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Chapter 3

**COLONIC DIVERTICULAR DISEASE
AND DIVERTICULITIS:
SYMPTOMS, TREATMENT OPTIONS AND
LONG-TERM HEALTH OUTCOMES**

***Yen-Chun Chen^{1,2}, MD, Chih-Wei Tseng, MD^{1,3,*},
Wu Chin-Chia^{1,4}, MD, Yu-Hsi Hsieh^{1,3}, MD,
Kuo-Chih Tseng^{1,3}, MD and Tsung-Hsing Hung^{1,3}, MD***

¹Division of Gastroenterology, Department of Medicine,
Dalin Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation,
Chia-Yi, Taiwan

²Division of Gastroenterology, Department of Medicine,
Kaohsiung Veterans General Hospital, Kaohsiung City, Taiwan

³College of Medicine, Tzu Chi University, Hualien, Taiwan

⁴Division of Colon and Rectal Surgery, Department of Surgery,
Dalin Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation,
Chia-Yi, Taiwan

* Corresponding author: Chih -Wei Tseng, M.D. Division of Gastroenterology, Department of Internal Medicine, Dalin Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Chia-Yi, Taiwan; No 2, Ming-Shen Road, Dalin Town, Chia-Yi County 622, Taiwan. Tel: 886-5-2648000 ext: 5333. Fax: +886-5-2838370. E-mail: cwtseng2@gmail.com.

ABSTRACT

Colonic diverticula occur when mucosal and submucosal layers protrude through weak points in the muscle wall. Most patients with diverticular disease are asymptomatic, but some may experience abdominal pain without inflammation. Diverticular disease may develop as diverticulitis, with or without perforation, or diverticular hemorrhage. Episodes of acute diverticulitis present with pain in the left or right lower quadrant, depending on the location of the diverticula. Patients may also exhibit fever or other non-specific symptoms like anorexia or nausea.

Treatment is not required for asymptomatic patients. For those with symptomatic uncomplicated diverticular disease, treatment choices include dietary fiber supplementation, mesalazine, probiotics, and non-absorbable antibiotics like rifaximin. However, reports on the effectiveness of these treatments are conflicting.

Acute diverticulitis develops when an episode of inflammation and/or infection occurs. The choice of treatment for acute diverticulitis should be based on the degrees of severity, from localized inflammation to generalized peritonitis. Patients who present with mild diverticulitis can be treated as outpatients with broad spectrum antibiotics. However, patients presenting with more severe illness or who have complicating comorbidities should be hospitalized for more aggressive management, which may range from intravenous antibiotics to surgical intervention in some cases. Elective surgery should be considered with caution for selected patients, and recent studies have found that conservative management is generally as effective as elective surgery and avoids the potential complications that may arise from surgery.

Complicated acute diverticulitis describes the co-existence of abscess, fistula, perforation, and obstruction. Smaller abscess can be treated by antibiotics, but percutaneous drainage or surgery should be considered for those patients with larger abscesses, fistula, perforations, and obstructions. Most episodes of diverticular bleeding are self-limiting, but the recurrence rate is high. Treatment strategies include colonoscopic hemostasis, angiographic intervention, and even surgical resection. Colonoscopic hemostasis is usually the first line of treatment and includes clipping, band ligation, injection therapy, and thermal contact. If colonoscopic treatment fails, angiographic treatments such as vasoconstrictor infusion and superselective embolization should be performed. Blind colectomy for massive bleeding should not be considered. The rate of long-term complications due to a recurrence of diverticulitis after recovery from an uncomplicated episode is less than five percent. Factors identified as increasing the risk for colonic diverticular bleeding or recurrent bleeding include BMI ≥ 30 kg/m², the use of aspirin or non-steroidal anti-inflammatory drugs, advanced age at

the time of the initial episode, diverticulitis, peripheral vascular disease, and chronic renal diseases. Most recent recommendations have been based on studies that include primarily individuals with left-sided colonic diverticular disease. The ideal treatment options and the long-term outlook for those with right-sided lesions require further investigation.

INTRODUCTION

A diverticulum can be classified as true or false (Figure 1), depending on the layers involved. A true diverticulum involves all layers of the intestinal wall, such as in Meckel's diverticulum [1]. Colonic diverticula, which are pseudodiverticula, occur when mucosal and submucosal layers protrude through weak points in the muscle wall [2]. The term diverticular disease comprises diverticulosis, diverticulitis, and diverticular bleeding [3]. According to a 2009 report from the United States, diverticular disease is the sixth leading physician-diagnosed gastrointestinal disorder in outpatient clinic visits. Diverticulitis without hemorrhage and diverticulosis with hemorrhage are, respectively, the third and fourteenth principal discharge diagnoses from hospital admission [4]. Diverticular disease accounts for about 3.5 billion dollars in direct cost annually in the United States [12]. Diverticulosis is also the most common finding during colonoscopy and the second most common during sigmoidoscopy [5].

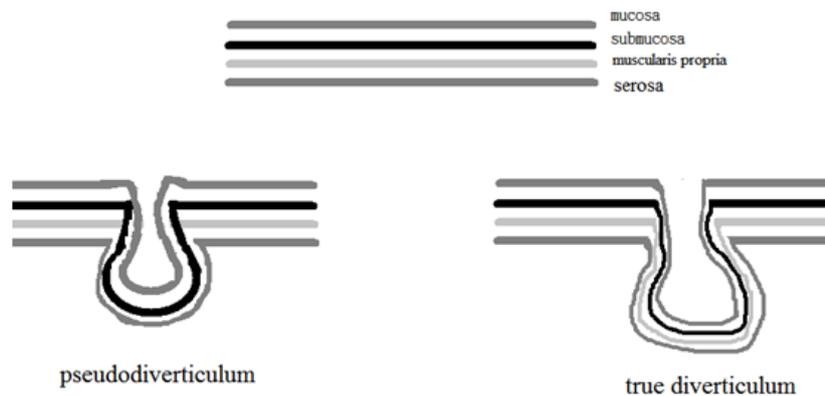


Figure 1. The difference between true and false diverticulum.

