

## Diverticular Disease of the Colon: Review and Update

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### Introduction

Diverticular disease of the colon (or diverticulosis) is an anatomical description of saccular outpouchings of mucosa through the wall of the colon. It is very common in the Western world, and its prevalence is rising. This paper will briefly review the epidemiology and pathophysiology of diverticular disease, followed by a focus on the diagnosis and management of the two most common complications of the disease: diverticulitis and diverticular bleeding.

### Epidemiology

The true prevalence of diverticulosis is unknown, but autopsy reports suggest that up to half of patients over 60 years are affected.<sup>1</sup> The frequency increases with age and is much higher in developed societies in which fibre intake is lower. In the Western world, the most commonly affected site in the colon is the sigmoid colon, sometimes with more proximal involvement.<sup>2</sup> However, in Asian countries diverticulae tend to be right-sided (in the ascending colon) and fewer in number. The reason for this difference is unknown.

### Pathophysiology

The colon is made up of circumferential and longitudinal (taenia coli) muscle layers, which act in unison to propel stool towards the rectum. Points of weakness exist in the circular muscle layers where blood vessels (vasa recta) penetrate to feed the submucosa.

Transmission of high pressures from the lumen to serosal layers in the colon (i.e., on the opposite side of the muscularis layer) occurs when muscu-

lar contractions of the circumferential muscle fibres obliterate the lumen at particular points, forming individual high-pressure segments of colon. The high pressure over time pushes the mucosa through the above-mentioned weak points in the circumferential layer and forms saccular pouches on the outside of the colon (Figure 1).<sup>3</sup> These extruded sacs are not true diverticulae that have full-thickness herniation of both mucosal and muscularis layers, but instead are “pseudodiverticulae”, in which only the mucosal layers herniate through these points of weakness.

As people age, the risk of diverticulae formation increases for two reasons. First, for unknown reasons, thickening and shortening of the taenia coli occur, allowing more frequent formation of iso-

lated segments of high-pressure bowel lumen. Second, age-related deterioration of elastin and collagen fibres leads to decreased compliance of the colon and increased transmission of pressure across the muscularis layer. Loss of elastin fibres may contribute to sacculation as well.

A further contributor to the development of diverticulae is the low bulk diet consumed in developed countries. Smaller, harder stools have longer transit times and cause higher colonic pressures. They also may increase the likelihood of segmentation and result in the transmission of higher pressures across the weak points of the circular muscle.<sup>4</sup>

### Diagnosis and Management

Diverticulosis is asymptomatic in 70% of patients.<sup>5</sup> Occasionally patients may complain of mild intermittent abdominal pain, bloating, excessive flatulence or irregular defecation. It is not clear if these symptoms are in fact caused by the diverticulosis *per se* or whether they are due to a concomitant irritable bowel syndrome—a frequently observed combination.

Figure 1: Formation of Diverticulae



Segmentation of bowel and resulting high intraluminal pressure herniates the mucosa through areas of muscular weakness.

## Diverticular Disease

Diagnosis usually occurs as part of the work-up when diverticulosis becomes symptomatic, or as an incidental finding while screening for colorectal cancer or other bowel pathology. Barium enema examination is the most commonly used test to establish the diagnosis of diverticulosis, and it gives valuable information on the extent and severity of the disease. Colonoscopy is also an excellent way to diagnose diverticulosis, with the added advantage of ruling out malignancy. Asymptomatic diverticulosis requires no

further work-up; rectal bleeding, however, is not a symptom of simple (uncomplicated) diverticulosis and must always be investigated further, with either barium enema or colonoscopy.

