; **94**: 709–11.
- 579 Eradi B, Sandhu BK, Spray C, Cusick E. Highly destructive perianal Crohn disease. *J Pediatr Gastroenterol Nutr* 2005; **41**: 667–9.
- 580 Schwartz DA, Loftus EV Jr, Tremaine WJ *et al*. The natural history of fistulizing Crohn's disease in Olmsted County, Minnesota. *Gastroenterology* 2002; **122**: 875–80.
- 581 Hannaway CD, Hull TL. Current considerations in the management of rectovaginal fistula from Crohn's disease. *Colorectal Dis* 2008; **10**: 747–55; discussion 755–6.
- 582 Andreani SM, Dang HH, Grondona P, Khan AZ, Edwards DP. Rectovaginal fistula in Crohn's disease. *Dis Colon Rectum* 2007; **50**: 2215–22.
- 583 Radcliffe AG, Ritchie JK, Hawley PR, Lennard-Jones JE, Northover JM. Anovaginal and rectovaginal fistulas in Crohn's disease. *Dis Colon Rectum* 1988; **31**: 94–9.
- 584 Scott NA, Nair A, Hughes LE. Anovaginal and rectovaginal fistula in patients with Crohn's disease. *Br J Surg* 1992; **79**: 1379–80.
- 585 Ruffolo C, Scarpa M, Bassi D, Angriman I. Inflammatory fibroid polyp causing intestinal obstruction following restorative proctocolectomy for ulcerative colitis. *Dig Surg* 2009; **26**: 285–6.
- 586 Dwarkasing S, Hussain SM, Hop WC, Krestin GP. Anovaginal fistulas: evaluation with endoanal MR imaging. *Radiology* 2004; **231**: 123–8.
- 587 Sloots CE, Felt-Bersma RJ, Poen AC, Cuesta MA. Assessment and classification of never operated and recurrent cryptoglandular fistulas-in-ano using hydrogen peroxide enhanced transanal ultrasound. *Colorectal Dis* 2001; **3**: 422–6.
- 588 Sloots CE, Felt-Bersma RJ, Poen AC, Cuesta MA, Meuwissen SG. Assessment and classification of fistula-in-ano in patients with Crohn's disease by hydrogen peroxide enhanced transanal ultrasound. *Int J Colorectal Dis* 2001; **16**: 292–7.
- 589 Baig MK, Zhao RH, Yuen CH *et al*. Simple rectovaginal fistulas. *Int J Colorectal Dis* 2000; **15**: 323–7.
- 590 Maconi G, Ardizzone S, Greco S, Radice E, Bezzio C, Bianchi Porro G. Transperineal ultrasound in the detection of perianal and rectovaginal fistulae in Crohn's disease. *Am J Gastroenterol* 2007; **102**: 2214–9.
- 591 Zhu YF, Tao GQ, Zhou N, Xiang C. Current treatment of rectovaginal fistula in Crohn's disease. *World J Gastroenterol* 2011; **17**: 963–7.
- 592 Brandt LJ, Bernstein LH, Boley SJ, Frank MS. Metronidazole therapy for perineal Crohn's disease: a follow-up study. *Gastroenterology* 1982; **83**: 383–7.
- 593 Turunen UM, Färkkilä MA, Hakala K *et al*. Long-term treatment of ulcerative colitis with ciprofloxacin: a prospective, double-blind, placebo-controlled study. *Gastroenterology* 1998; **115**: 1072–8.
- 594 Dejaco C, Harrer M, Waldhoer T, Miehsler W, Vogelsang H, Reinisch W. Antibiotics and azathioprine for the treatment of perianal fistulas in Crohn's disease. *Aliment Pharmacol Ther* 2003; **18**: 1113–20.
- 595 Hanauer SB, Smith MB. Rapid closure of Crohn's disease fistulas with continuous intravenous cyclosporin A. *Am J Gastroenterol* 1993; **88**: 646–9.
- 596 Present DH, Korelitz BI, Wisch N, Glass JL, Sachar DB, Pasternack BS. Treatment of Crohn's disease with 6-mercaptopurine. A long-term, randomized, double-blind study. *N Engl J Med* 1980; **302**: 981–7.
- 597 Hanauer SB, Feagan BG, Lichtenstein GR *et al*. Maintenance infliximab for Crohn's disease: the ACCENT I randomised trial. *Lancet* 2002; **359**: 1541–9.
- 598 Sands BE, Blank MA, Patel K, van Deventer SJ, ACCENT II Study. Long-term treatment of rectovaginal fistulas in Crohn's disease: response to infliximab in the ACCENT II Study. *Clin Gastroenterol Hepatol* 2004; **2**: 912–20.
- 599 Ruffolo C, Penninckx F, Van Assche G *et al*. Outcome of surgery for rectovaginal fistula due to Crohn's disease. *Br J Surg* 2009; **96**: 1190–5.
- 600 Gaertner WB, Madoff RD, Spencer MP, Mellgren A, Goldberg SM, Lowry AC. Results of combined medical and surgical treatment of recto-vaginal fistula in Crohn's disease. *Colorectal Dis* 2011; **13**: 678–83.
- 601 Nosti PA, Stahl TJ, Sokol AI. Surgical repair of rectovaginal fistulas in patients with Crohn's disease. *Eur J Obstet Gynecol Reprod Biol* 2013; **171**: 166–70.

- 602 Sonoda T, Hull T, Piedmonte MR, Fazio VW. Outcomes of primary repair of anorectal and rectovaginal fistulas using the endorectal advancement flap. *Dis Colon Rectum* 2002; **45**: 1622–8.
- 603 Hull TL, Fazio VW. Surgical approaches to low anovaginal fistula in Crohn's disease. *Am J Surg* 1997; **173**: 95–8.
- 604 Athanasiadis S, Yazigi R, Köhler A, Helmes C. Recovery rates and functional results after repair for rectovaginal fistula in Crohn's disease: a comparison of different techniques. *Int J Colorectal Dis* 2007; **22**: 1051–60.
- 605 Bell SJ, Williams AB, Wiesel P, Wilkinson K, Cohen RC, Kamm MA. The clinical course of fistulating Crohn's disease. *Aliment Pharmacol Ther* 2003; **17**: 1145–51.
- 606 Tozer PJ, Balmforth D, Kayani B, Rahbour G, Hart AL, Phillips RK. Surgical management of rectovaginal fistula in a tertiary referral centre: many techniques are needed. *Colorectal Dis* 2013; **15**: 871–7.
- 607 El-Gazzaz G, Hull T, Mignanelli E, Hammel J, Gurland B, Zutshi M. Analysis of function and predictors of failure in women undergoing repair of Crohn's related rectovaginal fistula. *J Gastrointest Surg* 2010; **14**: 824–9.
- 608 Cohen JL, Stricker JW, Schoetz DJ Jr, Collier JA, Veidenheimer MC. Rectovaginal fistula in Crohn's disease. *Dis Colon Rectum* 1989; **32**: 825–8.
- 609 Sher ME, Bauer JJ, Gelernt I. Surgical repair of rectovaginal fistulas in patients with Crohn's disease: transvaginal approach. *Dis Colon Rectum* 1991; **34**: 641–8.
- 610 Bauer JJ, Sher ME, Jaffin H, Present D, Gelernt I. Transvaginal approach for repair of rectovaginal fistulae complicating Crohn's disease. *Ann Surg* 1991; **213**: 151–8.
- 611 Bandy LC, Addison A, Parker RT. Surgical management of rectovaginal fistulas in Crohn's disease. *Am J Obstet Gynecol* 1983; **147**: 359–63.
- 612 Morrison JG, Gathright JB Jr, Ray JE, Ferrari BT, Hicks TC, Timmcke AE. Results of operation for rectovaginal fistula in Crohn's disease. *Dis Colon Rectum* 1989; **32**: 497–9.
- 613 Hesterberg R, Schmidt WU, Müller F, Röher HD. Treatment of anovaginal fistulas with an anocutaneous flap in patients with Crohn's disease. *Int J Colorectal Dis* 1993; **8**: 51–4.
- 614 O'Leary DP, Milroy CE, Durdey P. Definitive repair of anovaginal fistula in Crohn's disease. *Ann R Coll Surg Engl* 1998; **80**: 250–2.
- 615 Penninckx F, D'Hoore A, Filez L. Advancement flap plasty for the closure of anal and recto-vaginal fistulas in Crohn's disease. *Acta Gastroenterol Belg* 2001; **64**: 223–6.
- 616 Ruffolo C, Scarpa M, Bassi N, Angriman I. A systematic review on advancement flaps for rectovaginal fistula in Crohn's disease: transrectal vs transvaginal approach. *Colorectal Dis* 2010; **12**: 1183–91.
- 617 O'Riordan JM, Datta I, Johnston C, Baxter NN. A systematic review of the anal fistula plug for patients with Crohn's and non-Crohn's related fistula-in-ano. *Dis Colon Rectum* 2012; **55**: 351–8.