Other hollow organs may also develop diverticula (Table 1), but these conditions will not be discussed in this article. Definitions for some of the terms used in this article are provided in Table 2.

Table 1. Organs which may develop diverticulum

| |
|---|
| Tracheal diverticulum [6] |
| Urinary bladder diverticulum [7] |
| Esophageal diverticulum (such as Zenker's diverticulum ^a , or diverticula at the middle or distal esophagus) [8] |
| Gastric diverticulum [#] [9] |
| Small bowel diverticulum [10] |
| Colonic diverticulum |

^a Pharyngoesophageal diverticulum located at pharyngoesophageal junction.

^b Prevalence reported to be 0.01% to 0.11%. ^c Prevalence reported to be 0.06% to 1.3%.

Table 2. Terminology and definition used in colonic diverticular disease [2, 3, 11]

| Term | Definition |
|--|--|
| Pseudo-diverticulum | Mucosal and submucosal layers protrude through the weak points in the muscle wall |
| Diverticulosis | The presence of diverticula in the lining of the gastrointestinal tract. |
| Diverticulitis | Inflammation of the diverticulum |
| Diverticular bleeding | Hemorrhage from the diverticulum. |
| Diverticular disease | Diverticulosis, diverticulitis, and diverticular bleeding. |
| Symptomatic uncomplicated diverticulosis | Abdominal symptoms attributed to diverticula with no gross evidence of diverticulitis |
| Uncomplicated diverticulitis | Diverticulitis without complication such as abscess formation, perforation, obstruction, fistula formation, or peritonitis |
| Complicated diverticulitis | Diverticulitis with complications such as abscess formation, perforation, obstruction, fistula formation, or peritonitis |

Colonic diverticula are more prevalent in developed countries than in developing countries. In addition, it occurs predominantly in the left-sided colon in Western countries but is predominantly in the right-sided colon in

Africans and Asians [11]. The prevalence is also age-dependent, affecting only about five percent of individuals under the age of 40 years [13], and increasing to more than sixty percent in those over 65 years of age [14, 15].

SYMPTOMS AND TREATMENT OPTIONS

Most patients with diverticulosis are asymptomatic (Figures 2, 3, 4) and require no treatment [3]. The natural course of the condition is summarized in Figures 5 and 6. Some patients with diverticula may complain of a variety of nonspecific symptoms, such as weight loss, rectal bleeding, abdominal pain, nighttime pain, abdominal distention, and altered stool frequency. However, those symptoms are as prevalent in persons without diverticulosis [16], and it is unclear if these are attributable to the underlying diverticulosis or to coexistent functional bowel disease [17, 18]. The treatment for patients in this group is still controversial. The treatments that are generally considered for symptomatic diverticulosis include dietary fiber supplementation, mesalazine, probiotics, and non-absorbable antibiotics such as rifaximin. The clinical presentation of diverticular disease is shown in Table 3.

Table 3. The clinical presentations of diverticular disease

| |
|--|
| <p>Symptomatic uncomplicated diverticulosis: Weight loss, rectal bleeding, abdominal pain, pain at night, abdominal distention, and altered stool frequency.</p> |
| <p>Uncomplicated diverticulitis: Symptoms: left or right lower quadrant pain, fever, nausea, vomiting, and even bowel habit change, hematochezia (rare). Laboratory test: leukocytosis (only seen in 55 to 60 percent of patients). Image: computed tomography showing colonic wall thickening and/or fat stranding.</p> |
| <p>Complicated diverticulitis: Symptoms: similar to uncomplicated disease but less responsive to medical treatment. Others were related to what kind of complication a patient has—for example, fecaluria in colovesicle fistula. Image: computed tomography showing abscess formation, perforation, obstruction, fistula formation, or peritonitis.</p> |
| <p>Diverticular bleeding: Melena, bright red blood per rectum, hematochezia, or maroon stool and possible massive and painless rectal hemorrhage.</p> |

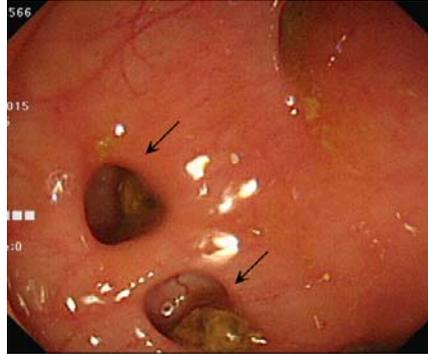


Figure 2. Several sigmoid diverticula are shown (arrows). Note there were some stools retained in the diverticula without impaction. (colonoscopic image).

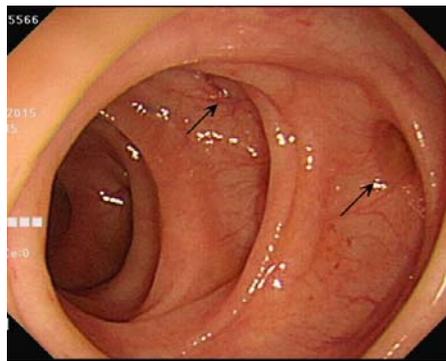


Figure 3. This figure also demonstrates two colonic diverticula (arrows). Unlike Figure 2, there is no stool in these diverticula. (colonoscopic image).