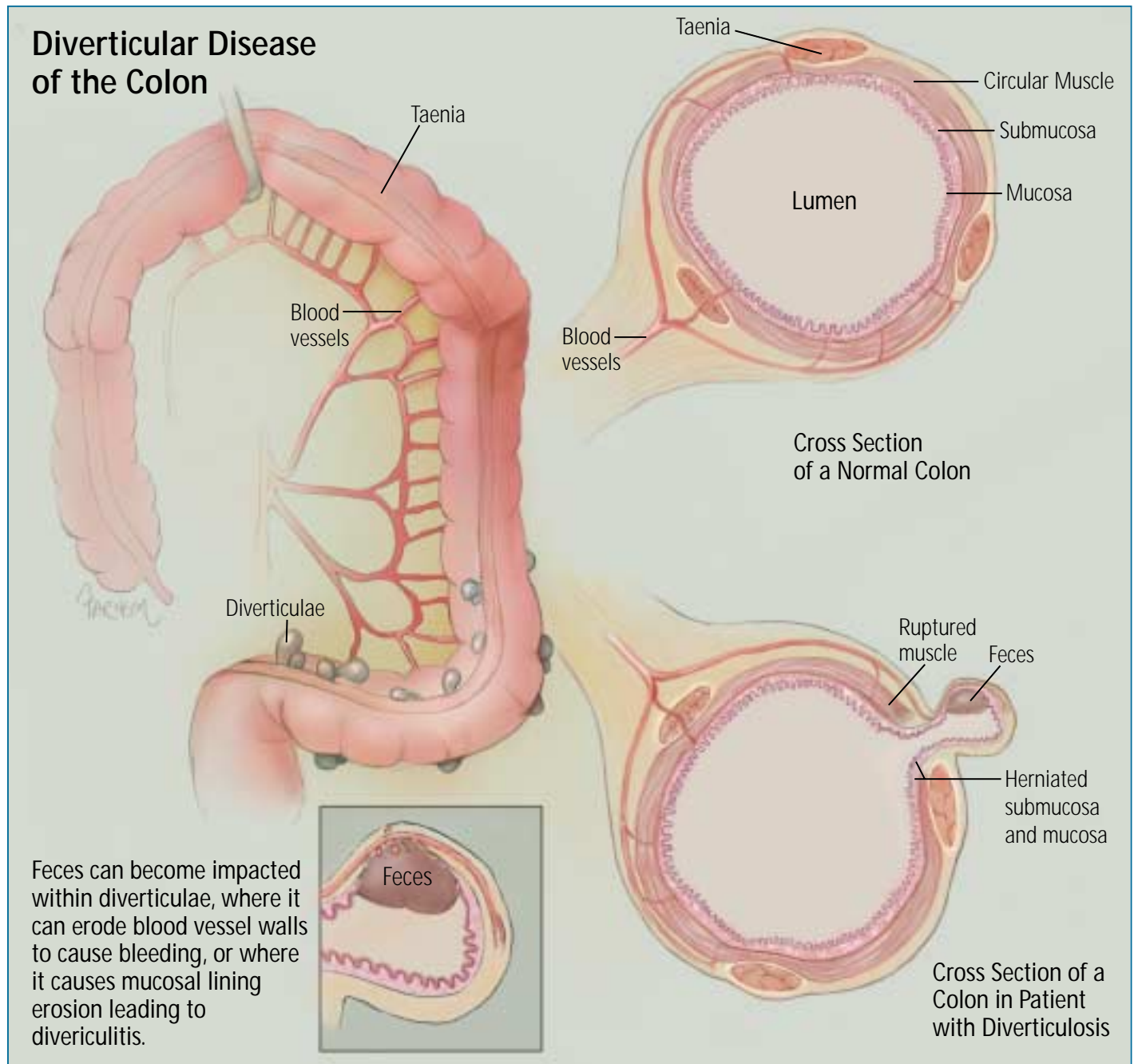
Management of diverticulosis is based on increasing dietary fibre to increase stool weight, increase transit time and lower intracolonic pressure. Patients should eat more insoluble fibre, especially whole wheat cereals and breads. If this is difficult, any of the commercially-available fibre supplements are

useful to bring patients' intake to the recommended 20–30g dietary fibre per day. Use of these fibre supplements has been associated with a slower development or prevention of diverticulae formation.<sup>6</sup> Surgery for asymptomatic or uncomplicated diverticulosis is not indicated.