- 618 Gajsek U, McArthur DR, Sagar PM. Long-term efficacy of the button fistula plug in the treatment of Ileal pouch-vaginal and Crohn's-related rectovaginal fistulas. *Dis Colon Rectum* 2011; **54**: 999–1002.
- 619 Schwandner O, Fuerst A, Kunstreich K, Scherer R. Innovative technique for the closure of rectovaginal fistula using Surgisis mesh. *Tech Coloproctol* 2009; **13**: 135–40.
- 620 Gonsalves S, Sagar P, Lengyel J, Morrison C, Dunham R. Assessment of the efficacy of the rectovaginal button fistula plug for the treatment of ileal pouch-vaginal and rectovaginal fistulas. *Dis Colon Rectum* 2009; **52**: 1877–81.
- 621 Wexner SD, Ruiz DE, Genua J, Noguera JJ, Weiss EG, Zmora O. Gracilis muscle interposition for the treatment of rectourethral, rectovaginal, and pouch-vaginal fistulas: results in 53 patients. *Ann Surg* 2008; **248**: 39–43.
- 622 Takano S, Boutros M, Wexner SD. Gracilis muscle transposition for complex perineal fistulas and sinuses: a systematic literature review of surgical outcomes. *J Am Coll Surg* 2014; **219**: 313–23.
- 623 Klionsky DJ, Abdelmohsen K, Abe A *et al.* Guidelines for the use and interpretation of assays for monitoring autophagy (3rd edition). *Autophagy* 2016; **12**: 1–222.
- 624 Fürst A, Schmidbauer C, Swol-Ben J, Iesalnieks I, Schwandner O, Agha A. Gracilis transposition for repair of recurrent anovaginal and rectovaginal fistulas in Crohn's disease. *Int J Colorectal Dis* 2008; **23**: 349–53.
- 625 Pitel S, Lefevre JH, Parc Y, Chafai N, Shields C, Turet E. Martius advancement flap for low rectovaginal fistula: short- and long-term results. *Colorectal Dis* 2011; **13**: e112–5.
- 626 Songne K, Scotté M, Lubrano J *et al.* Treatment of anovaginal or rectovaginal fistulas with modified Martius graft. *Colorectal Dis* 2007; **9**: 653–6.
- 627 Marchesa P, Hull TL, Fazio VW. Advancement sleeve flaps for treatment of severe perianal Crohn's disease. *Br J Surg* 1998; **85**: 1695–8.
- 628 Simmang CL, Lacey SW, Huber PJ Jr. Rectal sleeve advancement: repair of rectovaginal fistula associated with anorectal stricture in Crohn's disease. *Dis Colon Rectum* 1998; **41**: 787–9.
- 629 Cutait DE, Figliolini FJ. A new method of colorectal anastomosis in abdominoperineal resection. *Dis Colon Rectum* 1961; **4**: 335–42.
- 630 de Weerd L, Weum S, Norderval S. Novel treatment for recalcitrant rectovaginal fistulas: fat injection. *Int Urogynecol J* 2015; **26**: 139–44.
- 631 García-Olmo D, García-Arranz M, García LG *et al.* Autologous stem cell transplantation for treatment of rectovaginal fistula in perianal Crohn's disease: a new cell-based therapy. *Int J Colorectal Dis* 2003; **18**: 451–4.
- 632 García-Arranz M, Herreros MD, González-Gómez C *et al.* Treatment of Crohn's-related rectovaginal fistula with allogeneic expanded-adipose derived stem cells: a phase I-IIa clinical trial. *Stem Cells Transl Med* 2016; **5**: 1441–6.

- 633 Loffler T, Welsch T, Mühl S, Hinz U, Schmidt J, Kienle P. Long-term success rate after surgical treatment of anorectal and rectovaginal fistulas in Crohn's disease. *Int J Colorectal Dis* 2009; **24**: 521–6.
- 634 Heyen F, Winslet MC, Andrews H, Alexander-Williams J, Keighley MR. Vaginal fistulas in Crohn's disease. *Dis Colon Rectum* 1989; **32**: 379–83.
- 635 Wexner SD, Rothenberger DA, Jensen L *et al*. Ileal pouch vaginal fistulas: incidence, etiology, and management. *Dis Colon Rectum* 1989; **32**: 460–5.
- 636 Groom JS, Nicholls RJ, Hawley PR, Phillips RKS. Pouch-vaginal fistula. *Br J Surg* 1993; **80**: 936–40.
- 637 Lee PY, Fazio VW, Church JM, Hull TL, Eu K-W, Laverty IC. Vaginal fistula following restorative proctocolectomy. *Dis Colon Rectum* 1997; **40**: 752–9.
- 638 Mallick IH, Hull TL, Remzi FH, Kiran RP. Management and outcome of pouch-vaginal fistulas after IPAA surgery. *Dis Colon Rectum* 2014; **57**: 490–6.
- 639 Shah NS, Remzi F, Massmann A, Baixauli J, Fazio VW. Management and treatment outcome of pouch-vaginal fistulas following restorative proctocolectomy. *Dis Colon Rectum* 2003; **46**: 911–7.
- 640 Burke D, van Laarhoven CJ, Herbst F, Nicholls RJ. Transvaginal repair of pouch-vaginal fistula. *Br J Surg* 2001; **88**: 241–5.
- 641 Fazio VW, Tjandra JJ. Pouch advancement and neoleoanal anastomosis for anastomotic stricture and anovaginal fistula complicating restorative proctocolectomy. *Br J Surg* 1992; **79**: 694–6.
- 642 Gorenstein L, Boyd JB, Ross TM. Gracilis muscle repair of rectovaginal fistula after restorative proctocolectomy. Report of two cases. *Dis Colon Rectum* 1988; **31**: 730–4.
- 643 Heriot AG, Tekkis PP, Smith JJ, Bona R, Cohen RG, Nicholls JR. Management and outcome of pouch-vaginal fistulas following restorative proctocolectomy. *Dis Colon Rectum* 2005; **48**: 451–8.
- 644 Nugent FW, Roy MA. Duodenal Crohn's disease: an analysis of 89 cases. *Am J Gastroenterol* 1989; **84**: 249–54.
- 645 Griffiths AM, Alemayehu E, Sherman P. Clinical features of gastroduodenal Crohn's disease in adolescents. *J Pediatr Gastroenterol Nutr* 1989; **8**: 166–71.
- 646 Lenaerts C, Roy CC, Vaillancourt M, Weber AM, Morin CL, Seidman E. High incidence of upper gastrointestinal tract involvement in children with Crohn disease. *Pediatrics* 1989; **83**: 777–81.
- 647 Horjus Talabur Horje CS, Meijer J, Rovers L, van Lochem EG, Groenen MJM, Wahab PJ. Prevalence of upper gastrointestinal lesions at primary diagnosis in adults with inflammatory bowel disease. *Inflamm Bowel Dis* 2016; **22**: 1896–901.
- 648 Wright CL, Riddell RH. Histology of the stomach and duodenum in Crohn's disease. *Am J Surg Pathol* 1998; **22**: 383–90.
- 649 Sakuraba A, Iwao Y, Matsuoka K *et al*. Endoscopic and pathologic changes of the upper gastrointestinal tract in Crohn's disease. *Biomed Res Int* 2014; **2014**: 610767.
- 650 Iizuka M, Harada T, Yamano HO, Etou T, Sagara S. Typical gastroduodenal endoscopic findings in a Crohn's disease patient in remission stage. *World J Gastrointestinal Endoscopy* 2012; **4**: 96–8.
- 651 Karateke F, Menekşe E, Das K, Ozyazici S, Demirtürk P. Isolated duodenal Crohn's disease: a case report and a review of the surgical management. *Case Rep Surg* 2013; **2013**: 421961.
- 652 Kim YL, Park YS, Park EK *et al*. Refractory duodenal Crohn's disease successfully treated with infliximab. *Intestinal Res* 2014; **12**: 66–9.
- 653 Racz JM, Davies W. Severe stricturing Crohn's disease of the duodenum: a case report and review of surgical options. *Int J Surg Case Rep* 2012; **3**: 242–5.
- 654 Song DJ, Whang IS, Choi HW, Jeong CY, Jung SH. Crohn's disease confined to the duodenum: a case report. *World J Clin Cases* 2016; **4**: 146–50.
- 655 Rutgeerts P, Onette E, Vantrappen G, Geboes K, Broeckaert L, Talloen L. Crohn's disease of the stomach and duodenum: a clinical study with emphasis on the value of endoscopy and endoscopic biopsies. *Endoscopy* 1980; **12**: 288–94.
- 656 Mottet C, Vader J-P, Felley C *et al*. Appropriate management of special situations in Crohn's disease (upper gastro-intestinal; extra-intestinal manifestations; drug safety during pregnancy and breastfeeding): results of a multidisciplinary international expert panel-EPACT II. *J Crohn's Colitis* 2009; **3**: 257–63.