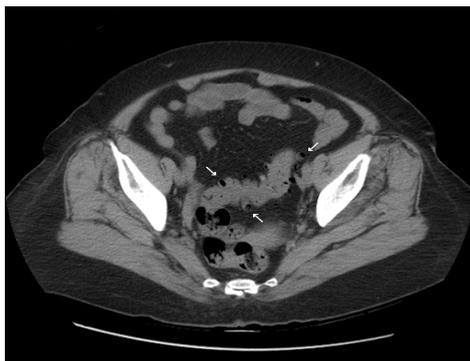


Figure 4. This figure shows several sigmoid diverticula (arrows). (CT scan image).

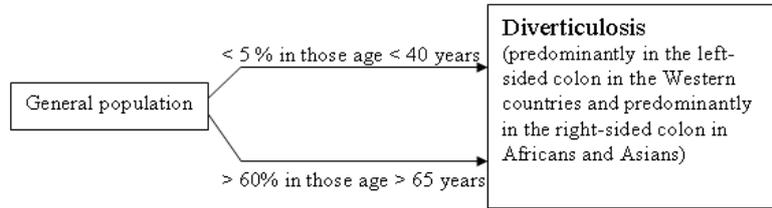


Figure 5. The epidemiology of diverticulosis among the general population.

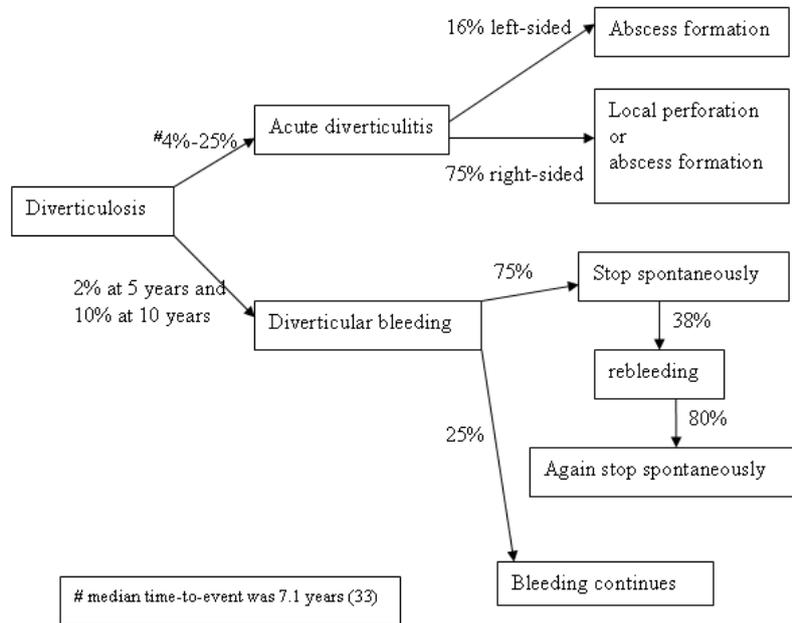


Figure 6. The natural course of diverticulosis.

TREATMENT OPTIONS FOR SYMPTOMATIC UNCOMPLICATED DIVERTICULOSIS

It is a popular belief that colonic diverticulosis is associated with diets low in fiber, and that a high fiber diet is supposed to prevent diverticular disease. Since 1970 there have been several studies exploring the effects of high fiber diet in individuals with diverticulosis, and the results have been controversial.

Some support the view that fiber supplementation can reduce symptoms, the rate of complications, and the rate of surgical intervention for diverticular disease [19, 20], but others show an effect only on constipation [21]. One interesting study assessed the effects of different components of dietary fiber, i.e., total dietary fiber, soluble fiber, insoluble fiber, hemicellulose, cellulose, and lignin. A total of 43881 patients were studied and followed for up to four years. These investigators found that the insoluble component of dietary fiber significantly decreased the risk of diverticular disease, and this benefit was especially strong for cellulose [22]. In general, the role of dietary fiber is more protective than therapeutic.

Gut flora is also considered to contribute to the pathogenesis of gastrointestinal disease. Hence, rifaximin, a type of non-absorbable antibiotic, in combination with fiber supplementation is used to treat uncomplicated diverticular disease. A double-blind placebo-controlled trial in which 168 outpatients were enrolled focused on the effect of rifaximin plus glucomannan, a commercially available dietary fiber supplement, on uncomplicated diverticular disease [24]. The results revealed that rifaximin appears to relieve symptoms in colonic diverticular disease. Another larger multicenter prospective trial involving 968 patients with diverticular disease demonstrated that those treated with cyclic glucomannan plus rifaximin (twice daily for 7 days every month) had fewer symptoms and complications compared to those treated with glucomannan alone [25]. A meta-analysis comparing the long-term efficacy of rifaximin plus fiber supplementation compared with fiber supplementation alone [26] found symptom relief to be better and the incidence of complications lower after one year in the former group.

Probiotics are live microorganisms that are believed to be beneficial for health. Fecal stasis in the diverticulum may alter the normal flora. The efficacy of antimicrobials plus absorbent was compared with the same set-up supplemented with a probiotic containing one variety of non-pathogenic *Escherichia coli* in one study with 15 patients [27]. The results indicated the length of remission was prolonged and the symptoms decreased after the administration of probiotics. Another study evaluated the effectiveness of mesalazine, with or without *Lactobacillus casei*, in preventing the recurrence of symptoms [28]. Eighty-five patients completed the study and were followed up to 12 months. The patients were randomly assigned to receive one of the following three treatments: mesalazine only, *L. casei* only, or mesalazine plus *L. casei*. The results showed that mesalazine or probiotics alone was effective in achieving a good rate of symptom relief (76.7%) at the end of follow-up. However, the effect of combination therapy was much better than either

mesalazine or probiotics alone. Because most studies on the efficacy of probiotics have included small numbers of patients, a larger randomized double blind placebo-controlled trial is still needed to verify their effectiveness.

