

In the Clinic®

Acute Colonic Diverticulitis

Acute colonic diverticulitis is a gastrointestinal condition frequently encountered by primary care practitioners, hospitalists, surgeons, and gastroenterologists. Clinical presentation ranges from mild abdominal pain to peritonitis with sepsis. It can often be diagnosed on the basis of clinical features alone, but imaging is necessary in more severe presentations to rule out such complications as abscess and perforation. Treatment depends on the severity of the presentation, presence of complications, and underlying comorbid conditions. Medical and surgical treatment algorithms are evolving. This article provides an evidence-based, clinically relevant overview of the epidemiology, diagnosis, and treatment of acute diverticulitis.

CME/MOC activity available at Annals.org.

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doi:10.7326/AITC201805010

CME Objective: To review current evidence for diagnosis, treatment, and practice improvement of acute colonic diverticulitis.

Funding Source: American College of Physicians.

Disclosures: Dr. Swanson, ACP Contributing Author, has disclosed no conflicts of interest. Dr. Strate, ACP Contributing Author, reports grants from the National Institutes of Health during the conduct of the study. Disclosures can also be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M18-0023.

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Diagnosis

Treatment

Practice Improvement

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Acute colonic diverticulitis is a gastrointestinal condition commonly seen in the outpatient and inpatient settings. The prevalence of diverticulitis in the United States has increased dramatically over the past several decades and is estimated to be 180 cases per 100 000 persons per year (1, 2). Most patients with diverticulitis are older than 50 years; however, it is increasingly being seen in younger persons. Diverticulitis is more common in women than in men, particularly after the sixth decade of life, and in white persons than in other racial groups (1).

Diverticulosis is a condition in which outpouchings, or diverticula, develop in the colon. Most patients with diverticulosis are asymptomatic. However, 1%–4% of patients with diverticulosis develop diverticulitis (3). Of those with incident disease, approximately 20% have 1 or more recurrent episodes within 10 years (2). Diverticulitis is characterized by inflammation of one or several adjacent diverticula and the surrounding colon. Patients with diverticulitis present with acute or subacute onset of abdominal pain typically occurring in the left lower abdominal quadrant. Other common presenting signs and symptoms include nausea without vomiting, low-grade fever, change in bowel habits, and elevated leukocyte count and inflammatory markers (4).

Diverticulitis can be categorized as uncomplicated or complicated. Uncomplicated diverticulitis involves thickening of the colon wall and pericolonic inflammatory changes. Complicated disease also includes abscess, peritonitis, obstruction, and/or fistula. Approximately 12% of patients with diverticulitis present with complicated disease (2). Management depends on disease severity and the pres-

ence of complications and comorbid diseases. Antibiotics have been the mainstay of therapy, although recent studies indicate that selected patients with uncomplicated diverticulitis can be safely managed without antibiotics. Patients with complicated disease often require surgical intervention.

Diverticulosis is necessary for the development of diverticulitis. Increasing age is an important risk factor for both diverticulosis and diverticulitis; obesity and smoking also increase the likelihood of diverticulosis (5). Low fiber intake and constipation have historically been regarded as the predominant risk factors for diverticulosis, based on ecological studies from the 1960s. However, these studies relied on broad regional dietary habits rather than actual intake among individual patients and did not control for age or other important confounders. Two recent cross-sectional studies indicated that low fiber intake and constipation did not increase risk for diverticulosis after other potential risk factors were controlled for (5, 6).

However, diet and lifestyle are important contributors to diverticulitis. Low fiber intake, high red meat intake, obesity, physical inactivity, and smoking are all associated with increased risk (7–12). One study found that 50% of cases could be prevented with adherence to a healthy lifestyle, including fiber intake exceeding 23 grams per day, red meat intake less than 51 grams per day, vigorous physical activity for 2 hours per week, body mass index less than 25 kg/m², and avoidance of smoking (9). Dietary patterns also seem to be important. A Western dietary pattern high in red meat, refined grains, and fatty dairy foods is associated with increased risk for diverticulitis, whereas a diet high in fruits,

vegetables, and whole grains is associated with decreased risk (10). Alcohol use, particularly heavy use, may be a risk factor for diverticulitis, but the evidence is conflicting (13). Consumption of nuts, corn, and seeds is no longer believed to increase risk for diverticulitis, based on a large prospective study of men (14).

