

Management of acute diverticulitis

ABSTRACT

Acute diverticulitis is a major health-care concern. The optimal management of this common condition has been critically examined in recent years leading to a number of paradigm changes. In many areas, the debate continues.

Acute uncomplicated diverticulitis may be safely managed without antibiotics. A number of randomized controlled trials have examined the role of laparoscopic lavage vs resection for purulent peritonitis. In cases where resection is indicated the traditional Hartmann's procedure is being trialled against resection with primary anastomosis.

In the follow up of an acute uncomplicated episode, the value of colonoscopy is being questioned but remains in current guidelines. In the elective setting, more recent studies have led to a trend away from resection to prevent complications but towards resection to improve quality of life. This article presents an overview of the current guidance, areas of controversy and the associated evidence base.

Acute diverticulitis is an increasingly significant health-care concern. Hospital Episode Statistics data from 2017–18 showed 128 863 admissions in England with a primary diagnosis of diverticular disease, including 9790 episodes associated with abscess formation or perforation (NHS Digital, 2018). Given the incidence of diverticulitis, appropriate management is important in general practice and emergency medicine as well as general surgery. The management of diverticulitis has changed significantly over the past 5 years. The changes have affected the full range of management of the condition from diagnosis and work up, to management of both uncomplicated and complicated cases and follow up after resolution of an attack. This review presents these changes and describes current management.

Spectrum of diverticulosis

Colonic diverticula are small outpouchings of the colonic lumen where the mucosa herniates through the colonic wall at sites of vascular perforation (Tochigi et al, 2017). Diverticulosis refers to the presence of acquired colonic diverticula. There is no clear indication for follow up or treatment of patients with asymptomatic diverticulosis (Bhucket and Stollman, 2014). Diverticulosis may progress to diverticulitis with inflammation of diverticula, thought to be secondary to obstruction of the sac by a faecolith (Bhucket and Stollman, 2014). Diverticulitis is estimated to occur in

4% of patients with diverticulosis (Stollman et al, 2015). In addition to this acute presentation, diverticulosis can present as symptomatic uncomplicated diverticular disease or segmental colitis associated with diverticulosis. The former refers to chronic abdominal pain in the absence of acute diverticulitis or colitis (Strate et al, 2012). The latter is defined as non-specific segmental inflammation in the sigmoid colon surrounded by diverticula, which often presents with rectal bleeding. Segmental colitis associated with diverticulosis seems to run a self-limiting course (Freeman, 2016).

Aetiology of diverticulosis

Diverticulosis is associated with increased age (Comparato et al, 2007) and body mass index (Aune et al, 2017).

A popular hypothesis had suggested that diverticulosis might be the result of a lack of dietary fibre but the literature is conflicting. While a prospective study suggested that increased dietary fibre may be associated with reduced risk of diverticular disease-associated hospital admission and death (Crowe et al, 2014), a cross-sectional study challenged this concept (Peery et al, 2013). Taken in aggregation, the National Institute for Health and Care Excellence (2017) guidelines and Royal College of Surgeons and Association of Coloproctology of Great Britain and Ireland (2014) commissioning guide continue to recommend a high dietary fibre intake with adequate fluid intake for patients with a history of acute diverticulitis.

Genetics have emerged as a major player in the pathogenesis of the condition, with twin studies finding a relative risk for twin siblings of 2.92 compared to the general population (Strate et al, 2013). Heredity was estimated to contribute approximately 40–50% to the likelihood of developing diverticulosis (Rezapour et al, 2018).

A retrospective cohort study found that higher levels of vitamin D were associated with a lower incidence of complicated diverticulitis (Maguire et al, 2013). The possible protective role of vitamin D requires further investigation.

A meta-analysis examining the role of non-steroidal anti-inflammatory drugs (Kvasnovsky et al, 2014) found that use of non-steroidal anti-inflammatory drugs was associated with increased risk of diverticular perforation (odds ratio 3.4) and diverticular bleeding (odds ratio 2.6). The National Institute for Health and Care Excellence (2017) guidelines advise patients with previous diverticulitis to avoid non-steroidal anti-inflammatory drugs if possible.

Classification of acute diverticulitis

Diverticulitis is first classified as either uncomplicated or complicated. Uncomplicated disease is characterized by

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simple inflammation of diverticula. Complicated disease refers to the associated development of abscess, perforation, fistulation and/or obstruction (Bhucket and Stollman, 2014). A systematic review (Morris et al, 2014) suggested that 80% of patients with diverticulitis have an uncomplicated course, with the remaining 20% experiencing complications.