- 657 Ross TM, Fazio VW, Farmer RG. Long-term results of surgical treatment for Crohn's disease of the duodenum. *Ann Surg* 1983; **197**: 399–406.
- 658 Shapiro M, Greenstein AJ, Byrn J *et al*. Surgical management and outcomes of patients with duodenal Crohn's disease. *J Am Coll Surg* 2008; **207**: 36–42.
- 659 Worsey MJ, Hull T, Ryland L, Fazio V. Strictureplasty is an effective option in the operative management of duodenal Crohn's disease. *Dis Colon Rectum* 1999; **42**: 596–600.
- 660 Yamamoto T, Bain IM, Connolly AB, Allan RN, Keighley MR. Outcome of strictureplasty for duodenal Crohn's disease. *Br J Surg* 1999; **86**: 259–62.
- 661 Klein S, Greenstein AJ, Sachar DB. Duodenal fistulas in Crohn's disease. *J Clin Gastroenterol* 1987; **9**: 46–9.
- 662 Xingjun G, Feng Z, Min W, Renyi Q. Laparoscopic Pancreaticoduodenectomy for the Management of Localized Crohn's Disease of the Duodenum. *Ind J Surg* 2016; **78**: 331–3.
- 663 Sakakibara Y, Yamada T, Kimura K *et al*. A case report of a duodenal adenocarcinoma: a complication with Crohn's disease. *Nihon Shokakibyō Gakkai zasshi* 2016; **113**: 441–50.
- 664 Bernell O, Lapidus A, Hellers G. Risk factors for surgery and postoperative recurrence in Crohn's disease. *Ann Surg* 2000; **231**: 38–45.
- 665 Jeuring SF, van den Heuvel TRA, Liu LYL *et al*. Improvements in the long-term outcome of Crohn's disease over the past two decades and the relation to changes in medical

- management: results from the population-based IBDSL cohort. *Am J Gastroenterol* 2017; **112**: 325–36.
- 666 Roy P, Kumar D. Strictureplasty. *Br J Surg* 2004; **91**: 1428–37.
- 667 Agwunobi AO, Carlson GL, Anderson ID, Irving MH, Scott NA. Mechanisms of intestinal failure in Crohn's disease. *Dis Colon Rectum* 2001; **44**: 1834–7.
- 668 Reese GE, Nanidis T, Borysiewicz C, Yamamoto T, Orchard T, Tekkis PP. The effect of smoking after surgery for Crohn's disease: a meta-analysis of observational studies. *Int J Colorectal Dis* 2008; **23**: 1213–21.
- 669 Nunes T, Etchevers MJ, García-Sánchez V, *et al.* Impact of smoking cessation on the clinical course of Crohn's disease under current therapeutic algorithms: a multicenter prospective study. *Am J Gastroenterol* 2016; **111**: 411–9.
- 670 Thomsen T, Villebro N, Moller AM. Interventions for preoperative smoking cessation. *Cochrane Database Syst Rev* 2010; CD002294.
- 671 Buisson A, Chevaux J-B, Bommelaer G, Peyrin-Biroulet L. Diagnosis, prevention and treatment of postoperative Crohn's disease recurrence. *Dig Liver Dis* 2012; **44**: 453–60.
- 672 Yamamoto T, Bamba T, Umegae S, Matsumoto K. The impact of early endoscopic lesions on the clinical course of patients following ileocolonic resection for Crohn's disease: a 5-year prospective cohort study. *United European Gastroenterol J* 2013; **1**: 294–8.
- 673 De Cruz P, Kamm MA, Hamilton AL *et al.* Crohn's disease management after intestinal resection: a randomised trial. *Lancet* 2015; **385**: 1406–17.
- 674 Koilakou S, Sailer J, Peloschek P *et al.* Endoscopy and MR enteroclysis: equivalent tools in predicting clinical recurrence in patients with Crohn's disease after ileocolic resection. *Inflamm Bowel Dis* 2010; **16**: 198–203.
- 675 Soyer P, Boudiaf M, Sirol M *et al.* Suspected anastomotic recurrence of Crohn disease after ileocolic resection: evaluation with CT enteroclysis. *Radiology* 2010; **254**: 755–64.
- 676 Qiu Y, Mao R, Chen BL *et al.* Fecal calprotectin for evaluating postoperative recurrence of Crohn's disease: a meta-analysis of prospective studies. *Inflamm Bowel Dis* 2015; **21**: 315–22.
- 677 Schoepfer AM, Lewis JD. Serial fecal calprotectin measurements to detect endoscopic recurrence in postoperative Crohn's disease: is colonoscopic surveillance no longer needed? *Gastroenterology* 2015; **148**: 889–92.
- 678 Kamm MA, De Cruz PP, Wright EK *et al.* OP023 Optimising post-operative Crohn's disease management: best drug therapy alone versus endoscopic monitoring, disease evolution, and faecal calprotectin monitoring. The POCER study. *J Crohn's Colitis* 2014; **8**(Suppl. 1): S13.
- 679 Mowat C, Arnott I, Cahill A *et al.* Mercaptopurine versus placebo to prevent recurrence of Crohn's disease after surgical resection (TOPPIC): a multicentre, double-blind, randomised controlled trial. *Lancet Gastroenterol Hepatol* 2016; **1**: 273–82.
- 680 Lamb CA, Mohiuddin MK, Gicquel J *et al.* Faecal calprotectin or lactoferrin can identify postoperative recurrence in Crohn's disease. *Br J Surg* 2009; **96**: 663–74.
- 681 Lian L, Stocchi L, Remzi FH, Shen B. Comparison of Endoscopic Dilation vs Surgery for Anastomotic Stricture in patients With Crohn's disease following ileocolonic resection. *Clin Gastroenterol Hepatol* 2017; **15**: 1226–31.
- 682 Bruining DH, Siddiki HA, Fletcher JG, Tremaine WJ, Sandborn WJ, Loftus EV Jr. Prevalence of penetrating disease and extraintestinal manifestations of Crohn's disease detected with CT enterography. *Inflamm Bowel Dis* 2008; **14**: 1701–6.
- 683 Efron JE, Young-Fadok TM. Preoperative optimization of Crohn's disease. *Clin Colon Rectal Surg* 2007; **20**: 303–8.
- 684 Zerbib P, Koriche D, Truant S *et al.* Pre-operative management is associated with low rate of post-operative morbidity in penetrating Crohn's disease. *Aliment Pharmacol Ther* 2010; **32**: 459–65.
- 685 Heerasing N, Thompson B, Hendy P *et al.* Exclusive enteral nutrition provides an effective bridge to safer interval elective surgery for adults with Crohn's disease. *Aliment Pharmacol Ther* 2017; **45**: 660–9.
- 686 Milsom JW, Hammerhofer KA, Böhm B, Marcello P, Elson P, Fazio VW. Prospective, randomized trial comparing laparoscopic vs. conventional surgery for refractory ileocolic Crohn's disease. *Dis Colon Rectum* 2001; **44**: 1–8; discussion 8–9.
- 687 Soop M, Larson DW, Malireddy K, Cima RR, Young-Fadok TM, Dozois EJ. Safety, feasibility, and short-term outcomes of laparoscopically assisted primary ileocolic resection for Crohn's disease. *Surg Endosc* 2009; **23**: 1876–81.
- 688 Holubar SD, Dozois EJ, Privitera A *et al.* Laparoscopic surgery for recurrent ileocolic Crohn's disease. *Inflamm Bowel Dis* 2010; **16**: 1382–6.
- 689 Pinto RA, Shawki S, Narita K, Weiss EG, Wexner SD. Laparoscopy for recurrent Crohn's disease: how do the results compare with the results for primary Crohn's disease? *Colorectal Dis* 2011; **13**: 302–7.
- 690 Redan JA, McCarus SD. Protect the ureters. *JSLs* 2009; **13**: 139–41.
- 691 Myrelid P, Söderholm JD, Olaison G, Sjö Dahl R, Andersson P. Split stoma in resectional surgery of high-risk patients with ileocolonic Crohn's disease. *Colorectal Dis* 2012; **14**: 188–93.
- 692 Tekkis PP, Lovegrove RE, Tilney HS *et al.* Long-term failure and function after restorative proctocolectomy – a multi-centre study of patients from the UK National Ileal Pouch Registry. *Colorectal Dis* 2010; **12**: 433–41.
- 693 de Zeeuw S, Ali UA, Donders RAR, Hueting WE, Keus F, van Laarhoven CJHM. Update of complications and functional outcome of the ileo-pouch anal anastomosis: overview of evidence and meta-analysis of 96 observational studies. *Int J Colorectal Dis* 2012; **27**: 843–53.