Several medications are associated with increased risk for diverticulitis (13, 15). Regular use (≥ 2 times per week) of nonaspirin nonsteroidal anti-inflammatory drugs (NSAIDs) is associated with

a 70% increased risk. Nonaspirin NSAIDs pose a greater risk than aspirin, particularly for complicated diverticulitis (11). Corticosteroids and opiate analgesics also seem to increase risk (15).

Patients with a family history of diverticulitis are at increased risk. Genetic factors are estimated to account for 50% of the susceptibility to diverticular disease (16), although genetic markers have not been identified. Low vitamin D levels may predispose the patient to diverticulitis (17).

What are the symptoms of diverticulitis?

Depending on disease severity, the clinical presentation of acute diverticulitis ranges from mild abdominal pain to peritonitis with hemodynamic instability. The most common presenting symptom is abdominal pain, which typically has acute to subacute onset (mean time to presentation is 2 days) and is located in the left lower quadrant. The pain is constant and tends to be exacerbated by movement. The left-sided predominance is because diverticulitis usually occurs in the sigmoid or descending colon. However, in Asian populations, diverticulitis is predominantly right-sided, and therefore pain is more often located on the right. In addition, some patients present with right-sided or suprapubic pain due to the location or anatomy of the sigmoid colon. Other common presenting symptoms include diarrhea, constipation, and nausea without vomiting (4). Rectal bleeding is uncommon and should prompt evaluation of other sources of pain. Some patients have urinary symptoms due to the proximity of the inflamed colon to the bladder. In a patient with diverticulitis,

the presence of fecaluria, pneumaturia, or pyuria signifies the presence of a colovesical fistula, and passage of gas or stool through the vagina is indicative of a colovaginal fistula. Constipation, obstipation, and abdominal distention may indicate obstruction. Obstruction can be seen with acute diverticulitis due to colonic inflammation or abscess but is more common after 1 or more episodes as a result of scarring and stricture formation (18).

What should the physical examination of a patient with suspected diverticulitis include?

Physical examination should include vital signs, with close attention to temperature, heart rate, and blood pressure. The clinician should carefully examine the abdomen to assess the location of pain (usually left lower quadrant or suprapubic), guarding, rebound, and distention. An inflammatory mass can sometimes be appreciated. Hemodynamic instability, abdominal rigidity, and diffuse guarding are seen in patients with free perforation and generalized peritonitis. Women should have a pelvic examination to look for potential gynecologic

Diagnosis

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causes of pain. A rectal examination may reveal tenderness. Frank blood in the stool is uncommon. Mental status or respiratory impairment indicates severe diverticulitis with sepsis.

What other conditions should clinicians consider?

Several other diseases have a presentation similar to that of diverticulitis (**Table 1**). Gastrointestinal diseases that can mimic diverticulitis include appendicitis, biliary disease, bowel obstruction, colon cancer, inflammatory bowel disease, acute pancreatitis, constipation, acute gastroenteritis, and incarcerated hernia. Biliary disease, including acute cholecystitis, choledocholithiasis, and cholangitis, typically presents with pain in the right upper quadrant, and abnormalities are found on liver function tests and biliary imaging. Patients with ischemic, infectious, and inflammatory colitis present with diarrhea that is often bloody. Colorectal cancer can be distinguished from diverticulitis on the basis of more chronic onset of symptoms, including progressive changes in bowel habits and hematochezia. On abdominal imaging, bowel wall abnormalities tend to be focal with no pericolic inflammation. In women, gynecologic disorders, including pelvic inflammatory disease, ovarian torsion, ruptured ovarian cyst, or ectopic pregnancy, are common causes of abdominal pain. The pain associated with ovarian conditions is generally acute in onset and intermittent. Abnormalities on the pelvic examination and findings on abdominal imaging differentiate gynecologic causes from diverticulitis. Genitourinary causes of abdominal pain include nephrolithiasis and urinary tract infections. Pain associated with these conditions usually occurs in the

back or flank and groin and is accompanied by dysuria.

