Management of Acute Diverticulitis and its Complications

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Abstract Colonic diverticular disease is a common condition, and around a quarter of people affected by it will experience acute symptoms at some time. The most common presentation is uncomplicated acute diverticulitis that can be managed conservatively with bowel rest and antibiotics. However, some patients will present with diverticular abscesses or purulent or faeculent peritonitis due to perforated diverticular disease. Whilst most mesocolic abscesses can be managed with percutaneous drainage alone, pelvic abscesses are associated with a higher rate of future complications and usually require percutaneous drainage followed by interval sigmoid resection. Patients who require emergency surgery for complicated acute diverticulitis most commonly undergo a Hartmann's procedure, although resection with primary anastomosis and laparoscopic peritoneal lavage have emerged as alternative treatment options for patients with purulent peritonitis in recent years. However, robust evidence from randomized trials is lacking for these alternative procedures, and the studies that have reported good outcomes from them have included carefully selected patient groups. There has been a move away from recommending elective prophylactic colectomy after two episodes of acute diverticulitis in the light of evidence that most patients will not experience a significant recurrence of their symptoms; elective surgery is indicated for those with ongoing symptoms, pelvic abscesses, complications—such as fistulating disease, strictures or recurrent diverticular bleeding—and those who are at high risk of perforation during future episodes, for example, due to immunosuppression, chronic renal failure or collagen-vascular diseases.

Keywords Diverticulitis · Diverticular abscess · Diverticular perforation

Introduction

Colonic diverticular disease is a common condition, which increases in frequency with age, affecting up to two thirds of individuals in Western countries by the age of 80 years [1, 2]. Diverticulosis can affect any part of the colon, and although left-sided diverticulosis is more common in Europe and North America: the right colon is more commonly affected in Japan, Singapore and China [3, 4]. The pathogenesis of diverticular disease is thought to involve an interplay of low dietary fibre resulting in high intraluminal pressures within the colon, disordered gut motility and increased colonic wall resistance [3, 5, 6].

Only around a quarter of individuals with colonic diverticular disease will ever develop symptoms, usually in the form of acute diverticulitis [2]. Acute diverticulitis occurs when the mouth of a diverticulum becomes blocked with inspissated faeces, resulting in localized inflammation and bacterial proliferation; it commonly presents with abdominal pain and tenderness in the left iliac fossa, but right-sided symptoms may be present if the inflamed diverticular segment is on the right side of the colon or if there is a long, mobile sigmoid loop. Three quarters of patients who develop acute diverticulitis will present with this uncomplicated picture [3]. However, the infection and inflammation may spread, and microperforations may occur, initiating the formation of an inflammatory phlegmon or a localized abscess. If there is a free perforation into the peritoneal cavity, generalized peritonitis, either purulent or faecal, ensues. Acute complicated diverticulitis is conventionally graded by the Hinchey classification system; stage I describes inflammation with an associated pericolic or mesenteric abscess, stage II describes a pelvic or intra-abdominal abscess, stage III

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describes generalized purulent peritonitis and stage IV describes generalized faecal peritonitis [7].

Patients presenting with clinical features of acute diverticulitis are increasingly being investigated by computed tomography (CT), as studies have shown that the accuracy of clinical diagnosis in diverticulitis is low [8, 9]. CT has been shown to be more sensitive than water-soluble contrast enema in the assessment of acute diverticulitis [10, 11] and can predict the failure of medical treatment and the likelihood of secondary complications [12]; it also has the advantage of allowing the detection of other pathologies. Ultrasound may be used as an alternative investigation, depending on the local expertise [6].

There are many challenges in the management of acute diverticulitis, including the decisions about when and how to perform emergency surgery and when elective resection is required. This review aims to appraise the existing evidence for the management of acute diverticulitis and its complications.