Chronic mucosal inflammation is also thought to lead to the symptoms of diverticula [29]. Mesalazine, which belongs to the category of 5-aminosalicylic acid derivatives, has a topical anti-inflammatory effect and acts by inhibiting cyclooxygenase. It is used to treat uncomplicated diverticular disease. Mesalazine has been investigated in a double-blind, placebo-controlled, multicenter trial in patients with symptomatic uncomplicated diverticular disease. The result indicated that mesalazine may be superior to placebo in relieving pain [30]. Most of the trials of mesalazine for diverticular disease focused on preventing the recurrence of diverticulitis and are discussed below.

Data on the effectiveness of treatment for symptomatic diverticulosis are conflicting. The treatments may be better when used in primary prevention (i.e., to prevent a first episode) or just for symptom relief, or when used in combination therapy (e.g., mesalazine plus probiotics, or rifaximin plus a fiber supplement). These treatments have only a small role in the treatment of complicated diverticular disease and are less effective in preventing recurrence (discussed further below).

ACUTE DIVERTICULITIS

Acute diverticulitis (Figure 7) may develop when an obstruction occurs in the neck of diverticulum. This may result in bacterial overgrowth and local ischemia [31], and an episode of acute inflammation may develop subsequently. Acute diverticulitis affects from 4% to 25% of patients with diverticulosis [32, 33]. Diverticulitis is uncommon (< 5%) in those younger than 40 years of age [34], and more than half of young diverticulitis patients are obese [35]. Clinical presentation is nonspecific and includes left or right lower quadrant pain, fever, nausea, vomiting, and even a change in bowel habit [31, 36]. Hematochezia is rarely reported in those with acute diverticulitis. Leukocytosis is seen in nearly 55% to 60% of patients [32, 37]. The differential diagnoses of diverticulitis include irritable bowel syndrome, ischemic colitis, colorectal cancer, inflammatory bowel disease, appendicitis (right-sided diverticulitis), infectious colitis, and pelvic inflammatory disease.

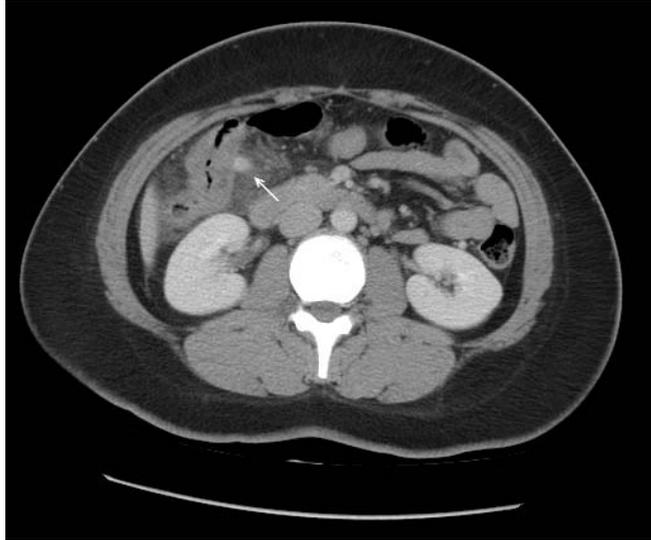


Figure 7a. Ascending colon diverticulitis (wall thickening and fat stranding) was seen (arrow) in CT image.



Figure 7b. Coronal view from CT image of the same patient as Figure 7a.

A clinical scoring system was used to improve the diagnostic accuracy in one study. From patient information (e.g., age, symptoms, physical examination, number of episodes, or blood tests such as C-reactive protein) the physician calculated the probability of acute left-sided colonic diverticulitis [38]. When the probability of acute diverticulitis is high, abdominal computed tomography (CT) should be considered. Abdominal CT can be helpful in evaluating the severity, the local extent, and possible complications related to diverticulitis [39]. After acute diverticulitis has resolved, colonoscopy should be performed, if there is no contraindication, to rule out possible coexisting malignancy.

Treatment Options for Uncomplicated Diverticulitis

Uncomplicated diverticulitis is defined as acute diverticulitis with only inflammation and wall thickening, without abscess, fistula, perforation, and obstruction [40]. The treatment for uncomplicated disease includes antibiotics to cover anaerobes and gram-negative rods, clear liquid diet, fluids hydration, or even bowel rest [41]. Either oral or intravenous antibiotics can be an appropriate treatment, depending in the clinical condition. A randomized trial found in selected patients more than 18 years old who were diagnosed with uncomplicated acute diverticulitis, outpatient treatment may also be safe and effective [42]. Although antibiotics are viewed as a mainstay in the management of uncomplicated acute diverticulitis [43], a meta-analysis with systematic review concluded that antibiotics may not be so important for some patients diagnosed with uncomplicated disease [44]. The clinical outcomes showed no significant difference when it compared antibiotics to placebo, single agent-treatment to double compound antibiotics, and short with longer course IV antibiotics. This presents a valuable viewpoint considering the growing issue of antibiotic resistance. However, a larger randomized, controlled trial will be needed to validate this conclusion.

Preventative Treatment for Diverticulitis Recurrence

Prevention of diverticulitis recurrence has been investigated in a number of trials of rifaximin, mesalazine, and probiotics. In one proof-of-concept study [45] of 167 patients with a recent diagnosis of colonic diverticulitis, the result shows cyclic rifaximin treatment (one week per month) in combination

with fiber supplements for 12 months may reduce the risk of recurrences of diverticulitis in patients in remission. However, a commentary [46] pointed out that better designed clinical trials are still needed.