Irritable bowel syndrome and symptomatic uncomplicated diverticular disease can be difficult to distinguish from mild diverticulitis, particularly because patients with both disorders may have a history of diverticulitis. Risk for functional bowel disorders and irritable bowel syndrome is increased in patients after an episode of diverticulitis, perhaps due to visceral hypersensitivity (19). Symptomatic uncomplicated diverticular disease is defined as chronic abdominal symptoms in a patient with diverticulosis without signs of diverticulitis (20). However, the evidence linking diverticulosis to chronic intestinal symptoms is poor. In a prospective study, no association was found between diverticulosis on colonoscopy and irritable bowel syndrome (21). In general, patients with these conditions have chronic abdominal pain and altered bowel habits without other worrisome features. Results of laboratory tests, including evaluation for inflammatory markers and imaging, are unremarkable. It is important to recognize these conditions to avoid unnecessary work-ups and antibiotic treatment for presumed acute diverticulitis.

What laboratory tests should be ordered?

Patients with diverticulitis commonly present with an elevated leukocyte count and C-reactive protein (CRP) level. The leukocyte count is typically mildly elevated in uncomplicated diverticulitis but can be higher in complicated cases. In 1 study, an elevated leukocyte count combined with increased CRP level was associated with 4-fold increased likelihood of diverticulitis versus other causes of abdominal pain (22). In addition, elevations in CRP level correlate with dis-

Table 1. Differential Diagnosis of Acute Colonic Diverticulitis

Condition	Symptoms	Findings
Colorectal cancer	Chronic or subacute onset of constipation and frank blood in the stool	Localized bowel wall thickening without pericolic inflammation on imaging
Ischemic colitis	Acute onset of abdominal pain followed by diarrhea and hematochezia	Increased levels of serum lactate dehydrogenase; negative infectious stool studies; segmental bowel wall thickening often with “thumbprinting” or pneumatosis
Inflammatory bowel disease	Subacute or chronic presentation; diarrhea as a predominant feature; hematochezia; constitutional symptoms, such as weight loss, and fatigue	Diffuse or multifocal bowel wall thickening on imaging; colon ulceration seen at endoscopy
Infectious colitis	Diarrhea as a predominant feature; nonlocalizing pain that is generally mild	Positive stool culture
Acute appendicitis	Acute onset periumbilical pain that migrates to the right lower quadrant; anorexia; younger age at onset	Abnormal appendix on imaging
Epiploic appendagitis	Acute to subacute onset of localized abdominal pain without other symptoms	Normal laboratory testing; abdominal imaging with inflamed epiploic appendage
Bowel obstruction, volvulus	Obstipation and vomiting, high-pitched or absent bowel sounds	Obstructive bowel pattern on imaging
Irritable bowel syndrome and symptomatic uncomplicated diverticular disease	Chronic, intermittent abdominal pain and altered bowel habits; may have a history of diverticulitis; patients with irritable bowel syndrome tend to be younger with a female predominance	Normal laboratory tests and imaging; meets Rome IV criteria
Cholecystitis, biliary disease	Acute epigastric or right-upper quadrant pain that radiates to the back or shoulder; jaundice	Elevated liver enzymes; abnormalities of the biliary tree on imaging
Urinary tract disorders	Flank or back pain that radiates to the groin; dysuria, hematuria	Urinalysis with active sediment
Gynecologic disorders	Acute onset of pelvic pain; menstrual irregularities; vaginal discharge; dyspareunia	Adnexal or cervical motion tenderness, mucopurulent discharge, or other abnormalities on pelvic examination; detection of sexually transmitted disease; positive results on pregnancy test; gynecologic abnormalities on imaging

ease severity and can help identify patients with complications, such as abscess (23). Nonetheless, a normal leukocyte count or inflammatory markers do not exclude uncomplicated diverticulitis. Clinicians should order a urinalysis to exclude urinary causes of pain and a pregnancy test in women of child-bearing age. Electrolytes and liver enzymes are helpful in ruling out biliary causes of pain. In patients presenting with diarrhea, stool studies should be done to eliminate infectious causes.

What is the role of decision-making tools?

The diagnostic accuracy of the clinical evaluation alone for diverticulitis is imperfect, particularly in patients without a prior diagnosis. Studies indicate that suspected diverticulitis is misdiagnosed in 40%–60% of patients (22, 24). Several decision tools have been created to increase the accuracy of the clinical diagnosis of diverticulitis in patients presenting with acute abdominal pain.

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In a prospective study of patients presenting to the emergency department, the following 3 predictors of diverticulitis were identified: absence of vomiting, localized left lower quadrant tenderness, and CRP levels exceeding 50 mg/L (24). These 3 features were present in 25% of patients, and the positive predictive value of the combination was 97%. However, in an external validation study, the positive predictive value was 81% and a misdiagnosis would have delayed treatment in 5 of 11 patients without diverticulitis. In addition, 7 patients correctly diagnosed with diverticulitis had complicated disease requiring further intervention (25).