Management of Acute Uncomplicated Diverticulitis

The management of acute uncomplicated diverticulitis is generally conservative, with the use of antibiotics, restriction of oral intake and administration of intravenous fluids; around 90 % of patients managed in this way will improve without requiring any further intervention during that episode [13, 14]. Most clinical guidelines have recommended treatment with a broad-spectrum antibiotic, usually including anaerobic cover, for a period of 7 to 10 days [15]. There is evidence that a short course of intravenous antibiotics followed by oral antibiotics, or even oral antibiotics alone, are just as effective in achieving symptom resolution as a full course of intravenous antibiotics [16, 17].

There is increasing interest in the role of outpatient management of patients with acute uncomplicated diverticulitis. A recent randomized trial comparing outpatient and inpatient management of such patients found no differences between the two groups in terms of treatment failures or quality of life [2]. However, outpatient management of uncomplicated diverticulitis is not feasible in every hospital, as it requires rapid access to CT scanning, in order to confirm the diagnosis prior to discharge, and facilities for frequent outpatient follow-up.

The use of antibiotics for acute uncomplicated diverticulitis has been questioned in recent years due to a lack of supportive evidence from prospective or randomized studies [1]. The problems associated with antibiotic use, such as the development of antibiotic-resistant organisms, serious side effects, the development of *Clostridium*-associated colitis and the cost involved, have motivated studies to attempt to clarify whether or not antibiotics are really necessary in these patients. The first study of the role of antibiotics in mild colonic diverticulitis showed no difference in the rate of treatment failures between patients treated with and without antibiotics [18]. It

is notable, however, that the group who received antibiotics had more pronounced inflammation at baseline. A subsequent study reached the same conclusion [19]. These results should be interpreted with caution, as neither study was randomized, and the impact of selection bias on the outcomes must be considered. A recent Cochrane review concluded that there were no significant differences in outcomes whether or not antibiotics were given, although this was based on a single randomized controlled trial [20] and was accompanied by a recommendation that confirmation from further randomized trials should be obtained before incorporating these findings into clinical practice [15]. It appears that although this approach may not be appropriate for all patients, the potential for omitting antibiotics in selected patients with radiologically confirmed uncomplicated diverticulitis does exist. A randomized multicentre trial is currently underway in the Netherlands to try and answer this question [1].

Following successful conservative management of an episode of acute diverticulitis, it is mandatory to perform further outpatient investigations in order to confirm the diagnosis and exclude a co-existent malignancy; this may consist of either barium enema or colonoscopy performed after the acute inflammation has settled [6].

Management of Diverticular Abscesses

Diverticular abscesses may be managed with antibiotics with or without percutaneous drainage under radiological guidance; if clinical deterioration occurs despite maximal medical therapy, surgical intervention may be indicated. A study of the long-term outcomes of diverticular abscesses reported that 15 % of patients with a mesocolic abscess required surgery during their first admission compared with 39 % of patients with pelvic abscesses [21]. After a median follow-up period of 43 months, 42 % of patients managed non-operatively for their mesocolic abscess went on to require surgical intervention compared with 53 % of those with a pelvic abscess. Overall, 51 % of patients with mesocolic abscesses required surgical intervention compared with 71 % of patients with a pelvic abscess. On this basis, the authors recommended percutaneous drainage followed by interval colectomy for patients with pelvic abscesses and percutaneous drainage for mesocolic abscesses greater than 5 cm, with a trial of medical management for smaller ones, and subsequent colectomy only for those with persistent or recurrent symptoms. A subsequent study confirmed that CT-guided percutaneous drainage of pelvic or abdominal abscesses was successful in two thirds of patients, facilitating a subsequent elective sigmoid resection with primary anastomosis where appropriate [22]. There is some evidence that antibiotics alone are a feasible alternative for smaller pelvic or abdominal abscesses that are not amenable to percutaneous drainage [23].

Management of Perforated Diverticulitis

When to Operate?