- 694 Theodoropoulos GE, Choman EN, Wexner SD. Salvage procedures after restorative proctocolectomy: a systematic

- review and meta-analysis. *J Am Coll Surg* 2015; **220**: 225–42 e1.
- 695 Fonkalsrud EW, Bustorff-Silva J. Reconstruction for chronic dysfunction of ileoanal pouches. *Ann Surg* 1999; **229**: 197–204.
- 696 Ouro S, Thava B, Shaikh I, Clark SK. Management of pouch dysfunction in a tertiary centre. *Colorectal Dis* 2016; **18**: 1167–71.
- 697 Shen B, Achkar JP, Lashner BA *et al.* Irritable pouch syndrome: a new category of diagnosis for symptomatic patients with ileal pouch-anal anastomosis. *Am J Gastroenterol* 2002; **97**: 972–7.
- 698 McLaughlin SD, Clark SK, Tekkis PP, Ciclitira PJ, Nicholls RJ. Review article: restorative proctocolectomy, indications, management of complications and follow-up—a guide for gastroenterologists. *Aliment Pharmacol Ther* 2008; **27**: 895–909.
- 699 Baixauli J, Delaney CP, Wu JS, Remzi FH, Lavery IC, Fazio VW. Functional outcome and quality of life after repeat ileal pouch-anal anastomosis for complications of ileoanal surgery. *Dis Colon Rectum* 2004; **47**: 2–11.
- 700 Prudhomme M, Dehni N, Dozois RR, Tiret E, Parc R. Causes and outcomes of pouch excision after restorative proctocolectomy. *Br J Surg* 2006; **93**: 82–6.
- 701 Lohsiriwat V, Clark SK. Persistent perineal sinus after ileoanal pouch excision in inflammatory bowel diseases: incidence, risk factors, and clinical course. *Dis Colon Rectum* 2008; **51**: 1795–9.
- 702 Kiran RP, Kirat HT, Rottoli M, Khaja X, Remzi FH, Fazio VW. Permanent ostomy after ileoanal pouch failure: pouch *in situ* or pouch excision? *Dis Colon Rectum* 2012; **55**: 4–9.
- 703 Nisar PJ, Turina M, Lavery IC, Kiran RP. Perineal wound healing following ileoanal pouch excision. *J Gastrointest Surg* 2014; **18**: 200–7.
- 704 Maya AM, Boutros M, DaSilva G, Wexner SD. IPAA-related sepsis significantly increases morbidity of ileoanal pouch excision. *Dis Colon Rectum* 2015; **58**: 488–93.
- 705 Lightner AL, Dattani S, Dozois EJ, Moncrief SB, Pemberton JH, Mathis KL. Pouch excision: indications and outcomes. *Colorectal Dis* 2017; **19**: 912–6.
- 706 Bharadwaj S, Tandon P, Rivas JM *et al.* Update on the management of intestinal failure. *Cleve Clin J Med* 2016; **83**: 841–8.
- 707 Fleming CR, Remington M. Intestinal failure. In: *Nutrition and the Surgical Patient* (ed. Hill GL). Edinburgh: Churchill Livingstone, 1981. pp. 219–35.
- 708 Pironi L, Arends J, Baxter J *et al.* ESPEN endorsed recommendations. Definition and classification of intestinal failure in adults. *Clin Nutr* 2015; **34**: 171–80.
- 709 2013/14 NHS standard contract for intestinal failure (adult) 2013.
- 710 Smith T, Naghibi M. *BANS Report 2016 – Artificial Nutrition Support in the UK 2005–2015: Adult Home Parenteral Nutrition & Home Intravenous Fluids*. 2016; <https://www.bapen.org.uk/images/pdfs/reports/bans-report-2016.pdf>.
- 711 Gearry RB, Kamm MA, Hart AL, Bassett P, Gabe SM, Nightingale JM. Predictors for developing intestinal failure in patients with Crohn's disease. *J Gastroenterol Hepatol* 2013; **28**: 801–7.
- 712 Vather R, Trivedi S, Bissett I. Defining postoperative ileus: results of a systematic review and global survey. *J Gastrointest Surg* 2013; **17**: 962–72.
- 713 Paton F, Chambers D, Wilson P *et al.* Effectiveness and implementation of enhanced recovery after surgery programmes: a rapid evidence synthesis. *BMJ Open* 2014; **4**: e005015.
- 714 NICE. *NICE Clinical Guideline CG32: Nutrition support for adults: oral nutrition support, enteral tube feeding and parenteral nutrition*. 2006; <https://www.nice.org.uk/guidance/cg32> (accessed 15 March 2018).
- 715 Todorovic V, Russell C, Elia M. *A Guide to the 'Malnutrition Universal Screening Tool' ('MUST') for Adults*. 2003 (revised 2011).
- 716 Stewart JAD, Mason DG, Smith N, Protopapa K, Mason M. *A Mixed Bag: An enquiry into the care of hospital patients receiving parenteral nutrition. A report by the National Confidential Enquiry into Patient Outcome and Death 2010*. 2010. http://www.ncepod.org.uk/2010report1/downloads/PN_report.pdf. (accessed 15 August 2017)
- 717 McDermott FD, Arora S, Smith J, Steele RJC, Carlson GL, Winte DC. (2016). *Prevention, Diagnosis and Management of Colorectal Anastomotic Leakage*. London: Association of Surgeons of Great Britain and Ireland.
- 718 Boele van Hensbroek P, Wind J, Dijkstra MG, Busch OR, Goslings JC. Temporary closure of the open abdomen: a systematic review on delayed primary fascial closure in patients with an open abdomen. *World J Surg* 2009; **33**: 199–207.
- 719 Quyn AJ, Johnston C, Hall D *et al.* The open abdomen and temporary abdominal closure systems—historical evolution and systematic review. *Colorectal Dis* 2012; **14**: e429–38.
- 720 Kirkpatrick AW, Roberts DJ, De Waele J *et al.* Intra-abdominal hypertension and the abdominal compartment syndrome: updated consensus definitions and clinical practice guidelines from the World Society of the Abdominal Compartment Syndrome. *Intensive Care Med* 2013; **39**: 1190–206.
- 721 Dubose JJ, Lundy JB. Enterocutaneous fistulas in the setting of trauma and critical illness. *Clin Colon Rectal Surg* 2010; **23**: 182–9.
- 722 Adaba F, Vaizey CJ, Warusavitarne J. Management of intestinal failure: the high-output enterostomy and enterocutaneous fistula. *Clin Colon Rectal Surg* 2017; **30**: 215–22.
- 723 Byrne TA, Persinger RL, Young LS, Ziegler TR, Wilmore DW. A new treatment for patients with short-bowel syndrome. Growth hormone, glutamine, and a modified diet. *Ann Surg* 1995; **222**: 243–54; discussion 254–5.
- 724 Scolapio JS, Camilleri M, Fleming CR. Gastrointestinal motility considerations in patients with short-bowel syndrome. *Dig Dis* 1997; **15**: 253–62.

- 725 Jeppesen PB, Szkudlarek J, Høy CE, Mortensen PB. Effect of high-dose growth hormone and glutamine on body composition, urine creatinine excretion, fatty acid absorption, and essential fatty acids status in short bowel patients: a randomized, double-blind, crossover, placebo-controlled study. *Scand J Gastroenterol* 2001; **36**: 48–54.
- 726 Nehra V, Camilleri M, Burton D, Oenning L, Kelly DG. An open trial of octreotide long-acting release in the management of short bowel syndrome. *Am J Gastroenterol* 2001; **96**: 1494–8.
- 727 Bielawska B, Allard JP. Parenteral nutrition and intestinal failure. *Nutrients* 2017; **9**: E466.
- 728 Carlson GL, Patrick H, Amin AI *et al.* Management of the open abdomen: a national study of clinical outcome and safety of negative pressure wound therapy. *Ann Surg* 2013; **257**: 1154–9.
- 729 Coccolini F, Montori G, Ceresoli M *et al.* The role of open abdomen in non-trauma patient: WSES consensus paper. *World J Emerg Surg* 2017; **12**: 39.
- 730 Coetzee E, Rahim Z, Boutall A, Goldberg P. Refeeding enteroclysis as an alternative to parenteral nutrition for enteric fistula. *Colorectal Dis* 2014; **16**: 823–30.
- 731 Schecter WP, Hirshberg A, Chang DS *et al.* Enteric fistulas: principles of management. *J Am Coll Surg* 2009; **209**: 484–91.
- 732 Slade DA, Carlson GL. Takedown of enterocutaneous fistula and complex abdominal wall reconstruction. *Surg Clin North Am* 2013; **93**: 1163–83.
- 733 Vaizey CJ, Maeda Y, Barbosa E *et al.* European Society of Coloproctology consensus on the surgical management of intestinal failure in adults. *Colorectal Dis* 2016; **18**: 535–48.