In a multivariable analysis, factors associated with diverticulitis were age older than 50 years, pain localized in the left lower quadrant, left lower quadrant tenderness on examination, exacerbation of pain with movement, absence of vomiting, temperature of 38.5 °C or higher, history of 1 or more episodes of diverticulitis, and CRP levels of 50 mg/L or greater (22). The area under the receiver-operating characteristic curve was 86%, representing good ability to discriminate between diverticulitis and other causes of pain, and was 84% and 89% in 2 separate validation cohorts (25). When a scoring nomogram was used, patients with greater than 90% probability of diverticulitis had positive predictive values of 92% and 89%.

Given the high specificity and positive predictive value, these tools may aid in identifying possible diverticulitis. However, the proportion of patients who meet the criteria for these rules is small and sensitivity is low, so they are not useful for ruling out diverticulitis. Furthermore, patients with these risk factors, particularly those with elevated CRP levels, are at risk for complicated diverticulitis. Such patients may require cross-

sectional imaging to assess the need for further intervention. Therefore, these risk factor models can be used to aid diagnosis of diverticulitis in conjunction with clinical judgment but are not a substitute for imaging, particularly in patients with severe signs and symptoms.

When should clinicians consider imaging tests?

As noted, diagnosing diverticulitis on the basis of clinical findings alone can be difficult. In addition, complications, such as abscess, cannot be confirmed without imaging. Distinguishing complicated from uncomplicated disease is essential for determining the need for antibiotics, percutaneous abscess drainage, and surgery. Nonetheless, diverticulitis can sometimes be diagnosed on the basis of clinical criteria, particularly in patients with a history of the disorder (26) and in settings where imaging is difficult to obtain.

Abdominal imaging is generally useful to confirm the diagnosis in patients presenting for the first time with suspected diverticulitis, but it may not be necessary for subsequent episodes if presentation and severity are similar to prior events. However, in patients with multiple recurrent episodes, documentation of the location of diverticulitis during at least 2 episodes is useful if prophylactic surgery is being considered. The likelihood of recurrent episodes after surgery is minimized when all previously involved segments are resected.

Imaging must be done in patients who present with severe signs and symptoms, such as severe pain, hemodynamic or respiratory compromise, diffuse tenderness and guarding on examination, abdominal rigidity, and markedly elevated leukocyte count or CRP level. Imaging should also be done to assess for complications if the patient has not responded to

medical treatment. Immunocompromised patients are at higher risk for complications and may not mount an inflammatory response. Therefore, the threshold for imaging in this subgroup is low.

The imaging method of choice is multidetector-row abdominal computed tomography (CT) with intravenous and luminal contrast (26). In a systematic review and meta-analysis, abdominal CT had sensitivity of 95% and specificity of 96% for diagnosing diverticulitis (27). Low-radiation dose protocols seem to perform similarly. Abdominal ultrasonography can also be used to evaluate patients with suspected diverticulitis—reported sensitivity and specificity are approximately 90% (27). Ultrasonography has the advantage of reducing contrast and radiation exposure and can be performed at the bedside in critically ill patients; however, it is more operator-dependent than CT and views are more limited, particularly in obese patients (26). Magnetic resonance imaging is also highly sensitive and specific and can be considered in patients who are not candidates for CT or ultrasonography. Plain abdominal radiography can be helpful in identifying pneumoperitoneum and ruling out other diagnoses, such as bowel obstruction, but cannot be used to confirm the diagnosis of diverticulitis or abscess.

When should clinicians consult with a gastroenterologist or surgeon?

Diverticulitis can usually be diagnosed on the basis of physical examination and abdominal imaging and does not require consultation with a gastroenterologist or surgeon. A gastroenterology consultation may be useful in patients in whom inflammatory bowel disease, other forms of colitis, or colon cancer remain in the differential diagnosis after the initial evaluation. Indeed, all patients should have colonoscopy after recovery from an initial episode of diverticulitis to exclude the possibility of misdiagnosed colon cancer if a high-quality colonoscopy has not been done recently (28).