One of the major challenges in the management of acute diverticulitis is deciding when a patient requires an emergency operation. Opinion on this differs, and subsequently, there is a wide variation in the emergency resection rates between individual units and countries, with published figures ranging from 16.4 to 37 % of acute admissions with diverticulitis [13, 24–27]. Studies have shown that surgical intervention is required during the first episode of acute diverticulitis in 4 % of those with moderate diverticulitis and 26 % of those with severe diverticulitis, as diagnosed on CT [11]. Generally, the indications for surgery include the presence of diffuse peritonitis and evidence of a pneumoperitoneum or associated sepsis that is not responding to full medical treatment. However, there is no precise definition of patients requiring surgery, as even some patients who present with generalized peritonitis may respond to a trial of conservative therapy [28]. A small observational study of 28 patients with radiological evidence of pneumoperitoneum secondary to complicated diverticulitis who were initially managed non-operatively found that 13 patients did not go on to require surgery during the index admission [29]. If a trial of conservative management is opted for, it is important to perform serial examinations in order to detect deterioration early.

A number of emergency surgical approaches have been described for perforated diverticulitis, including laparotomy without resection, laparotomy with resection and formation of a stoma, laparotomy with resection and primary anastomosis with or without a defunctioning stoma and laparoscopic lavage and drainage. The classical three-stage approach, with proximal diversion followed by resection and then restoration of intestinal continuity, has been entirely replaced by these one- or two-stage techniques. Whichever surgical intervention is chosen, it should always be preceded by examination of the distal colon by means of sigmoidoscopy in order to exclude a rectal or sigmoid cancer, which may alter the surgical approach [28].

Primary Anastomosis Versus Hartmann's Procedure

The conventional approach to perforated diverticular disease is a Hartmann's procedure, with resection of the inflamed sigmoid colon and formation of an end colostomy. One of the first published reviews of emergency surgery for perforated diverticular disease reported improved mortality and morbidity when the colon was resected compared with procedures in which the colon was left in the abdomen [30]. A subsequent randomized trial reported that primary resection was associated with significantly lower rates of postoperative peritonitis and early re-operation when compared with initial suture of

the perforation and diverting colostomy followed by secondary sigmoid resection [31].

Although a Hartmann's procedure is still the most frequently performed operation for acute complicated diverticulitis [32], there is an increasing trend towards primary anastomosis in carefully selected patients. This approach has the advantage of avoiding the need for a further major laparotomy in order to restore intestinal continuity. It may also result in fewer patients with a permanent stoma, as up to 30 % of patients undergoing a Hartmann's procedure do not have their colostomy reversed [33]. However, it tends to increase the operating time and there is a risk of anastomotic leakage. A number of studies and systematic reviews have reported good outcomes in patients with generalized purulent peritonitis managed with colectomy and primary anastomosis, with or without intra-operative colonic lavage or a defunctioning stoma [32, 34–41], and this approach had been shown to be associated with significantly lower costs than the two-stage approach [36]. However, none of these studies were randomized and therefore suffer from a high likelihood of selection bias, with fitter, more stable patients being more likely to be selected for primary anastomosis. A comprehensive systematic review and meta-analysis including 963 patients from 15 studies concluded that mortality after primary anastomosis was significantly lower than after Hartmann's procedure in emergency surgery for acute diverticulitis, with comparable mortality rates for grade Hinchey III and IV generalized peritonitis [42]. However, the authors acknowledge the limitations of the conclusions due to considerable selection bias.

More recently, the first randomized trial comparing Hartmann's procedure and primary anastomosis with diverting ileostomy for perforated diverticulitis with purulent or faecal peritonitis was published [43]. The trial reported no differences between the groups with regard to overall complications and morbidity and mortality for the initial colon resection, but the Hartmann's group had a significantly lower stoma reversal rate and significantly higher rates of serious complications following the reversal surgery. The authors concluded that the trial favoured primary anastomosis with diverting ileostomy over Hartmann's procedure. However, this trial should be interpreted with caution, as only 62 patients were included, and it was discontinued after an interim analysis found significant differences in some of the secondary outcome measures and a decreasing recruitment rate. The trial was not originally powered to detect differences in these secondary outcome measures. A further 52 patients presenting during the study period were not assessed for eligibility for inclusion in the trial because the surgeons involved were not willing to enroll the patient, thus introducing the possibility of selection bias. An earlier attempt at a randomized trial also had to be stopped prematurely because of poor recruitment, highlighting the difficulties of performing a randomized trial on an emergency procedure for a potentially life-threatening condition [44].