### Complications of Diverticular Disease

#### Diverticulitis

Diverticulitis is the most common complication of diverticular disease, occur-



## Diverticular Disease

ring in 10–25% of patients. Once diverticulae have developed, they are permanent. Stool can become impacted or inspissated within diverticulae, where they can erode the mucosal lining and lead to local inflammation and perforation. This usually occurs in the sigmoid colon, and tends only to affect one diverticulum at a time. If the perforation is microscopic, only localised inflammation ensues (peridiverticulitis); this is called “simple” diverticulitis and it most often responds to conservative therapy. If the perforation is more extensive and penetrates the bowel wall, it can cause inflammatory phlegmon, abscess, fistula, obstruction or free perforation. Development of any of these outcomes is termed “complicated” diverticulitis, and usually requires operative intervention. Resulting symptoms can range from mild local pain (akin to appendicitis, but occurring in the lower-left quadrant of the abdomen) to generalised peritonitis.

Patients typically present with persistent, non-colicky, lower-left quadrant pain (93–100%), fever (57–100%) and leukocytosis (69–83%).<sup>2</sup> The pain has often been present for several days prior to presentation. Nausea, vomiting, diarrhea or obstipation are common, and are

### Diverticulosis: Quick Facts

- Up to half of people older than 60 years have diverticulosis
- 70% remain asymptomatic
- Risk factors include low-fibre diet and aging
- Fibre supplementation can prevent new diverticulae formation
- No further treatment or intervention required if asymptomatic

### Diverticulitis: Quick Facts

- Results from perforation of bowel mucosa in diverticulum
- Symptoms range from localized pain to fecal peritonitis
- CT scanning is the diagnostic modality of choice
- Uncomplicated cases can be treated with antibiotics
- Complicated cases (abscess, fistula, peritonitis) require surgery

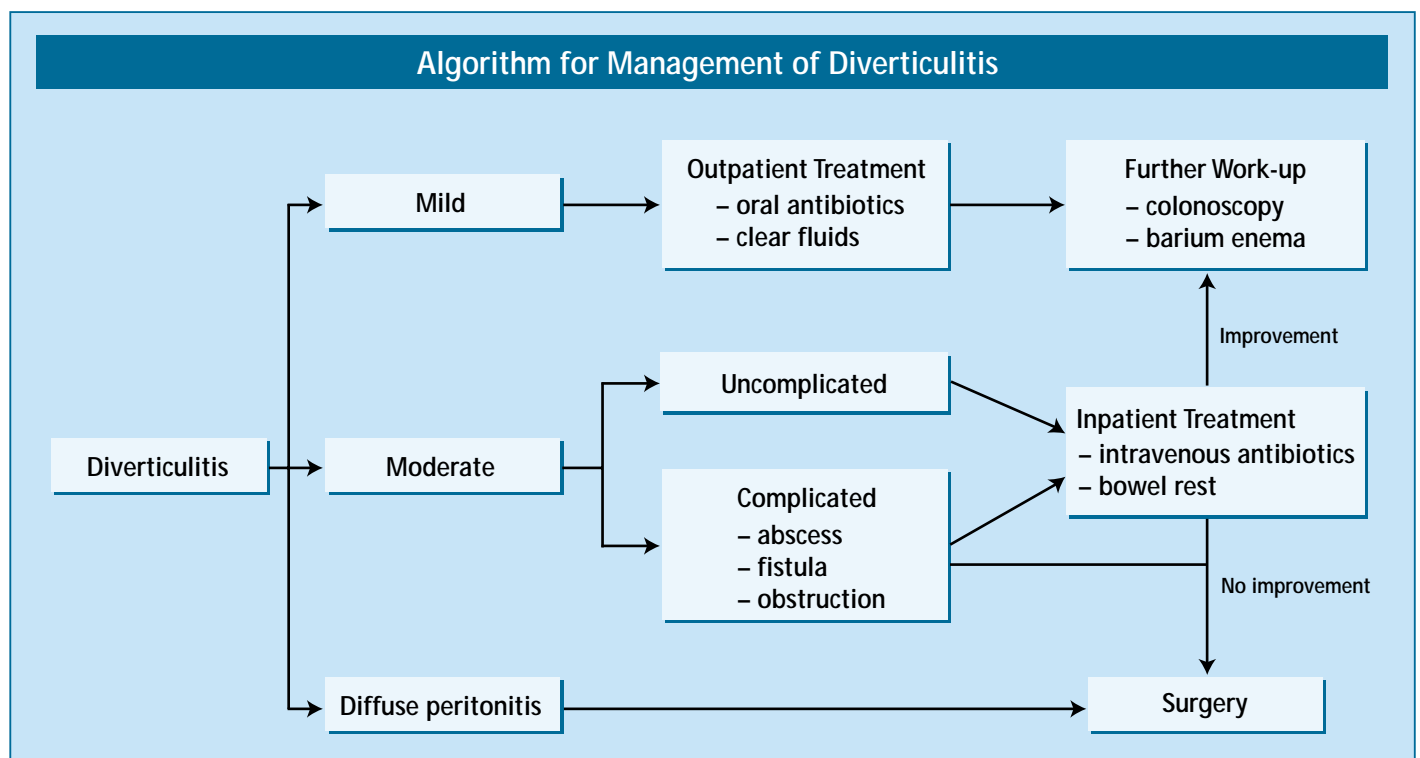
often accompanied by urinary symptoms (such as dysuria, frequency and urgency).