In patients with chronic or recurrent symptoms but no clear evidence of inflammation, a gastroenterology consultation can be useful to evaluate the possibility of symptomatic uncomplicated diverticular disease or irritable bowel syndrome. In addition, patients with refractory symptoms, symptoms that recur shortly after completion of therapy, or significant hematochezia may benefit from surgical and gastroenterology consultation. These patients may have an alternative diagnosis, such as inflammatory bowel disease, segmental colitis associated with diverticulitis, or “smoldering” refractory diverticulitis.

Diagnosis... Diagnosis of acute diverticulitis is based on the presence of abdominal pain, usually located in the left lower quadrant. Other features that support the clinical diagnosis include age older than 50 years, left-sided tenderness on examination, exacerbation of pain with movement, absence of vomiting, fever (usually low-grade), history of diverticulitis, and elevated CRP levels. Abdominal CT should be performed in patients with a severe presentation to assess for complications and in those who are immunocompromised or do not respond to initial therapy. Computed tomography can also confirm the diagnosis in patients without a history of imaging-confirmed disease. Ultrasonography or magnetic resonance imaging can also be used.

CLINICAL BOTTOM LINE

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What is the overall approach to management of patients with acute diverticulitis?

The treatment approach to patients with diverticulitis depends on the severity of the presentation, presence of complications, and comorbid conditions. The first step involves determining whether the patient has complicated or uncomplicated disease. Uncomplicated diverticulitis can often be managed medically and in the outpatient setting, whereas complicated disease requires more aggressive care and often urgent or elective surgery. Antibiotics are the mainstay of therapy for most patients with diverticulitis, although selected patients with uncomplicated disease may be managed without antibiotics.

How can the Hinchey classification scheme help guide management?

Several classification systems have been developed to categorize diverticulitis severity and guide management. **Table 2** outlines a widely used modified Hinchey classification scheme based on CT findings (29). Stages 0 and Ia signify uncomplicated diverticulitis; stages Ib, II, III, and IV indicate complicated diverticulitis. Managing patients with stage Ib disease depends on the size of the abscess and the severity of presentation. Patients with stage II disease (distant abscess) require antibiotics and generally percutaneous drainage as a bridge to elective resection. Patients with stage III and IV disease (purulent and feculent peritonitis) require urgent surgical management. Hinchey-based classification systems do not account for such chronic manifestations as stricture, fistula, and recurrence and thus are largely helpful in guiding management in the acute setting.

What is the role of antibiotics?

In the past, all cases of diverticulitis were treated with antibiotics.

Two randomized trials and several observational studies have indicated that many patients with uncomplicated diverticulitis (Hinchey stages 0, Ia, and Ib with abscess < 5 cm) can be treated safely without antibiotics (30, 31). In these studies, time to recovery, complications, and recurrence did not statistically differ between patients who were treated with antibiotics and those who were not. However, the numbers of patients with complications and recurrence were small and thus the potential benefit of antibiotics on these outcomes was unclear.

Several guidelines now recommend that antibiotics be used selectively rather than routinely in patients with acute, uncomplicated diverticulitis (28). Of note, all patients in these studies had abdominal CT to rule out complicated disease and were briefly admitted to the hospital. Patients with signs of severe infection or sepsis or those with comorbid conditions, including immunocompromise, were excluded. On the basis of existing data and guidelines, stable, immunocompetent, adherent patients with CT-proven uncomplicated diverticulitis can be treated without antibiotics. Patients with recurrent diverticulitis presenting with mild, typical manifestations can also be managed conservatively. They should consume a clear liquid diet and take acetaminophen for pain relief. If improvement does not occur in 2–3 days, antibiotic treatment can be initiated. Antibiotics remain first-line therapy for patients with complicated diverticulitis and those with severe presentations, multiple comorbid conditions, or immunocompromise.