Regarding mesalazine, one study [47] revealed the combination of rifaximin plus mesalazine was more effective than rifaximin alone in preventing the recurrence of diverticulitis. However, a report [48] of a phase-3, randomized, double-blind, placebo-controlled, multicenter trial concluded that the efficacy of mesalazine in preventing recurrent diverticulitis was not significantly better than placebo.

There is not enough evidence to support probiotic treatment in preventing recurrent diverticulitis. Thirty patients previously diagnosed with uncomplicated colonic diverticulitis were enrolled in one study [49] and were treated with balsalazide in combination with high-potency probiotic mixture or high-potency probiotic mixture alone. It showed that combination therapy resulted in a lower rate of relapse of uncomplicated diverticulitis, though the difference between groups was not statistically significant.

There is a role for elective surgery, and it may be considered for selected patients. The American College of Gastroenterology practice guideline suggested elective (prophylactic) surgery may be reasonable for patients with recurrent attacks of diverticulitis, patients with complicated disease (e.g., fistulas, abscess), or for young or immunocompromised patients [32]. However, further systemic review studies [50, 51] found that the incidence of complicated recurrence after recovery from an uncomplicated episode of diverticulitis is less than five percent. The risk of complications does not increase in younger patients (age < 50 years) who have had a first episode, and the risk also does not increase in those with two or more recurrences. The systematic review concluded that elective colectomy after two episodes of diverticulitis should not be viewed as standard. Elective surgery should be approached with caution and only after a thorough evaluation. One decision analysis study [52] demonstrated that colectomy after the fourth episode of diverticulitis is associated with lower rates of death and colostomy. Surgery is also cost-saving for both younger and older patients.

A larger well-designed randomized controlled trial is needed to validate the effectiveness of surgery in those with uncomplicated recurrent diverticulitis. In addition, such a trial should include right-sided as well as left-sided colonic diverticulitis because most guidelines on the management of diverticulitis are based primarily on the studies of left-sided or sigmoid colonic diverticulitis.

In conclusion, medical treatment for the prevention of diverticulitis recurrence has shown no significant benefit. In the past, elective surgery was recommended for younger patients (age < 50 years) or for those with two attacks of uncomplicated diverticulitis, but that strategy should not be considered standard. Recent studies [50, 51, 52] found that conservative management generally is as effective as elective surgery and avoids the potential of surgery-related complications.

Treatment Options for Complicated Diverticulitis

Complicated acute diverticulitis includes complications like abscess, fistula, perforations, and obstructions. At least 16% of patients with left-sided diverticulitis will have associated abscess formation, and the proportion may be much higher among those with right-sided disease [53, 54, 55]. Hinchey Classification was proposed by Hinchey et al. to classify the severity of perforation of colonic diverticulitis [31]. The Hinchey stage I means localized abscess (para-colonic), the Hinchey stage II means pelvic abscess, the Hinchey stage III means purulent peritonitis (the presence of pus in the abdominal cavity) and the Hinchey IV means feculent peritonitis. Surgeons can use Hinchey Classification as a guide about how conservative they can be when emergency surgery is considered.

The symptoms in complicated diverticulitis are similar to those of the uncomplicated disease. Abscess formation should be suspected when clinical improvement is slow even after empirical antibiotics have been used. CT scanning should be considered for further diagnosis, followed by possible CT-guided percutaneous drainage [32]. Once acute diverticulitis with abscess formation is diagnosed, the management includes medical treatment, percutaneous drainage, and surgical treatment, depending on the size of abscess. Conservative treatment by antibiotics alone can be considered if the size is smaller than 4 cm. Empirical antibiotics include aminoglycoside with metronidazole, cephalosporin with metronidazole, fluoroquinolone with (when ciprofloxacin or levofloxacin is chosen) or without (when moxifloxacin is chosen) metronidazole, ticarcillin-clavulanate, piperacillin-tazobactam and carbapenem. The choice depends on the severity of disease, age, comorbidity, and whether the patient is in an immunocompromised state [56]. Antibiotic treatment alone will not be adequate if the size of abscess is larger than 4 cm. In such cases, percutaneous catheter drainage or even surgical intervention should be considered [57, 58]. With the development of CT-guided

percutaneous drainage, surgery can be avoided or be decreased from a multiple- to single-stage procedure in selective cases [57, 59, 60].

Perforation is a serious complication in acute diverticulitis, and diffuse peritonitis may develop thereafter. The risks and prognostic factors for colonic perforation have been summarized in Table 4. Management of diverticulitis with perforation often includes resuscitation, broad spectrum antibiotics, and surgical intervention. Resection with or without primary anastomosis should be considered in patients with perforated sigmoid diverticulitis, whether the peritonitis is localized or diffused [61]. For patients with perforated sigmoid diverticulitis, proximal colostomy combined with resection or exteriorization offers a better outcome than proximal colostomy combined with drainage [62]. An increased risk of mortality was found in four clinical conditions: (a) persistent postoperative sepsis, (b) fecal peritonitis, (c) preoperative hypotension, and (d) prolonged duration of symptoms. Patients with these conditions will benefit more from colostomy and resection, which affords better eradication of the septic focus.