On examination, the patient has abdominal tenderness, usually in the lower-left quadrant. A tender mass representing the inflammatory phlegmon may be present. There may be abdominal distention. Signs of generalised peritonitis suggest free perforation.

Diagnosis is usually suspected from the history and examination. Initial labo-

ratory studies may show leukocytosis and a left shift. Pyuria suggests inflammatory involvement of the genitourinary tract, whereas mixed bacteruria or overt fecaluria is strongly associated with a colovesical fistula.

If the diagnosis remains in doubt, abdominal imaging is useful. Plain abdominal X-rays may help to exclude other causes of acute abdominal pain, but will not establish a diagnosis of divertic-



ulitis. Free air in the abdomen is a surgical emergency and, in most cases, obviates the need for further work-up prior to surgery.

Computerized tomography (CT) scanning is the imaging modality of choice, both because it can give detailed information on complicated diverticulitis (abscess, fistula, obstruction) and because it can be used for intervention (i.e., CT-guided abscess drainage, allowing elective as opposed to emergent surgical intervention). CT is also safer than barium enema or colonoscopy in the acute setting. A recent prospective trial compared CT to water-soluble contrast enema in 420 patients for the diagnosis of suspected acute left-sided colonic diverticulitis.<sup>7</sup> Of the 132 patients who underwent resection and had histologically proven diverticulitis, CT was more sensitive than standard barium enema for diagnosis (98% vs. 92%). More importantly, CT scan identified all patients who had an associated abscess, whereas contrast enema only detected complicated diverticular disease in 29%.

Treatment of diverticulitis depends on the severity of inflammation and/or infection. Patients with simple diverticulitis without marked signs of inflammation can be treated as outpatients, with a clear liquid diet and oral antibiotics, such as metronidazole and ciprofloxacin for seven to 10 days. Pain control with narcotics should be avoided. If the patient is immunosuppressed, diabetic or with questionable cognitive ability, extra caution should be used when choosing outpatient treatment.

Patients with more severe inflammation—characterized by severe pain, fever, chills or obstipation—should be admitted to hospital for volume resuscitation, broad-spectrum intravenous antibiotics and bowel rest. There are a number of suitable antibiotic choices, but gram-negative and anaerobic bacteria must be covered (e.g., piperacillin/tazobactam; ciprofloxacin and metronidazole; ampicillin/sulbactam; cefotetan). Improvement should occur in the first 48–72 hours; patients may then be stepped-down to oral antibiotics and

allowed to complete a 7–10 day course as an outpatient.