Oral antibiotics are considered adequate for stable, immunocompetent patients with uncomplicated diverticulitis. Several

48. Hall JF, Roberts PL, Ricciardi R, Read T, Scheirey C, Wald C, et al. Long-term follow-up after an initial episode of diverticulitis: what are the predictors of recurrence? *Dis Colon Rectum*. 2011;54:283-8. [PMID: 21304297]
49. Lidor AO, Segal JB, Wu AW, Yu Q, Feinberg R, Schneider EB. Older patients with diverticulitis have low recurrence rates and rarely need surgery. *Surgery*. 2011;150:146-53. [PMID: 21801956]
50. Lidor AO, Schneider E, Segal J, Yu Q, Feinberg R, Wu AW. Elective surgery for diverticulitis is associated with high risk of intestinal diversion and hospital readmission in older adults. *J Gastrointest Surg*. 2010;14:1867-73. [PMID: 20878256]
51. Oor JE, Atema JJ, Boermeester MA, Vrouwenraets BC, Ünlü Ç. A systematic review of complicated diverticulitis in post-transplant patients. *J Gastrointest Surg*. 2014;18:2038-46. [PMID: 25127673] doi:10.1007/s11605-014-2593-2

Table 2. Management of Acute Complicated and Uncomplicated Diverticulitis

Stage of Modified Hinchey Classification		Clinical Category	Management
0	Clinically mild diverticulitis, or diverticula with colonic wall thickening on CT	Uncomplicated	Clear liquid diet for 2-3 days Advance to low-fiber diet until pain improves Antibiotics on case-by-case basis Acetaminophen and antispasmodics for pain
Ia	Colonic wall thickening with inflammatory reaction in the pericolic fat (phlegmon)	Uncomplicated	Clear liquid diet for 2-3 days Advance to low-fiber diet until pain improves Antibiotics on case-by-case basis Acetaminophen and antispasmodics for pain
IIb	Pericolic or mesenteric abscess in proximity to the primary inflammatory process	Complicated	Hospitalization if large abscesses requiring drainage Liquid diet if tolerating oral intake and being treated on an outpatient basis Advance to a low-fiber diet when symptoms improve Oral or intravenous antibiotics, depending on severity Abscesses <3 cm likely to resolve with antibiotics and in some cases without antibiotics Percutaneous drainage for larger abscesses or persistent symptoms/abscess Elective surgical resection if large abscess Acetaminophen and opiate analgesics if needed
II	Intra-abdominal abscess distant from the primary inflammatory process; pelvic or retroperitoneal abscess	Complicated	Hospitalization Nothing by mouth until stable and improving Intravenous antibiotics until improvement/ source control Percutaneous abscess drainage Surgical consultation Elective surgical resection Acetaminophen and opiate analgesics if needed
III	Generalized purulent peritonitis	Complicated	Hospitalization Nothing by mouth Intravenous antibiotics Urgent surgical evaluation and resection; laparoscopic lavage in highly selected patients Acetaminophen and opiate analgesics if needed
IV	Generalized fecal peritonitis	Complicated	Hospitalization Nothing by mouth Intravenous antibiotics Urgent surgical evaluation and resection; laparoscopic lavage inappropriate Acetaminophen and opiate analgesics if needed

prospective randomized and open-label trials have found no benefit of intravenous versus oral antibiotics in these patients (32); also, a short 4-day course may be equivalent to a 7-day course (33). Patients with small abscesses who are well enough to be managed in the outpatient setting may also be treated with oral antibiotics but with a longer course until resolution. Patients with perforation, large abscesses, sepsis, or bowel obstruction or those who cannot tolerate liquid intake or have significant comorbid disease should be managed as in-

patients and receive intravenous antibiotics.

Trials comparing specific antibiotics for diverticulitis treatment are limited. In general, broad-spectrum antibiotics with gram-negative and anaerobic coverage should be prescribed (**Table 3**). Commonly used antibiotics for stable outpatients include a combination of a fluoroquinolone or trimethoprim-sulfamethoxazole plus metronidazole or single agents, such as moxifloxacin or amoxicillin-clavulanate. For inpatients with moderate disease,

intravenous treatment with a combination of a fluoroquinolone plus metronidazole or single-agent ticarcillin-clavulanic acid, ertapenem, or moxifloxacin is recommended.

Meropenem, imipenem-cilastatin, piperacillin-tazobactam, or doripenem may be needed for severely ill patients, especially those who are immunocompromised (34, 35).

How should diet be managed during an acute episode?

There is little evidence to guide dietary recommendations in the setting of acute diverticulitis. Traditionally, a clear liquid diet has been recommended early in the course, with gradual advancement to a low-fiber diet until symptoms resolve. A small, uncontrolled prospective study allowed patients with uncomplicated diverticulitis to consume an unrestricted diet and found that it generally was well-tolerated; however, 8% of patients had serious events (36). Therefore, in patients with mild diverticulitis, it is reasonable to recommend a clear liquid diet until symptoms begin to improve, with subsequent advancement to a low-fiber diet until symptoms resolve. After symptom resolution, a high-fiber diet low in red meat is recommended. Patients hospitalized with severe disease should abstain from oral intake until they become stable.