At best, these studies show that primary anastomosis is a safe alternative to the Hartmann's procedure in carefully selected patients. The factors influencing this decision, such as patient co-morbidities, pre-operative status and intra-operative Hinchey grade, have yet to be fully elucidated, although one study reported that the risk of anastomotic leakage was associated with patient co-morbidities rather than Hinchey grade [45]. It is apparent that most authors consider the presence of faecal peritonitis, septic shock, pre-operative organ failure, ASA IV and an immunocompromised status to be contraindications to primary anastomosis [34, 35]. The need for a defunctioning stoma in patients undergoing a primary anastomosis is debatable, although there is some evidence that anastomotic leak rates are lowest when a defunctioning stoma is created [46]. In summary, the uncertainties about patient selection and the lack of a conclusive randomized trial makes recommending primary anastomosis as the standard approach in patients with generalized purulent peritonitis controversial.

The Role of Laparoscopic Peritoneal Lavage

In recent years, there have been reports of the successful use of laparoscopic peritoneal lavage in the management of patients with perforated diverticulitis. Its proponents claim that in selected patients, this approach avoids the need for an acute colectomy and colostomy formation. The first published study of patients undergoing laparoscopic lavage for generalized purulent peritonitis due to perforated diverticular disease reported that all eight patients made a complete recovery, with no patient requiring further surgical intervention in the 12- to 48-month follow-up period [47]. Subsequent small series also concluded that laparoscopic lavage is a safe and effective alternative to colectomy in patients with diffuse purulent peritonitis [48–55]. The largest published series to date included 100 patients with generalized peritonitis and radiological evidence of pneumoperitoneum [56]; 92 of these were managed by laparoscopic lavage, and all eight patients with faecal peritonitis were converted to an open Hartmann's procedure. Of those managed laparoscopically, 89 % recovered fully without morbidity. The mortality rate was 3 %. The authors concluded that laparoscopic lavage was associated with lower rates of morbidity and mortality than those reported for emergency colectomy. It is notable that during the time period of the study, a total of 1,257 patients were admitted with acute diverticulitis; it is unlikely that only 100 of these patients required surgical intervention, thereby raising the possibility of selection bias within the study. There have also been a number of systematic literature reviews regarding laparoscopic lavage, all of which have concluded that the procedure was successful in controlling sepsis in the vast majority of patients, with low morbidity and mortality rates, and could therefore be a valid alternative to a Hartmann's procedure [8, 57–59]. However, in general, the published studies included were of low methodological quality.

More recently, the Dutch Diverticular Disease Collaborative Study Group published their results with laparoscopic lavage in 38 patients with either pneumoperitoneum or purulent peritonitis due to perforated diverticulitis [60]. At operation, 5 patients had a pelvic or retroperitoneal abscess, 29 had localized peritonitis and 4 had generalized purulent peritonitis. The sepsis was controlled in 81.6 % of patients, although 44.7 % of the patients developed complications. The authors concluded that laparoscopic lavage was feasible in the majority of patients with perforated purulent diverticulitis, although the importance of patient selection was emphasized. However, the small number of patients who were treated by this method makes this conclusion difficult to justify. Furthermore, this was a retrospective, non-randomized study and, therefore, subject to selection bias.

The role of laparoscopic lavage in the management of acute diverticulitis is yet not clear. Although there are reports of laparoscopic lavage being used in patients with generalized purulent diverticulitis with good outcomes, these studies are not robust and are subject to considerable biases. In all of these studies, the question arises as to how many of these patients actually needed surgical intervention and how many would have settled with conservative management; for example, in the Dutch trial [60], the majority of patients had only localized purulent peritonitis or a pelvic abscess, both of which are scenarios known to respond well to medical management. In most studies, the criteria used to select patients for laparoscopic lavage were not clear. A number of randomized trials are currently underway to try to address this difficult issue; however, the challenges of performing a randomized trial in this setting are significant. Most patients with localized peritonitis or a small abscess, without an overt perforation, are likely to settle with conservative management and, therefore, subjecting those patients to a resection is difficult to justify. Conversely, those with an overt perforation are clearly likely to have or to develop faecal peritonitis and will undoubtedly require a resection. Currently, the evidence is insufficient to recommend laparoscopic lavage as an approach to the management of perforated diverticulitis. It may have a role in situations where sigmoid inflammation without overt perforation is found during an acute laparoscopy performed for another presumed diagnosis, such as suspected appendicitis.