Table 4. Risk and prognostic factors for colonic perforation [63, 64]

| |
|--|
| Risk factors |
| Diverticulitis |
| Carcinoma |
| Corticosteroid use (among those with rheumatic disease) |
| Non-steroidal anti-inflammatory drugs (among those with rheumatic disease) |
| Prognostic factors |
| Old age (>65 years old) |
| Organ failure |
| Mannheimer Peritonitis Index (an increase of 10 points) |

Patients with compromised immune systems generally have a poor prognosis when acute diverticulitis develops [65, 66]. In patients with perforation, the clinical manifestations are subtle and diagnosis is more difficult [65]. There is a high rate of failure for medical treatment, and most patients require surgery [65]. In this group, patients who opt for colostomy with resection also experience fewer post-operative complications than in those who receive colostomy and drainage [65].

Fistula formation is an uncommon complication of diverticular disease, but it was found to account for 20% of surgically treated cases in such patients

[67]. The fistula often involves sigmoid segment and surrounding organs, e.g., colovesical, colovaginal, coloenteric, and colouterine fistulas. Colovesical fistula is the most common type, with a clinical presentation that may include pneumaturia, fecaluria, abdominal pain, hematuria, fever, rectal mass, or tender prostate [69]. Cystoscopy can help in diagnosing the existence of colovesical fistula, and proctosigmoidoscopy and CT scan are needed for assessment before surgery [68, 69]. CT scan may reveal a thickened bladder wall, thickened bowel adjacent to bladder, gas in the bladder, or opacified fistula [69]. The surgical options for fistula include resection with anastomosis, resection with anastomosis and diversion, Hartmann procedure, and a three- or two-stage procedure [67, 68, 69]. These are summarized in Figure 8.

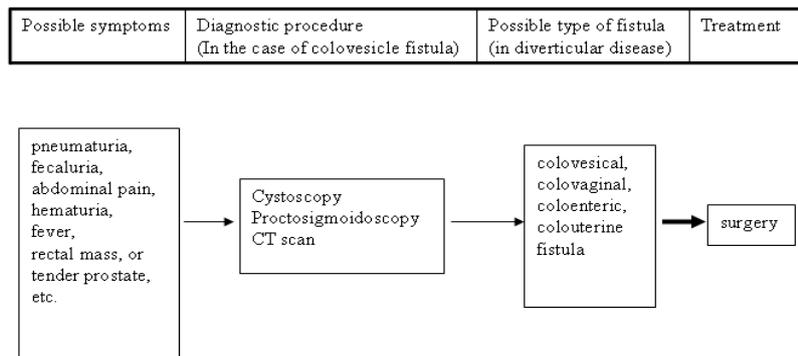


Figure 8. The symptoms, diagnostic procedure, and types of fistula.

Repeated episodes of diverticulitis may lead to stricture of bowel lumen or even bowel obstruction. If bowel obstruction is noted, the possibility of malignancy should be excluded. Surgery is indicated when diverticulitis is complicated with bowel obstruction. Although elective surgery has not been recommended for patients with uncomplicated diverticulitis, elective colectomy is recommended for those recovering from an episode of complicated disease.

In summary, complicated diverticulitis may present complications with abscess, fistula, perforation, and obstruction. Once acute diverticulitis with abscess formation is diagnosed, the management includes medical treatment, percutaneous drainage, and surgical treatment. When the size of abscess is small (usually < 4 cm), medical treatment alone will be successful, but

drainage should be considered if medical treatment fails or if a larger abscess is encountered. Urgent surgical resection is indicated when facing perforation with generalized peritonitis. Based on the clinical condition, whether open surgery or a laparoscopic approach can be considered [70]. In contrast to the treatment approach for uncomplicated acute diverticulitis, elective colectomy is recommended for those recovering from an episode of complicated disease.

LEFT- VS RIGHT- SIDE DIVERTICULITIS

Most recent treatment recommendations are based primarily on studies involving patients with left-sided colonic diverticulitis. The ideal treatments for complicated right-sided diverticulitis are still unknown. Right-sided colonic diverticulitis mimics appendicitis, and making a correct diagnosis is difficult. Cases of right-sided diverticulitis are generally uncomplicated at the first attack, and the recurrence rate is not high after conservative management [73]. Diverticulitis of the ascending colon should be managed the same as left-side colonic diverticulitis [71]. Medical treatment may be considered initially, but surgical intervention is indicated under the following conditions: (a) when the diagnosis is not clear, (b) when the response to nonsurgical therapy is poor, or (c) when the diverticulitis is complicated with perforation. Furthermore, resection may also be considered if malignancy is suspected and if there is no contraindication [72]. An inflamed colonic segment can be resected safely with primary anastomosis and can be performed using a laparoscopic procedure [55]. One retrospective study [74] demonstrated poor outcomes for patients with right-side diverticulitis. Those patients had a high incidence of complicated diverticulitis and operative complications, high in-hospital mortality, as well as longer duration of post-operative hospitalization.

TREATMENT OPTIONS FOR COLONIC DIVERTICULAR BLEEDING

Colonic diverticular bleeding (Figure 9) is the most common etiology of lower gastrointestinal bleeding [75, 76]. Other relatively common etiologies are summarized in Table 5. Patients may complain of melena, bright red blood per rectum, hematochezia, maroon stool, and possible massive and painless rectal hemorrhage [77]. History and physical examination, especially vital

signs, should be obtained soon after hearing a patient's complaints. The initial blood test should at least include complete blood count, electrolytes, renal function, liver function test, blood type and crossmatch, and coagulation profile. Resuscitation should be initiated promptly in the event of unstable hemodynamics. Diagnostic testing or other therapeutic interventions can be started later. It is important to determine the source of bleeding. Most episodes of diverticular bleeding stop spontaneously, but there is a high rate of recurrence.