- 734 Yannam GR, Sudan DL, Grant W, Botha J, Langnas A, Thompson JS. Intestinal lengthening in adult patients with short bowel syndrome. *J Gastrointest Surg* 2010; **14**: 1931–6.
- 735 Grant D, Abu-Elmagd K, Mazariegos G *et al.* Intestinal transplant registry report: global activity and trends. *Am J Transplant* 2015; **15**: 210–9.
- 736 Benchimol EI, Fortinsky KJ, Gozdyra P, Van den Heuvel M, Van Limbergen J, Griffiths AM. Epidemiology of pediatric inflammatory bowel disease: a systematic review of international trends. *Inflamm Bowel Dis* 2011; **17**: 423–39.
- 737 Sawczenko A, Sandhu BK, Logan RF *et al.* Prospective survey of childhood inflammatory bowel disease in the British Isles. *Lancet* 2001; **357**: 1093–4.
- 738 Henderson P, Hansen R, Cameron FL *et al.* Rising incidence of pediatric inflammatory bowel disease in Scotland. *Inflamm Bowel Dis* 2012; **18**: 999–1005.
- 739 Ashton JJ, Wiskin AE, Ennis S, Batra A, Afzal NA, Beattie RM. Rising incidence of paediatric inflammatory bowel disease (PIBD) in Wessex, Southern England. *Arch Dis Child* 2014; **99**: 659–64.
- 740 Courtney ED, Brennan M, Noble-Jamieson G, Heuschkel R, Davies RJ. Laparoscopic adult colorectal surgeon and adolescents with inflammatory bowel disease: a safe combination? *Int J Colorectal Dis* 2011; **26**: 357–60.
- 741 McMullin CM, Morton J, Vickramarajah S *et al.* A comparison of outcomes for adults and children undergoing resection for inflammatory bowel disease: is there a difference? *ISRN Gastroenterol* 2014; **2014**: 410753.
- 742 Sanka S, Gomez A, Set P *et al.* Use of small bowel MRI enteroclysis in the management of paediatric IBD. *J Crohns Colitis* 2012; **6**: 550–6.
- 743 Parakkal D, Sifuentes H, Semer R, Ehrenpreis ED. Hepatosplenic T-cell lymphoma in patients receiving TNF-alpha inhibitor therapy: expanding the groups at risk. *Eur J Gastroenterol Hepatol* 2011; **23**: 1150–6.
- 744 Diamond IR, Gerstle JT, Kim PC, Langer JC. Outcomes after laparoscopic surgery in children with inflammatory bowel disease. *Surg Endosc* 2010; **24**: 2796–802.
- 745 Page AE, Sashittal SG, Chatzizacharias NA, Davies RJ. The role of laparoscopic surgery in the management of children and adolescents with inflammatory bowel disease. *Medicine (Baltimore)* 2015; **94**: e874.
- 746 Huntington JT, Boomer LA, Pepper VK, Diefenbach KA, Dotson JL, Nwomeh BC. Single-incision laparoscopic surgery (SILS) for children with Crohn's disease. *Pediatr Surg Int* 2016; **32**: 459–64.
- 747 Di Abriola GF, De Angelis P, Dall'oglio L, Di Lorenzo M. Strictureplasty: an alternative approach in long segment bowel stenosis Crohn's disease. *J Pediatr Surg* 2003; **38**: 814–8.
- 748 Bamford R, Hay A, Kumar D. Resection leads to less recurrence than strictureplasty in a paediatric population with obstructive Crohn's disease. *Surg Res Pract* 2014; **2014**: 709045.
- 749 Seemann NM, King SK, Elkadri A, Walters T, Fish J, Langer JC. The operative management of children with complex perianal Crohn's disease. *J Pediatr Surg* 2016; **51**: 1993–7.
- 750 Keljo DJ, Markowitz J, Langton C *et al.* Course and treatment of perianal disease in children newly diagnosed with Crohn's disease. *Inflamm Bowel Dis* 2009; **15**: 383–7.
- 751 Seemann NM, Elkadri A, Walters TD, Langer JC. The role of surgery for children with perianal Crohn's disease. *J Pediatr Surg* 2015; **50**: 140–3.
- 752 Orkin BA, Telander RL. The effect of intra-abdominal resection or fecal diversion on perianal disease in pediatric Crohn's disease. *J Pediatr Surg* 1985; **20**: 343–7.
- 753 Ashton JJ, Versteegh HP, Batra A *et al.* Colectomy in pediatric ulcerative colitis: a single center experience of indications, outcomes, and complications. *J Pediatr Surg* 2016; **51**: 277–81.
- 754 Chatzizacharias NA, Torrente F, Brennan M, Heuschkel R, Davies RJ. Single port laparoscopic subtotal colectomy and ileostomy in an adolescent with ulcerative colitis. *J Crohns Colitis* 2012; **6**: 1031–3.
- 755 Knod JL, Holder M, Cortez AR *et al.* Surgical outcomes, bowel habits and quality of life in young patients after ileoanal anastomosis for ulcerative colitis. *J Pediatr Surg* 2016; **51**: 1246–50.

- 756 Shannon A, Eng K, Kay M *et al.* Long-term follow up of ileal pouch anal anastomosis in a large cohort of pediatric and young adult patients with ulcerative colitis. *J Pediatr Surg* 2016; **51**: 1181–6.
- 757 Indar AA, Efron JE, Young-Fadok TM. Laparoscopic ileal pouch-anal anastomosis reduces abdominal and pelvic adhesions. *Surg Endosc* 2009; **23**: 174–7.
- 758 Harbord M, Eliakim R, Bettenworth D *et al.* Third European evidence-based consensus on diagnosis and management of ulcerative colitis. Part 2: current management. *J Crohns Colitis* 2017; **11**: 769–84.
- 759 Malgarinos G, Gikas A, Delicha E *et al.* Pregnancy and inflammatory bowel disease: a prospective case-control study. *Rev Med Chir Soc Med Nat Iasi* 2007; **111**: 613–9.
- 760 Beaulieu DB, Kane S. Inflammatory bowel disease in pregnancy. *World J Gastroenterol* 2011; **17**: 2696–701.
- 761 Ferguson CB, Mahsud-Dornan S, Patterson RN. Inflammatory bowel disease in pregnancy. *BMJ* 2008; **337**: a427.
- 762 Habal FM, Huang VW. Review article: a decision-making algorithm for the management of pregnancy in the inflammatory bowel disease patient. *Aliment Pharmacol Ther* 2012; **35**: 501–15.
- 763 Pedersen N, Bortoli A, Duricova D *et al.* The course of inflammatory bowel disease during pregnancy and postpartum: a prospective European ECCO-EpiCom Study of 209 pregnant women. *Aliment Pharmacol Ther* 2013; **38**: 501–12.
- 764 Huang V, Leung Y, Nguyen GC, Seow CH. Management of inflammatory bowel disease in pregnancy: a practical approach to new guidelines. *Can J Gastroenterol Hepatol* 2016; **2016**: 9513742.
- 765 Bortoli A, Saibeni S, Tatarella M *et al.* Pregnancy before and after the diagnosis of inflammatory bowel diseases: retrospective case-control study. *J Gastroenterol Hepatol* 2007; **22**: 542–9.
- 766 Reddy D, Murphy SJ, Kane SV, Present DH, Kornbluth AA. Relapses of inflammatory bowel disease during pregnancy: in-hospital management and birth outcomes. *Am J Gastroenterol* 2008; **103**: 1203–9.
- 767 Abhyankar A, Ham M, Moss AC. Meta-analysis: the impact of disease activity at conception on disease activity during pregnancy in patients with inflammatory bowel disease. *Aliment Pharmacol Ther* 2013; **38**: 460–6.
- 768 Schulze H, Esters P, Dignass A. Review article: the management of Crohn's disease and ulcerative colitis during pregnancy and lactation. *Aliment Pharmacol Ther* 2014; **40**: 991–1008.
- 769 Cornish JA, Tan E, Singh B *et al.* Female infertility following restorative proctocolectomy. *Colorectal Dis* 2011; **13**: e339–44.
- 770 Woolfson K, Cohen Z, McLeod RS. Crohn's disease and pregnancy. *Dis Colon Rectum* 1990; **33**: 869–73.
- 771 Selinger CP, Leong RW, Lal S. Pregnancy related issues in inflammatory bowel disease: evidence base and patients' perspective. *World J Gastroenterol* 2012; **18**: 2600–8.
- 772 Vermeire S, Carbonnel F, Coulie PG *et al.* Management of inflammatory bowel disease in pregnancy. *J Crohns Colitis* 2012; **6**: 811–23.
- 773 Damas OM, Deshpande AR, Avalos DJ, Abreu MT. Treating inflammatory bowel disease in pregnancy: the issues we face today. *J Crohns Colitis* 2015; **9**: 928–36.