Elective Surgical Intervention

Previously, there has been an approach of recommending elective surgical resection following two episodes of acute diverticulitis managed conservatively [61] based on a belief that patients were likely to have further episodes and eventually require emergency surgery, with the associated risks of morbidity and mortality. However, over recent years, evidence has emerged that only a minority of patients will go on to

experience a further episode, with only 1.4 to 5.5 % requiring a subsequent emergency colectomy, leading to a move away from routine elective resection [6, 13, 24–26, 61–66]. Furthermore, only a fifth of those undergoing emergency surgery have a history of diverticulosis [27], and the majority of patients who die following an acute diverticular perforation have no previous history of diverticulitis [67], indicating that elective resection may not reduce the rate of emergency surgery or its associated mortality. A decision and cost analysis of the timing of elective resection concluded that expectant management was associated with lower mortality rates, lower rates of colostomy formation and reduced costs when compared with an approach of elective prophylactic colectomy [46].

It appears that elective resection should be reserved for those with ongoing symptoms, those with pelvic abscesses and those with complications such as fistulating disease, strictures or recurrent diverticular bleeding. Patients who are at high risk of perforation during future episodes of acute diverticulitis, such as those who are immunosuppressed, or those with chronic renal failure or collagen-vascular diseases may also benefit from early elective resection [27]. The decision should be tailored to the individual patient, with due regard to their initial presentation, ongoing symptoms and comorbidities. It should also be considered that patients who report continued pain after an episode of diverticulitis may have an alternative cause for their symptoms, such as irritable bowel syndrome, which may result in unexpected recurrence of symptoms after a sigmoid resection [6].

Acute Diverticulitis in Younger Patients

There have been conflicting reports on the impact of age on the presentation and management of acute diverticulitis. Some studies have suggested that patients under 50 years of age experience more severe attacks of diverticulitis, have a greater risk of developing recurrent episodes and are more likely to require subsequent emergency colectomy [25, 26, 61]. This led to the opinion that younger patients presenting with a first episode of diverticulitis should be managed more aggressively, with earlier recourse to emergency colectomy. Conversely, other studies have reported that patients under 50 years are no more likely to have a severe episode [18, 68] or recurrent disease than those over 50 years of age [24]. In the absence of clear evidence of an increased severity of disease in younger patients, it is recommended that these patients are managed in the same way as older patients with regard to decision-making in the elective setting [6].

Conclusions

Acute diverticulitis is a common condition, although most patients have uncomplicated disease which is managed

successfully with conservative measures. The management of diverticular abscesses depends on their location; mesocolic abscesses greater than 5 cm should be treated by percutaneous drainage, with a trial of antibiotics alone for smaller abscesses, and interval colectomy only for those who remain symptomatic. Pelvic abscesses should be managed with percutaneous drainage followed by routine interval colectomy. In patients with perforated diverticulitis and diffuse peritonitis, a largely conservative approach should be adopted wherever possible in order to avoid subjecting patients unnecessarily to emergency surgery. When emergency surgery is required, the Hartmann's procedure is still the most frequently performed operation. In recent years, alternative approaches have been advocated, including resection with primary anastomosis and laparoscopic peritoneal lavage. It is difficult to make recommendations on the role of resection with primary anastomosis because of a lack of high-quality evidence, but it appears to be a safe procedure in carefully selected patients. Further research into the exact selection criteria is required. At present, there is insufficient evidence on the role of laparoscopic lavage for it to be a recommended approach for perforated diverticulitis; however, the existing studies are promising and future trials may change this. Decisions regarding elective prophylactic resection should be tailored to the individual patient, and resection may be appropriate for those with ongoing symptoms, pelvic abscesses or associated complications.

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