Episodes of complicated acute diverticulitis must be further classified. This classification is significant as most treatment algorithms are based on these classes. The traditional classification is the Hinchey classification. This was designed to be used based on laparotomy findings and classes presentations as follows:

- I – phlegmon or localized paracolic abscess
- II – pelvic abscess
- III – purulent peritonitis
- IV – faeculent peritonitis.

The preoperative investigations available to the surgeon have changed dramatically since Hinchey's (1978) classification, allowing patients to be staged preoperatively and treatment tailored accordingly. One useful classification system (Kaiser et al, 2005) attempts to marry up the traditional Hinchey classification with computed tomography findings, with addition of an extra stage 0 (Table 1).

Management of acute uncomplicated diverticulitis

The use of antibiotics

The role of antibiotics in the management of acute uncomplicated diverticulitis has been critically examined over recent years. Two large randomized controlled trials provide evidence to support the selective omission of antibiotics.

The AVOD study (Chabok et al, 2012) was a randomized controlled trial of 623 patients with computed tomography-proven acute uncomplicated diverticulitis that compared antibiotics (at least a 7-day course of intravenous and oral antibiotics) to no antibiotics (intravenous fluids only). They found no significant difference in recovery time or complication rate. However, 32% of patients in the no antibiotic arm required antibiotic treatment as a result of abdominal pain, fever or rising C-reactive peptide levels.

The DIABOLO trial (Daniels et al 2017) was similar, assessing 528 patients with a first episode of computed tomography-confirmed left-sided acute uncomplicated diverticulitis (including stage Ia and those Ib patients with abscess <5 cm). The antibiotic arm received 10 days of antibiotics. No benefit to antibiotic therapy was seen at discharge and following longer-term follow up.

The National Institute for Health and Care Excellence (2017) guidelines advise giving oral antibiotics in cases of mild, uncomplicated acute diverticulitis if there is suspicion of infection, with watchful waiting reserved for patients who are systemically well, without comorbidities and without suspicion of infection. This recommendation is partly because the trials mentioned above are based on computed tomography-proven cases of acute diverticulitis, and the extent to which these results can be extrapolated to patients with a clinical diagnosis is uncertain. The Royal

Table 1. Classification of acute diverticulitis based on computed tomography findings

Stage	Computed tomography findings
0	Diverticula only
Ia	Colonic wall thickening with inflammatory reaction in pericolic fatty tissue
Ib	As for Ia + local (pericolic or mesocolic) abscess
II	As for Ia + distant abscess (pelvic, intra-abdominal or retroperitoneal)
III	Free air with local or generalized free fluid but no open communication with bowel lumen
IV	Free perforation with open communication with bowel lumen

From Tochigi et al (2017)

College of Surgeons and Association of Coloproctology of Great Britain and Ireland (2014) commissioning guide acknowledges that evidence exists to support the management of patients without antibiotics, but in general a course of oral antibiotics is still recommended. In particular, the commissioning guide advises antibiotic treatment for those patients sufficiently unwell to require admission to hospital.

Outpatient management

A second area of development concerns the feasibility of outpatient management of uncomplicated episodes. Failure rates for primary treatment were similar between inpatient and outpatient management of such cases in a multicentre randomized controlled trial (Biondo et al, 2014), in a systematic review (Balasubramanian et al, 2017) and in a retrospective analysis (Joliat et al, 2017). The latter included patients with acute uncomplicated diverticulitis and mild complicated diverticulitis (abscess <4 cm, pneumoperitoneum <2 cm). Importantly, however, all patients in these trials received antibiotic therapy. Outpatient management should lead to significant reduction in health-care costs, with a Spanish study suggesting a 60% saving (Lorente et al, 2013).

Management of acute complicated diverticulitis

The optimal treatment strategy for acute complicated diverticulitis should be guided by abdominal and vital signs, blood results and computed tomography findings. If, for example, a more conservative treatment strategy is chosen, the patient should be re-reviewed regularly. Evidence of treatment failure includes spreading abdominal signs, and worsening vital signs and blood tests. In such a case, escalation of intervention should be considered. Similarly, treatment should not be dictated by computed tomography findings alone. Urgent surgery may be indicated for the patient with generalized peritonitis despite apparently localized computed tomography findings, while a patient with computed tomography showing free air but localized signs and stable vital signs may undergo a trial of conservative treatment (Tochigi et al, 2017).

Stage Ib–II

Patients with a local abscess <5 cm may be managed expectantly with antibiotics (Boermeester et al, 2016). A proportion of patients will not resolve and require escalation of treatment. Regular clinical review is required to detect such patients early.

For larger abscesses, drainage can often be achieved percutaneously under computed tomography or ultrasound guidance (Tochigi et al, 2017). Again, deterioration despite drainage of the abscess would be an indication for surgery.