If the episode of diverticulitis was the patient's first, follow-up must include a barium enema or colonoscopy to confirm the presence and elucidate the extent of diverticulosis after the acute inflammation has subsided. If bowel carcinoma is suspected as an alternate diagnosis (e.g., from mass effect on imaging), colonoscopy is preferable, or flexible sigmoidoscopy at a minimum.

Surgery is generally not recommended after a first episode of uncomplicated diverticulitis, as only 20–30% of patients have a recurrent episode. Of those who do have a recurrence, the probability of a third episode is greater than 50%; thus, elective resection can be considered after the second attack.

If the patient has frank peritonitis, or develops complicated disease (abscess, fistula, obstruction), they will require surgical intervention on the same admission. Peritonitis carries a high mortality rate (up to 35% for fecal peritonitis) and requires emergent intervention with a two-stage resection and colostomy (Hartmann procedure).

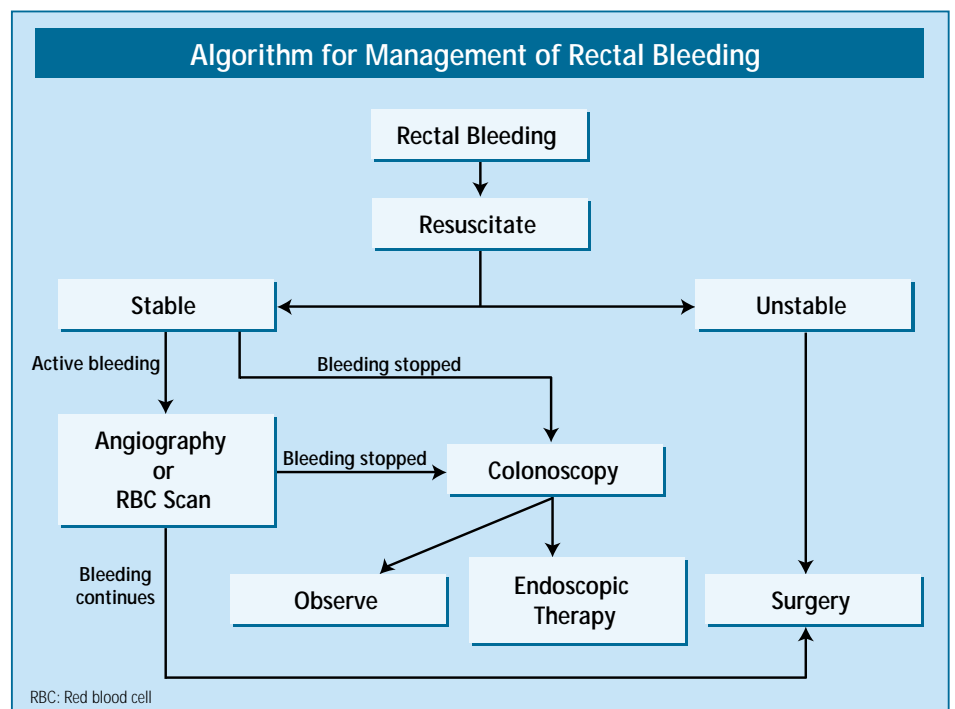
Laparoscopic surgery shows considerable promise as a method for resection.

A large, multicentre prospective trial of 1,118 patients who underwent laparoscopic bowel resection (over 80% for peridiverticulitis, recurrent inflammation or diverticular stricture) showed an overall mortality rate of 1.1% and rate of conversion to open laparotomy of 1.4%.<sup>8</sup> Conversion rates and complications increased with the severity of disease; resection of more advanced disease should only be attempted by experienced surgeons. Laparoscopic resection provides a shorter hospital stay and earlier return to oral intake compared to open colectomy.<sup>9</sup>

### Diverticular Bleeding

Bleeding develops in approximately 15% of patients with marked diverticulosis. In one-third of these (5%), it will be massive and may cause hemodynamic instability.