- 774 Poturoglu S, Ormeci AC, Duman AE. Treatment of pregnant women with a diagnosis of inflammatory bowel disease. *World J Gastrointest Pharmacol Ther* 2016; **7**: 490–502.
- 775 Hill J, Clark A, Scott NA. Surgical treatment of acute manifestations of Crohn's disease during pregnancy. *J R Soc Med* 1997; **90**: 64–6.
- 776 Aytac E, Ozuner G, Isik O, Gorgun E, Remzi FH. Surgical management of patients with ulcerative colitis during pregnancy: maternal and fetal outcomes. *J Crohns Colitis* 2015; **9**: 82–5.
- 777 Killeen S, Gunn J, Hartley J. Surgical management of complicated and medically refractory inflammatory bowel disease during pregnancy. *Colorectal Dis* 2017; **19**: 123–38.
- 778 Carlin A, Alfirevic Z. Physiological changes of pregnancy and monitoring. *Best Pract Res Clin Obstet Gynaecol* 2008; **22**: 801–23.
- 779 Pasupathy D, Morgan M, Plaat FS, Langford KS. (2012). *Bacterial Sepsis in Pregnancy (Green-top Guideline No. 64a)*. Royal College of Obstetricians and Gynaecologists, London.
- 780 Cappell MS, Colon VJ, Sidhom OA. A study of eight medical centers of the safety and clinical efficacy of esophagogastroduodenoscopy in 83 pregnant females with follow-up of fetal outcome with comparison control groups. *Am J Gastroenterol* 1996; **91**: 348–54.
- 781 Debby A, Golan A, Sadan O, Glezerman M, Shirin H. Clinical utility of esophagogastroduodenoscopy in the management of recurrent and intractable vomiting in pregnancy. *J Reprod Med* 2008; **53**: 347–51.
- 782 Cappell MS, Fox SR, Gorrepati N. Safety and efficacy of colonoscopy during pregnancy: an analysis of pregnancy outcome in 20 patients. *J Reprod Med* 2010; **55**: 115–23.
- 783 Shergill AK, Ben-Menachem T, Chandrasekhara V *et al.* ASGE Standard of Practice Committee Guidelines for endoscopy in pregnant and lactating women. *Gastrointest Endosc* 2012; **76**: 18–24.
- 784 Copel J, El-Sayed Y, Heine RP, Wharton KR. Guidelines for diagnostic imaging during pregnancy and lactation. ACOG committee opinion number 723. *Obstet Gynecol* 2017; **130**: e210–6.
- 785 Wall BF, Kendall GM, Edwards AA, Bouffler S, Muirhead CR, Meara JR. What are the risks from medical X-rays and other low dose radiation? *Br J Radiol* 2006; **79**: 285–94.
- 786 The Royal College of Radiologists. *Radiation and the Early Fetus*. London: The Royal College of Radiologists, 2013.
- 787 Brodsky JB, Cohen EN, Brown BW Jr, Wu ML, Whitcher C. Surgery during pregnancy and fetal outcome. *Am J Obstet Gynecol* 1980; **138**: 1165–7.

- 788 Mazze RI, Kallen B. Reproductive outcome after anesthesia and operation during pregnancy: a registry study of 5405 cases. *Am J Obstet Gynecol* 1989; **161**: 1178–85.
- 789 Germain A, Brunaud L. Visceral surgery and pregnancy. *J Visc Surg* 2010; **147**: e129–35.
- 790 Kizer NT, Powell MA. Surgery in the pregnant patient. *Clin Obstet Gynecol* 2011; **54**: 633–41.
- 791 Abbasakoor F, Evans A, Stephenson BM. Obstructed defecation after undiverted ileoanal pouch reconstruction for ulcerative colitis: pharmacologic approach. Report of a case. *Dis Colon Rectum* 2000; **43**: 1599–600.
- 792 NICE. *NICE Guideline NG25: Preterm labour and birth*. 2015. 2017.
- 793 Conde-Agudelo A, Romero R. Antenatal magnesium sulfate for the prevention of cerebral palsy in preterm infants less than 34 weeks' gestation: a systematic review and metaanalysis. *Am J Obstet Gynecol* 2009; **200**: 595–609.
- 794 Cooksey G, Gunn A, Wotherspoon WC. Surgery for acute ulcerative colitis and toxic megacolon during pregnancy. *Br J Surg* 1985; **72**: 547.
- 795 Anderson JB, Turner GM, Williamson RC. Fulminant ulcerative colitis in late pregnancy and the puerperium. *J R Soc Med* 1987; **80**: 492–4.
- 796 Watson WJ, Gaines TE. Third-trimester colectomy for severe ulcerative colitis. A case report. *J Reprod Med* 1987; **32**: 869–72.
- 797 Ooi BS, Remzi FH, Fazio VW. Turnbull-Blowhole colostomy for toxic ulcerative colitis in pregnancy: report of two cases. *Dis Colon Rectum* 2003; **46**: 111–5.
- 798 Dozois EJ, Wolff BG, Tremaine WJ *et al.* Maternal and fetal outcome after colectomy for fulminant ulcerative colitis during pregnancy: case series and literature review. *Dis Colon Rectum* 2006; **49**: 64–73.
- 799 Fatzer H, Wyss C. Ileal perforation as the first manifestation of Crohn disease in pregnancy. *Chirurg* 1986; **57**: 646–8.
- 800 Czymek R, Limmer S, Kleemann M *et al.* Crohn's disease—a chameleon during pregnancy. *Langenbecks Arch Surg* 2009; **394**: 517–27.
- 801 Sur MD, Romanoff AM, Greenstein AJ, Greenstein AJ. Laparoscopic ileocolic resection for perforated Crohn's disease in pregnancy. *J Crohns Colitis* 2013; **7**: 678–9.
- 802 Kaiser AM. (2009). *Chapter 4: Diseases and Problems in McGraw-Hill Manual: Colorectal Surgery*. New York, NY: McGraw-Hill.
- 803 Greenfield C, Pounder RE, Craft IL, Lewis AA. Severe ulcerative colitis during successful pregnancy. *Postgrad Med J* 1983; **59**: 459–61.
- 804 Parker AR, Baker N, Maxwell D. A modification of the surgical indications for the treatment of ulcerative colitis during pregnancy. *Am Surg* 2011; **77**: E281–3.
- 805 Wilson IA, Dench J, Garrett WV. Surgical management of ulcerative colitis in an ongoing pregnancy: report of a case and literature review. *Int J Colorectal Dis* 2014; **29**: 271.
- 806 Turnbull RB Jr, Hawk WA, Weakley FL. Surgical treatment of toxic megacolon. Ileostomy and colostomy to prepare patients for colectomy. *Am J Surg* 1971; **122**: 325–31.
- 807 Horowitz MD, Gomez GA, Santiesteban R, Burkett G. Acute appendicitis during pregnancy. Diagnosis and management. *Arch Surg* 1985; **120**: 1362–7.
- 808 Bohe MG, Ekelund GR, Genell SN *et al.* Surgery for fulminating colitis during pregnancy. *Dis Colon Rectum* 1983; **26**: 119–22.
- 809 Spring A, Lee M, Patchett S, Deasy J, Wilson I, Cahill RA. Ileostomy obstruction in the third trimester of pregnancy. *Colorectal Dis* 2012; **14**: e631–2.
- 810 Soriano D, Yefet Y, Seidman DS, Goldenberg M, Mashiach S, Oelsner G. Laparoscopy versus laparotomy in the management of adnexal masses during pregnancy. *Fertil Steril* 1999; **71**: 955–60.
- 811 Curet MJ. Special problems in laparoscopic surgery. Previous abdominal surgery, obesity, and pregnancy. *Surg Clin North Am* 2000; **80**: 1093–110.
- 812 Pucci RO, Seed RW. Case report of laparoscopic cholecystectomy in the third trimester of pregnancy. *Am J Obstet Gynecol* 1991; **165**: 401–2.
- 813 Weber AM, Bloom GP, Allan TR *et al.* Laparoscopic cholecystectomy during pregnancy. *Obstet Gynecol* 1991; **78**: 958–9.
- 814 Geisler JP, Rose SL, Mernitz CS, Warner JL, Hiatt AK. Non-gynecologic laparoscopy in second and third trimester pregnancy: obstetric implications. *JSLS* 1998; **2**: 235–8.
- 815 Rollins MD, Chan KJ, Price RR. Laparoscopy for appendicitis and cholelithiasis during pregnancy: a new standard of care. *Surg Endosc* 2004; **18**: 237–41.
- 816 Porter H, Seeho S. Obstructed ileostomy in the third trimester of pregnancy due to compression from the gravid uterus: diagnosis and management. *BMJ Case Rep* 2014; **2014**: bcr2014205884.
- 817 Bhavani-Shankar K, Steinbrook RA, Brooks DC, Datta S. Arterial to end-tidal carbon dioxide pressure difference during laparoscopic surgery in pregnancy. *Anesthesiology* 2000; **93**: 370–3.