Stage III–IV

The management of acute diverticulitis with generalized peritonitis has been intensively investigated in recent years. Initially, this was treated with a three-stage procedure:

1. Diversion with proximal colostomy and drainage of the perforated area
2. Resection of the affected area
3. Reversal of the stoma.

This treatment paradigm was followed by the Hartmann's procedure in which the affected segment is resected in the first operation. The proximal colonic end is brought out as an end stoma and the distal end left as a closed rectal stump. This procedure carries a high mortality and subjects the patient to a stoma that often remains permanent. Despite this, the Hartmann's procedure largely remains the standard of care for patients with perforated acute diverticulitis. However, this notion has become subject to debate.

The debate concerns first, the use of laparoscopic lavage *vs* colonic resection for Hinchey III cases and second, traditional Hartmann's *vs* colonic resection with primary anastomosis (with or without proximal defunctioning stoma) for cases where resection is indicated.

Laparoscopic lavage *vs* resection

The role of laparoscopic lavage in the management of Hinchey III diverticulitis has been the subject of three large multicentre randomized controlled trials, which presented conflicting conclusions.

The SCANDIV trial (Schultz et al, 2015) randomized 199 patients with suspected perforated diverticular disease to either laparoscopic lavage or primary colonic resection. Severe postoperative complications (Clavien–Dindo complication >IIIa) at 90 days were experienced in 30.7% of the lavage group and 26.0% of the resection group ($P=0.53$). The lavage group had a higher re-operation rate (12.9% *vs* 8.3%) and four missed sigmoid cancers. Lavage thus did not reduce severe complications, while being associated with higher re-operation rates and the risk of missed malignancy. The authors did not recommend lavage.

The LOLA arm (Vennix et al, 2015) of the LADIES trial randomized 90 patients with Hinchey III diverticulitis to either laparoscopic lavage or Hartmann's procedure. Recruitment terminated early because of poor results in the lavage group. At 30-day analysis, morbidity or mortality was 39% in the lavage group *vs* 19% in the Hartmann's group. Adverse events were mostly surgical re-intervention.

The DILALA study, the third multicentre randomized controlled trial, has been more favourable towards lavage: 83 patients with Hinchey III disease were randomized after diagnostic laparoscopy to lavage or Hartmann's. Kohl et al (2018) reported the 2-year follow-up data. Patients in the lavage group had a 45% ($P=0.012$) lower risk of undergoing one or more operations (including stoma reversal) within 24 months and had fewer operations (ratio 0.51, $P=0.024$) overall compared to the Hartmann's group. No difference was found in number of re-admissions or mortality. Based on these data, the authors recommend laparoscopic lavage for Hinchey III cases.

A recent meta-analysis (Penna et al, 2018), which included a total of 589 patients, comparing laparoscopic lavage to primary resection for acute perforated diverticulitis found no significant differences in mortality, 30-day reoperation and unplanned readmissions. Laparoscopic lavage had higher rates of intra-abdominal abscess, peritonitis and increased long-term emergency re-operation. By contrast, patients who underwent lavage experienced shorter operative times, fewer cardiac and wound complications, and shorter hospital stay. After primary resection, 90% of patients had stomas, of which 74% were reversed within 12 months; 14% of the lavage patients went on to require a stoma (48% of which were reversed within 12 months) and 36% proceeded to elective sigmoidectomy. The authors suggested that the Hinchey classification might be too broad to allow appropriate selection of patients for lavage *vs* resection. In the future, composite predictive scores may allow tailoring of lavage *vs* resection on an individualized basis.

Hartmann's procedure *vs* resection with primary anastomosis

The second major debate regarding the management of perforated acute diverticulitis concerns whether resection should be performed, leaving an end colostomy and rectal stump as in the traditional Hartmann's procedure, or combined with primary anastomosis. Traditional teaching that primary anastomosis should be avoided in the context of contamination, sepsis and a potentially unstable patient has been challenged in a recent meta-analysis (Shaban et al, 2018) which included a total of 765 patients. A significantly lower mortality was experienced in the primary anastomosis (10.6%) compared to the Hartmann's (20.7%) group ($P=0.0003$). Morbidity was also lower in the primary anastomosis group (41.8% *vs* 51.2%, $P=0.0483$). The average anastomotic leak rate was 5.9%. This hypothesis is the subject of the DIVA arm of the LADIES multicentre randomized controlled trial, the results of which are awaited.

Elective resection for diverticulitis

There are two possible indications for elective surgery for diverticular disease.

The first is as prophylaxis against recurrent attacks of acute diverticulitis and the associated complications.