Table 5. The common etiology of lower gastrointestinal bleeding

| |
|-------------------------------|
| Colonic diverticular bleeding |
| Inflammatory bowel disease |
| Colonic neoplasia |
| Benign anorectal disease |
| Arteriovenous malformations |

Urgent colonoscopy, after the colon is prepared, is effective and safe [78]. Colonoscopy can be used to identify the stigmata of a recent hemorrhage, which allows for various endoscopic hemostasis methods such as clipping, endoscopic band ligation, injection therapy, and thermal contact [79, 80]. However, those methods can only achieve temporary hemostasis, and further study is needed to clarify the efficacy of these methods in the prevention of rebleeding. When colonoscopy fails to identify the bleeding source or when there is continued bleeding, angiographic hemostasis or surgical resection should be considered.

Emergency angiography is a useful tool for preoperative evaluation and hemorrhage control. The specificity of angiography is excellent (100%), but the sensitivity is generally poor (30% to 47%) [81]. Surgeons can obtain information about the source of bleeding when there are positive preoperative mesenteric arteriography findings. The operative morbidity is lower in patients who receive preoperative angiography [82, 83]. Angiographic therapies include the infusion of vasoconstrictors or occlusion of vascular supply by the embolic material. Mesenteric embolization can be a relatively safe and effective method for acute lower gastrointestinal bleeding, but the possible complication of post-embolization ischemia should be kept in mind [84].

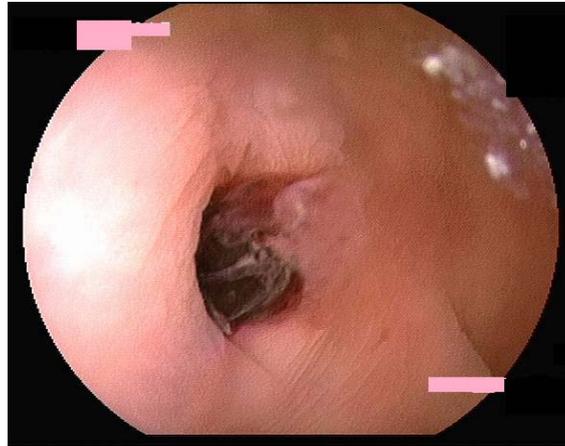


Figure 9a. Recent diverticular bleeding was highly suspected (blood clot retained in the diverticulum). Colonoscopic image by water immersion technique.

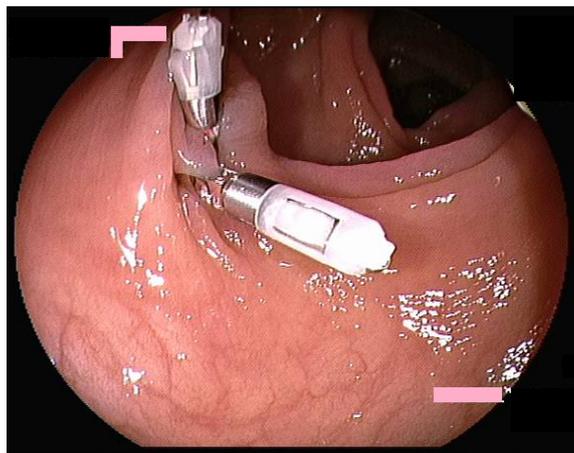


Figure 9b. Two hemoclips were applied, and hemostasis was achieved in the same patient in Figure 9a.

Blind colectomy was once suggested for massive and constant bleeding [85]. Because the source of the bleeding can be identified in most people before surgery using multiple modalities — e.g., angiography, colonoscopy, scintigraphy, small intestine series, and CT scan—exploratory laparotomy should be the final choice [86]. Further studies have suggested that blind colectomy is associated with high rates of complications and possible

misdiagnosis, e.g., small intestine bleeding instead of large bowel bleeding [86, 87].

If massive lower gastrointestinal bleeding occurs, surgical intervention may be considered. Segmental resection is better when the bleeding source can be identified through angiography. Subtotal colectomy is better when the source of massive bleeding is identified with negative angiography [88].

In conclusion, the most common cause of blood in stool (hematochezia) is colonic diverticular hemorrhage. Colonoscopy is the first choice for diagnosis and for hemostasis. Angiographic treatments and surgical intervention should be considered if endoscopic treatment fails. Blind colectomy should not be considered for massive bleeding because of the high morbidity and mortality and the possibility of misdiagnosis. When surgical intervention is required, segmental colectomy or subtotal colectomy can be chosen according to the angiographic result. The management of diverticular disease is summarized in Figure 10.

LONG-TERM OUTCOME

The prognosis for uncomplicated sigmoid diverticulitis is often benign. Approximately 13% of patients have one recurrence episode, and fewer than five percent have a second recurrence [89]. Factors associated with clinical outcomes include young age (≤ 50 years old), severe diverticulitis on computed tomography [90], pelvic abscess [91], and functional bowel disease diagnosed prior to elective colectomy [92]. These are summarized in Figure 11.

The long-term colonoscopy-based cohort study [93] enrolled 1514 patients diagnosed with asymptomatic diverticulosis. The overall incidence rate of diverticular bleeding was reported to be 0.46 per 1000 patient-years, with a cumulative incidence of diverticular bleeding of 0.21% at 12 months, 2.2% at 60 months, and 9.5% at 120 months [93]. Among those with diverticular hemorrhage treated by endoscopic clipping, recurrence occurred in about 21% of patients during approximately four years of follow-up [79]. BMI ≥ 30 kg/m² [94], the use of aspirin or non-steroidal anti-inflammatory drugs [95], cerebrovascular disease, hyperuricemia [96], old age at the time of initial episode, diverticulitis, peripheral vascular disease, and chronic renal diseases [97] were identified as risk factors for colonic diverticular bleeding or recurrence.