- 818 Pearl JP, Price RR, Tonkin AE, Richardson WS, Stefanidis D. SAGES guidelines for the use of laparoscopy during pregnancy. *Surg Endosc* 2017; **31**: 3767–82.
- 819 Nelson-Piercy C, MacCallum P, Mackillop L. *Reducing the Risk of Venous Thromboembolism during Pregnancy and the Puerperium*. 2015. Green-top Guideline No. 37a - reducing the risk of venous thromboembolism during pregnancy and the puerperium.
- 820 Seifarth C, Ritz JP, Pohlen U *et al.* Therapy of complicated Crohn's disease during pregnancy—an interdisciplinary challenge. *Int J Colorectal Dis* 2014; **29**: 645–51.
- 821 Van Horn C, Barrett P. Pregnancy, delivery, and postpartum experiences of fifty-four women with ostomies. *J Wound Ostomy Continence Nurs* 1997; **24**: 151–62.
- 822 Takahashi K, Funayama Y, Fukushima K *et al.* Pregnancy and delivery in patients with enterostomy due to anorectal complications from Crohn's disease. *Int J Colorectal Dis* 2007; **22**: 313–8.

- 823 Hubbard G, Taylor C, Beeken B *et al.* Research priorities about stoma-related quality of life from the perspective of people with a stoma: a pilot survey. *Health Expect* 2017; **20**: 1421–7.
- 824 Holstein A, Hansen T, Tebbe JJ. Continual stenting of ileal stricture after restorative proctocolectomy with ileostoma in a pregnant woman. *Dig Endosc* 2015; **27**: 531.
- 825 Castillo MJ, Phillippi JC. Hyperemesis gravidarum: a holistic overview and approach to clinical assessment and management. *J Perinat Neonatal Nurs* 2015; **29**: 12–22; quiz E1.
- 826 Nicholl MC, Thompson JM, Cocks PS. Stomas and pregnancy. *Aust N Z J Obstet Gynaecol* 1993; **33**: 322–4.
- 827 Jensen KK, Henriksen NA, Jorgensen LN. Abdominal wall hernia and pregnancy: a systematic review. *Hernia* 2015; **19**: 689–96.
- 828 Bröms G, Granath F, Linder M, Stephansson O, Elmberg M, Kieler H. Complications from inflammatory bowel disease during pregnancy and delivery. *Clin Gastroenterol Hepatol* 2012; **10**: 1246–52.
- 829 Andres PG, Friedman LS. Epidemiology and the natural course of inflammatory bowel disease. *Gastroenterol Clin North Am* 1999; **28**: 255–81, vii.
- 830 Hatch Q, Champagne BJ, Maykel JA *et al.* Crohn's disease and pregnancy: the impact of perianal disease on delivery methods and complications. *Dis Colon Rectum* 2014; **57**: 174–8.
- 831 Smink M, Lotgering FK, Albers L, de Jong DJ. Effect of childbirth on the course of Crohn's disease; results from a retrospective cohort study in the Netherlands. *BMC Gastroenterol* 2011; **11**: 6.
- 832 Carroli G, Mignini L. Episiotomy for vaginal birth. *Cochrane Database Syst Rev* 2009: CD000081.
- 833 Brandt LJ, Estabrook SG, Reinus JF. Results of a survey to evaluate whether vaginal delivery and episiotomy lead to perineal involvement in women with Crohn's disease. *Am J Gastroenterol* 1995; **90**: 1918–22.
- 834 Francis NK, Curtis NJ, Weegenaar C *et al.* Developing a national colorectal educational agenda: a survey of the ACPGBI. *Colorectal Dis* 2017; **20**: 68–73.
- 835 Ong JP, Edwards GJ, Allison MC. Mode of delivery and risk of fecal incontinence in women with or without inflammatory bowel disease: questionnaire survey. *Inflamm Bowel Dis* 2007; **13**: 1391–4.
- 836 Nguyen GC, Boudreau H, Harris ML, Maxwell CV. Outcomes of obstetric hospitalizations among women with inflammatory bowel disease in the United States. *Clin Gastroenterol Hepatol* 2009; **7**: 329–34.
- 837 van der Woude CJ, Ardizzone S, Bengtson MB *et al.* The second European evidenced-based consensus on reproduction and pregnancy in inflammatory bowel disease. *J Crohns Colitis* 2015; **9**: 107–24.
- 838 Porter RJ, Stirrat GM. The effects of inflammatory bowel disease on pregnancy: a case-controlled retrospective analysis. *Br J Obstet Gynaecol* 1986; **93**: 1124–31.
- 839 Ilnyckji A, Blanchard JF, Rawsthorne P, Bernstein CN. Perianal Crohn's disease and pregnancy: role of the mode of delivery. *Am J Gastroenterol* 1999; **94**: 3274–8.
- 840 Moser MA, Okun NB, Mayes DC, Bailey RJ. Crohn's disease, pregnancy, and birth weight. *Am J Gastroenterol* 2000; **95**: 1021–6.
- 841 Dominitz JA, Young JC, Boyko EJ. Outcomes of infants born to mothers with inflammatory bowel disease: a population-based cohort study. *Am J Gastroenterol* 2002; **97**: 641–8.
- 842 Bush MC, Patel S, Lapinski RH, Stone JL. Perinatal outcomes in inflammatory bowel disease. *J Matern Fetal Neonatal Med* 2004; **15**: 237–41.
- 843 Cornish JA, Tan E, Teare J *et al.* The effect of restorative proctocolectomy on sexual function, urinary function, fertility, pregnancy and delivery: a systematic review. *Dis Colon Rectum* 2007; **50**: 1128–38.
- 844 Burke KE, Haviland MJ, Hacker MR, Shinker SA, Cheifetz AS. Indications for mode of delivery in pregnant women with inflammatory bowel disease. *Inflamm Bowel Dis* 2017; **23**: 721–6.
- 845 Selinger CP, Eaden J, Selby W *et al.* Inflammatory bowel disease and pregnancy: lack of knowledge is associated with negative views. *J Crohns Colitis* 2013; **7**: e206–13.
- 846 Hahnloser D, Pemberton JH, Wolff BG *et al.* Pregnancy and delivery before and after ileal pouch-anal anastomosis for inflammatory bowel disease: immediate and long-term consequences and outcomes. *Dis Colon Rectum* 2004; **47**: 1127–35.
- 847 Foulon A, Dupas JL, Sabbagh C *et al.* Defining the most appropriate delivery mode in women with inflammatory bowel disease: a systematic review. *Inflamm Bowel Dis* 2017; **23**: 712–20.
- 848 Nguyen GC, Seow CH, Maxwell C *et al.* The Toronto consensus statements for the management of inflammatory bowel disease in pregnancy. *Gastroenterology* 2016; **150**: 734–57 e1.
- 849 Rogers RG, Katz VL. Course of Crohn's disease during pregnancy and its effect on pregnancy outcome: a retrospective review. *Am J Perinatol* 1995; **12**: 262–4.
- 850 Cheng AG, Oxford EC, Sauk J *et al.* Impact of mode of delivery on outcomes in patients with perianal Crohn's disease. *Inflamm Bowel Dis* 2014; **20**: 1391–8.
- 851 Grouin A, Brochard C, Siproudhis L *et al.* Perianal Crohn's disease results in fewer pregnancies but is not exacerbated by vaginal delivery. *Dig Liver Dis* 2015; **47**: 1021–6.
- 852 Feagan BG, Rutgeerts P, Sands BE *et al.* Vedolizumab as induction and maintenance therapy for ulcerative colitis. *N Engl J Med* 2013; **369**: 699–710.
- 853 Loftus EV Jr, Colombel JF, Feagan BG *et al.* Long-term efficacy of vedolizumab for ulcerative colitis. *J Crohns Colitis* 2017; **11**: 400–11.
- 854 Rutgeerts P, Sandborn WJ, Feagan BG *et al.* Infliximab for induction and maintenance therapy for ulcerative colitis. *N Engl J Med* 2005; **353**: 2462–76.
- 855 Cholakranee A, Hazlewood GS, Kaplan GG, Peyrin-Biroulet L, Ananthakrishnan AN. Systematic review with meta-analysis: comparative efficacy of biologics for induction and maintenance of mucosal healing in Crohn's

- disease and ulcerative colitis controlled trials. *Aliment Pharmacol Ther* 2017; **45**: 1291–302.
- 856 Jairath V, Zou G, Parker CE *et al.* Systematic review and meta-analysis: placebo rates in induction and maintenance trials of ulcerative colitis. *J Crohns Colitis* 2016; **10**: 607–18.
- 857 Coscia M, Gentilini L, Laureti S *et al.* Risk of permanent stoma in extensive Crohn's colitis: the impact of biological drugs. *Colorectal Dis* 2013; **15**: 1115–22.