Previous guidance from the European Association for Endoscopic Surgery (Kohler et al, 1999) and a *Lancet* review article (Stollman and Raskin, 2004) advised consideration of elective resection after two episodes of acute uncomplicated diverticulitis. However, more recent studies suggest that the majority of patients do not recur and for those that do, the severity of the presentation is not likely to be greater than previous uncomplicated episodes. The DIVER trial suggests that the frequency of perforation approximately halves with each subsequent episode (25% for the first, 12% for the second, 6% for the third and 1% for further episodes) (Biondo et al, 2014). These findings, along with the suggestion that even elective resections for diverticulitis carry significant morbidity and mortality (Van Arendonk et al, 2013), have informed more conservative recent guidelines. The Royal College of Surgeons and Association of Coloproctology of Great Britain and Ireland (2014) commissioning guide does not support elective resection in patients following a single episode of uncomplicated diverticulitis. In patients with two or more episodes, the decision to undergo elective resection should be individualized; a single recommendation suitable for all patients cannot be given.

The second indication for elective resection is chronic symptoms that impair quality of life. A systematic review reported improved quality of life following laparoscopic resection for recurrent or chronic symptoms (Andeweg et al, 2016). The DIRECT trial (van de Wall et al, 2017) was a multicentre randomized controlled trial that randomized patients with recurrent acute episodes or persistent abdominal symptoms to either sigmoid resection or conservative management. At 6 months, the surgical group had improved quality of life. However, there was a 12% leak rate and 21% of patients received a stoma (of which 82% had been reversed by 6 months).

Follow-up colonoscopy after an episode of acute diverticulitis

The Royal College of Surgeons and Association of Coloproctology of Great Britain and Ireland (2014) commissioning guide advises that all patients require investigation of the colonic lumen by colonoscopy, barium enema or computed tomography colonography after the acute attack has resolved. The intention is to detect occult cancer or alternative pathology. This is an area of debate.

A systematic review (Sharma et al, 2014) demonstrated a pick-up rate for cancer of 1.6% for patients after an episode of acute diverticulitis. Sub-group analysis demonstrated the corresponding value to be 0.7% and 10.8% for uncomplicated and complicated diverticulitis respectively. A Danish cohort study (Mortensen et al, 2017) showed the incidence of colon cancer to be higher in patients with diverticulitis (4.3% compared to 2.3%).

Other authors argue against routine colonoscopy following an episode of acute diverticulitis. They refer to the costs and risks of colonoscopy and a comparative cohort study demonstrating no significant difference in detection of advanced colonic neoplasia by colonoscopy between

KEY POINTS

- The spectrum of symptomatic diverticulosis includes acute diverticulitis, symptomatic uncomplicated diverticulosis and segmental colitis associated with diverticulosis.
- Acute diverticulitis should be classified according to computed tomography findings where possible, as staging dictates management.
- Acute uncomplicated diverticulitis can be safely managed without antibiotics or in the outpatient setting.
- Complicated cases with abscess <5 cm can be managed by a trial of antibiotic therapy. Larger abscesses should be considered for percutaneous drainage.
- For cases with purulent peritonitis, there remains debate regarding the relative efficacy of laparoscopic lavage vs resection.
- For cases where resection is indicated, a current randomized controlled trial is investigating the efficacy of primary anastomosis vs the traditional Hartmann's procedure.
- The trend for elective resection is away from resection to prevent complications but towards resection to improve quality of life.
- The requirement for follow-up colonoscopy after an episode of uncomplicated acute diverticulitis is under debate but remains in current guidelines.

patients following a first episode of computed tomography-proven uncomplicated acute diverticulitis and those undergoing routine screening (Daniels et al, 2015). This study argues that patients should simply return to screening following an episode of uncomplicated diverticulitis.

For the time being at least, guidelines continue to recommend interval luminal investigation following a first episode of acute diverticulitis. However, it is worth bearing in mind that if more cases are managed conservatively with measures such as laparoscopic lavage, the number of potential missed cancers may increase.

Conclusions

Acute diverticulitis is an increasingly common reason for patients to present to GPs and emergency departments. The management of these patients, both in initial presentation and follow up, is the topic of research and debate. Established treatment paradigms have been critically questioned over recent years, with a gradual shift towards more conservative management. There is a trend towards managing uncomplicated attacks in the community and without antibiotics. Localized abscesses can be drained percutaneously under radiological guidance. The previous standard of care for acute perforated disease, the Hartmann's procedure, is being trialled against laparoscopic lavage and primary anastomosis. Similarly, the indications for elective resection have changed and the need for follow-up colonoscopy is under scrutiny. This article sets out the current trends and provides the evidence base informing these changes. **BJHM**

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