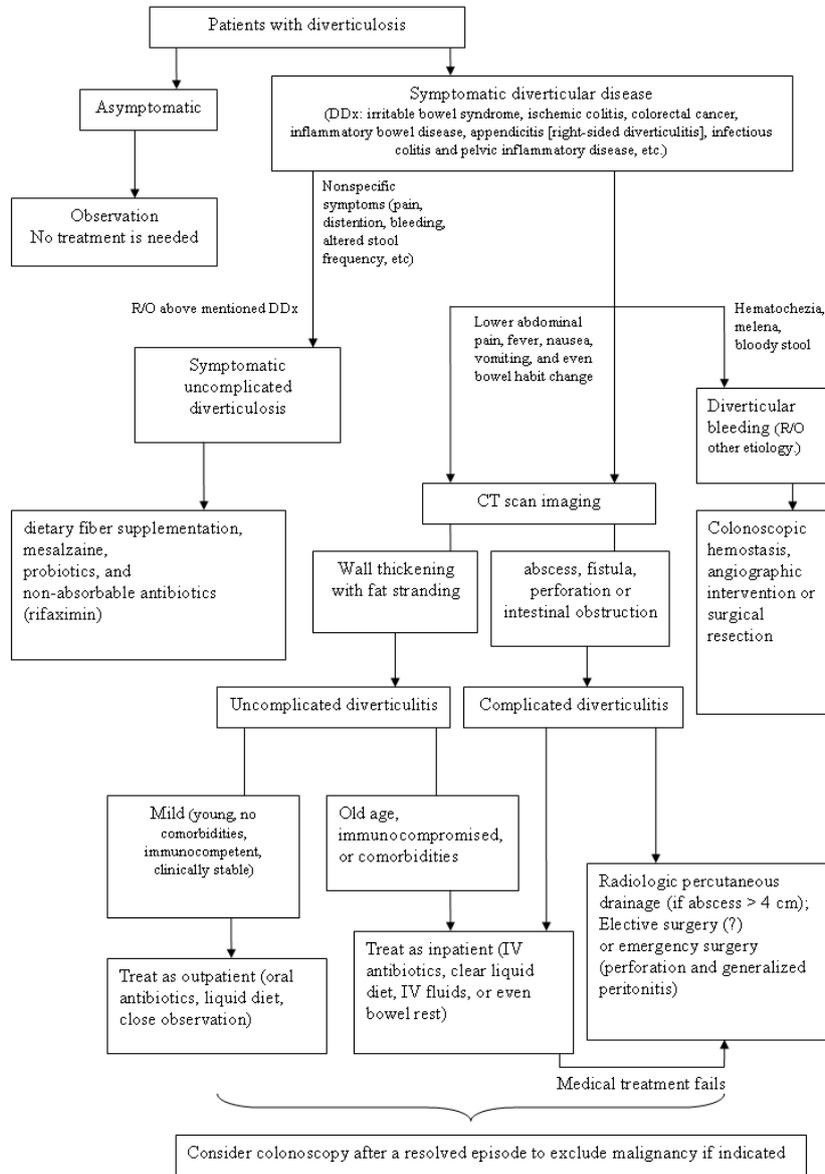


Figure 10. The management flow chart for diverticular disease.

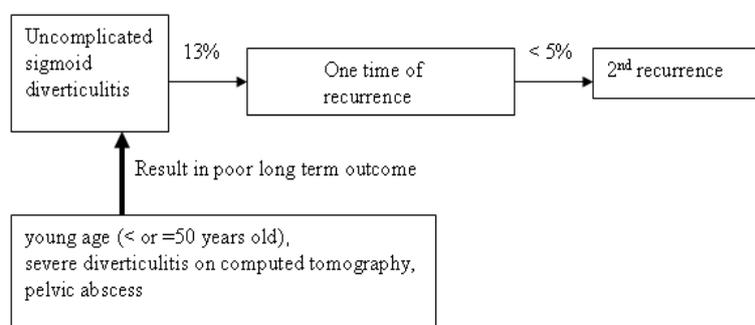


Figure 11. The long-term outcome of uncomplicated sigmoid diverticulitis.

CONCLUSION

Most patients with colonic diverticular disease are asymptomatic. Complications of diverticular diseases may develop as diverticulitis or diverticular hemorrhage. When acute diverticulitis exists, people may present with left or right lower quadrant pain, fever, and other non-specific symptoms. No treatment is required for those asymptomatic individuals. Dietary fiber supplementation, mesalazine, probiotics, and non-absorbable antibiotics can be considered in those with symptomatic uncomplicated diverticular disease. The treatment of acute diverticulitis should be based on the degree of severity. Patients with mild diverticulitis can be treated as outpatients with broad spectrum of antibiotics. Patients with more severe illness or with comorbidities should be hospitalized for more aggressive management. Elective surgery may be considered in cautiously selected patients. Complicated acute diverticulitis indicates the co-existence of abscess, fistula, perforation, and obstruction. Smaller abscess can be treated by antibiotics alone, but percutaneous drainage or even surgery should be considered in patients with larger abscess, fistula, perforation, and obstruction. Most episodes of diverticular bleeding are self-limited, but the recurrence rate is high. The treatment strategies include colonoscopic hemostasis, angiographic intervention, or even surgical resection. As to long-term health outcomes, complicated recurrence of diverticulitis after recovery from an uncomplicated episode is less than five percent. BMI ≥ 30 kg/m², the use of aspirin or NSAIDs, old age at the time of initial episode, diverticulitis, peripheral vascular disease, and chronic renal diseases have been identified as risk factors for colonic diverticular bleeding

or recurrent bleeding. The treatment options and the long-term outcome of right-sided lesions need more investigation.

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