- 858 de Groof EJ, Gardenbroek TJ, Buskens CJ *et al.* The association between intensified medical treatment, time to surgery and ileocolic specimen length in Crohn's disease. *Colorectal Dis* 2017; **19**: 551–8.
- 859 Jones GR, Kennedy NA, Lees CW, Arnott ID, Satsangi J. Systematic review: the use of thiopurines or anti-TNF in post-operative Crohn's disease maintenance—progress and prospects. *Aliment Pharmacol Ther* 2014; **39**: 1253–65.
- 860 Carla-Moreau A, Paul S, Roblin X, Genin C, Peyrin-Biroulet L. Prevention and treatment of postoperative Crohn's disease recurrence with anti-TNF therapy: a meta-analysis of controlled trials. *Dig Liver Dis* 2015; **47**: 191–6.
- 861 Shah SC, Colombel JF, Sands BE, Narula N. Systematic review with meta-analysis: mucosal healing is associated with improved long-term outcomes in Crohn's disease. *Aliment Pharmacol Ther* 2016; **43**: 317–33.
- 862 Kotze PG, Yamamoto T, Danese S *et al.* Direct retrospective comparison of adalimumab and infliximab in preventing early postoperative endoscopic recurrence after ileocaecal resection for Crohn's disease: results from the MULTIPER database. *J Crohns Colitis* 2015; **9**: 541–7.
- 863 van den Heuvel TR, Wintjens DS, Jeuring SF *et al.* Inflammatory bowel disease, cancer and medication: cancer risk in the Dutch population-based IBDSL cohort. *Int J Cancer* 2016; **139**: 1270–80.
- 864 Hyams JS, Dubinsky MC, Baldassano RN *et al.* Infliximab is not associated with increased risk of malignancy or hemophagocytic lymphohistiocytosis in pediatric patients with inflammatory bowel disease. *Gastroenterology* 2017; **152**: 1901–14 e3.
- 865 Singh S, Nagpal SJ, Murad MH *et al.* Inflammatory bowel disease is associated with an increased risk of melanoma: a systematic review and meta-analysis. *Clin Gastroenterol Hepatol* 2014; **12**: 210–8.
- 866 Lichtenstein GR, Feagan BG, Cohen RD *et al.* Serious infections and mortality in association with therapies for Crohn's disease: TREAT registry. *Clin Gastroenterol Hepatol* 2006; **4**: 621–30.
- 867 Uchino M, Ikeuchi H, Matsuoka H, Tsuchida T, Tomita N, Takesue Y. Risk factors associated with surgical site infection after ileal pouch-anal anastomosis in ulcerative colitis. *Dis Colon Rectum* 2010; **53**: 143–9.
- 868 Nguyen GC, Elnahas A, Jackson TD. The impact of pre-operative steroid use on short-term outcomes following surgery for inflammatory bowel disease. *J Crohns Colitis* 2014; **8**: 1661–7.
- 869 Curtis JR, Patkar N, Xie A *et al.* Risk of serious bacterial infections among rheumatoid arthritis patients exposed to tumor necrosis factor alpha antagonists. *Arthritis Rheum* 2007; **56**: 1125–33.
- 870 Waterman M, Xu W, Dinani A *et al.* Preoperative biological therapy and short-term outcomes of abdominal surgery in patients with inflammatory bowel disease. *Gut* 2013; **62**: 387–94.
- 871 Ali T, Yun L, Rubin DT. Risk of post-operative complications associated with anti-TNF therapy in inflammatory bowel disease. *World J Gastroenterol* 2012; **18**: 197–204.
- 872 El-Hussuna A, Andersen J, Bisgaard T *et al.* Biologic treatment or immunomodulation is not associated with postoperative anastomotic complications in abdominal surgery for Crohn's disease. *Scand J Gastroenterol* 2012; **47**: 662–8.
- 873 Kasperek MS, Bruckmeier A, Beigel F *et al.* Infliximab does not affect postoperative complication rates in Crohn's patients undergoing abdominal surgery. *Inflamm Bowel Dis* 2012; **18**: 1207–13.
- 874 Rosenfeld G, Qian H, Bressler B. The risks of post-operative complications following pre-operative infliximab therapy for Crohn's disease in patients undergoing abdominal surgery: a systematic review and meta-analysis. *J Crohns Colitis* 2013; **7**: 868–77.
- 875 Shah ED, Farida JP, Siegel CA, Chong K, Melmed GY. Risk for overall infection with anti-TNF and anti-integrin agents used in IBD: a systematic review and meta-analysis. *Inflamm Bowel Dis* 2017; **23**: 570–7.
- 876 Canedo J, Lee SH, Pinto R, Murad-Regadas S, Rosen L, Wexner SD. Surgical resection in Crohn's disease: is immunosuppressive medication associated with higher postoperative infection rates? *Colorectal Dis* 2011; **13**: 1294–8.
- 877 Yang ZP, Hong L, Wu Q, Wu KC, Fan DM. Preoperative infliximab use and postoperative complications in Crohn's disease: a systematic review and meta-analysis. *Int J Surg* 2014; **12**: 224–30.
- 878 Brouquet A, Maggiori L, Zerbib P *et al.* Anti-TNF therapy is associated with an increased risk of postoperative morbidity after surgery for ileocolonic Crohn disease: results of a prospective nationwide cohort. *Ann Surg* 2018; **267**: 221–8.
- 879 Yamada A, Komaki Y, Patel N *et al.* Risk of postoperative complications among inflammatory bowel disease patients treated preoperatively with vedolizumab. *Am J Gastroenterol* 2017; **112**: 1423–9.
- 880 Lightner AL, Tse CS, Potter DD Jr, Moir C. Postoperative outcomes in vedolizumab-treated patients undergoing abdominal operations for inflammatory bowel disease. *J Crohns Colitis* 2017; **11**: 185–90.
- 881 Lightner AL, McKenna NP, Tse CS, Raffals LE, Loftus EV, Mathis KL. Postoperative outcomes in vedolizumab-treated Crohn's disease patients undergoing major abdominal operations. *Aliment Pharmacol Ther* 2018; **47**: 573–80.
- 882 Colombel JF, Sands BE, Rutgeerts P *et al.* The safety of vedolizumab for ulcerative colitis and Crohn's disease. *Gut* 2017; **66**: 839–51.

- 883 Lightner AL, McKenna NP, Tse CS *et al.* Postoperative outcomes in Ustekinumab-treated patients undergoing abdominal operations for Crohn's disease. *J Crohns Colitis* 2018; **12**: 402–7.
- 884 Mor IJ, Vogel JD, da Luz Moreira A, Shen B, Hammel J, Remzi FH. Infliximab in ulcerative colitis is associated with an increased risk of postoperative complications after restorative proctocolectomy. *Dis Colon Rectum* 2008; **51**: 1202–7; discussion 1207–10.
- 885 Selvaggi F, Pellino G, Canonico S, Sciaudone G. Effect of preoperative biologic drugs on complications and function after restorative proctocolectomy with primary ileal pouch formation: systematic review and meta-analysis. *Inflamm Bowel Dis* 2015; **21**: 79–92.
- 886 Yang Z, Wu Q, Wu K, Fan D. Meta-analysis: pre-operative infliximab treatment and short-term post-operative complications in patients with ulcerative colitis. *Aliment Pharmacol Ther* 2010; **31**: 486–92.
- 887 Colombel JF, Loftus EV, Tremaine WJ *et al.* Early postoperative complications are not increased in patients with Crohn's disease treated perioperatively with infliximab or immunosuppressive therapy. *Am J Gastroenterol* 2004; **99**: 878–83.
- 888 Myrelid P, Olaison G, Sjö Dahl R, Nyström P-O, Almer S. Andersson P Thiopurine therapy is associated with postoperative intra-abdominal septic complications in abdominal surgery for Crohn's disease. *Dis Colon Rectum* 2009; **52**: 1387–94.
- 889 Regadas FS, Pinto RA, Murad-Regadas SM *et al.* Short-term outcome of infliximab and other medications on patients with inflammatory bowel disease undergoing ileostomy reversal. *Colorectal Dis* 2011; **13**: 555–60.
- 890 Muysoms FE, Antoniou SA, Bury K *et al.* European Hernia Society guidelines on the closure of abdominal wall incisions. *Hernia* 2015; **19**: 1–24.
- 891 Jairam AP, Timmermans L, Eker HH *et al.* Prevention of incisional hernia with prophylactic onlay and sublay mesh reinforcement versus primary suture only in midline laparotomies (PRIMA): 2-year follow-up of a multicentre, double-blind, randomised controlled trial. *Lancet* 2017; **390**: 567–76.
- 892 Lichtenstein GR, Feagan BG, Cohen RD *et al.* Drug therapies and the risk of malignancy in Crohn's disease: results from the TREAT Registry. *Am J Gastroenterol* 2014; **109**: 212–23.