The bleeding originates from the vasa recta vessel adjacent to the lumen of the diverticulum, which eventually erodes secondary to chronic injury. Inflammation, however, does not appear to play a role in this erosion.<sup>2</sup> Right-colon diverticulae bleed more commonly than left-sided, possibly due to the larger diverticular lumens that develop on the right side and which expose more vasa recta to disruption.



**Diverticular Bleeding:  
Quick Facts**

- Painless bright red or maroon rectal bleeding
- Most common cause of massive bleeding per rectum in the elderly
- Most bleeds stop spontaneously; treatment supportive if bleeding not severe or persistent
- Definitive treatment is resection of culprit bowel

The hallmark of diverticular bleeding is painless, bright red blood per rectum. Up to half of patients will have a history of prior intermittent red or maroon bleeding. Abdominal pain is unusual, and co-existing diverticulitis is rare. In elderly patients, brisk diverticular bleeding may lead rapidly to hypotension; prompt resuscitation is therefore critical, especially in those with pre-existing comorbidities. Most patients, however, will present as a slow persistent bleed as opposed to an acute exsanguinating event. This being the case, it is important to make diverticular bleeding a diagnosis of exclusion, after ruling out other potentially treatable causes of gastrointestinal blood loss, such as carcinoma, colitis or angiodysplasia.

Most diverticular bleeds stop spontaneously, and conservative management is sufficient. If a patient continues to bleed but is otherwise hemodynamically stable, further diagnostic imaging may be necessary to localize the bleeding vessel.

The “gold standard” diagnostic test to detect the site of diverticular bleeding is mesenteric angiography. Both sensitivity and specificity are high if the rate of bleeding is greater than 0.5–1.0mL per minute.<sup>2</sup> Other causes of bleeding can be

diagnosed by their appearance, such as tumours, diffuse mucosal bleeding or angiodysplasia. Once identified, the bleeding vessel can be infused with vasopressin for local vasoconstriction, or embolised with absorbable gelatin powder (e.g., Gelfoam). Unfortunately, the vasoconstrictive effects of vasopressin are temporary, with up to half of patients rebleeding following withdrawal of the drug.<sup>2</sup> Embolisation is effective, but post-embolisation bowel infarction is a significant risk.

Emergency angiography unfortunately has associated morbidity, and limited availability and is expensive. Technetium-tagged red blood cell scanning can be useful to detect slower rates of bleeding, but in many cases does not reliably provide the exact location of bleeding.

Colonoscopy is the procedure of choice in the hemodynamically stable patient who continues to bleed or once bleeding has stopped. Full bowel preparation with oral lavage is required. Colonoscopy allows identification of bleeding sites in up to 85% of patients,<sup>10</sup> and also permits exclusion of other causes of bleeding. In a recent study, aggressive and early endoscopic treatment of bleeding diverticulae reduced rebleeding rates and hospital stay.<sup>11</sup> This approach, however, has not garnered widespread acceptance due to lack of supporting evidence from other centres, and the requirement for a dedicated team of experienced endoscopists.

Surgery is indicated for patients who remain unstable after suitable volume/blood resuscitation and who continue to bleed. For patients who have had preoperative diagnostic testing and for whom the approximate localization of the bleeding site is known, segmental colectomy is appropriate, with a low rebleeding rate. In those patients for whom the location of diverticular bleeding is not known, subtotal colectomy is generally performed since blind segmental colectomy has a rebleed rate as high as 42%.<sup>5</sup> Mortality is above 20% in those patients needing emergency surgery.

Following a first diverticular bleed, there is a 20–30% risk of recurrent bleeding. Those with a second bleed have a recurrence rate greater than 50%. Elective resection of the affected bowel is generally reserved for those with recurrent bleeding and in whom the operative risks are acceptable. Other patients, particularly after their first bleed or for those who are not candidates for surgery, should start fibre supplementation to prevent worsening of their diverticulosis, with supportive management for recurrent bleeding episodes. ♦

No competing financial interests declared.

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