How should pain be managed during an acute episode?

As with diet, there are few data to guide pain management in diverticulitis, and most guidelines do not address this issue. Use of NSAIDs is associated with incident and complicated diverticulitis (11) and should thus be avoided in patients with acute diverticulitis. Similarly, opiates have been associated with increased risk for perforated diver-

iculitis (15). However, these agents are often used for pain control in studies of diverticulitis and can be prescribed if pain is refractory to other measures. Acetaminophen and such antispasmodics as dicyclomine are first-line agents for managing pain and cramping in mild to moderate disease.

When should patients be hospitalized?

Outpatient management can be considered in patients with uncomplicated diverticulitis and in some patients with stage Ib disease (small peridiverticular abscess) in the absence of severe clinical presentation, unstable comorbid conditions, immunosuppression, or oral intake intolerance and if social support is available (26).

In a randomized trial of 132 patients with uncomplicated Hinchey stage Ia diverticulitis, no difference was seen in readmission rates or the need for emergency surgery or percutaneous drainage in patients hospitalized for treatment versus those treated in the outpatient setting (37). Patients were excluded if they had persistent pain or fever after receiving 1 dose of antibiotics and analgesics. Patients in this study were also excluded if they had a severe presentation, unstable comorbid disease, immunosuppression, or oral intake intolerance.

When should clinicians consider consultation with a gastroenterologist or surgeon?

A surgeon should be consulted in cases of large abscesses, peritonitis, or severe signs and symptoms that do not improve with medical management. Surgical input is also necessary in patients with diverticulitis complicated by obstruction and fistula. Those with frequent or severe diverticulitis may also benefit from surgical consultation. An interventional radiologist should be consulted for patients with large abscesses (>3–4 cm) for consideration of percutaneous drainage.

A gastroenterologist should be consulted in patients with frequent, recurrent episodes and in those with chronic symptoms who do not have clear recurrent diverticulitis. In addition, patients with an uncertain diagnosis, such as those who may have inflammatory bowel disease or colon cancer, should see a gastroenterologist. Finally, all patients should have colonoscopy 4–8 weeks after the incident episode if it has not been done recently.

What is the role of surgery?

The main indications for surgical intervention in diverticulitis are complicated (perforation, abscess, stricture, and fistula) and recurrent diverticulitis. The surgical approach to both of these indications is evolving and generally becoming less aggressive.

The most common complication of diverticulitis is abscess (approximately 10% of patients). Patients with small abscesses (<3–4 cm), phlegmons, or small amounts of extraluminal air can usually be managed with antibiotics alone (Hinchey stages 0 and I) (38). Larger abscesses are generally treated with percutaneous drainage, particularly if the response to antibiotics alone is insufficient. In some cases, the location of the abscess may prevent percutaneous drainage, and laparoscopic drainage may be necessary. Careful monitoring is necessary, particularly in patients with large abscesses managed without drainage. Repeated abdominal CT should be considered in any patient whose condition deteriorates or who does not respond. After medical treatment of a large abscess, elective segmental colectomy is recommended on the basis of retrospective studies, which indicate a high rate of recurrence in this population (39). Successful nonsurgical treatment has also been reported and may be appropriate for well-selected and in-

Table 3. Antibiotic Regimens for Acute Diverticulitis*

Type of Treatment (References)	Single Agent	Multiple Agents	Duration
Outpatient treatment of mild uncomplicated diverticulitis (34, 35, 37)	Amoxicillin-clavulanic acid 875 mg/125 mg PO every 12 h or 1000/62.5 mg tab 2 PO every 12 h Moxifloxacin 400 mg PO every 24 h	Trimethoprim-sulfamethoxazole 1 DS 160/800 mg PO every 12 h Ciprofloxacin 750 mg PO every 12 h† Levofloxacin 750 mg PO every 24 h Each in combination with metronidazole 500 mg PO every 6 h†	4-7 days if source controlled/ abscess drained
Inpatient treatment of mild to moderate complicated diverticulitis (35, 36)	Ertepenem 1 g IV every 24 h Moxifloxacin 400 mg IV every 24 h Ticarcillin-clavulanic acid 200-300 mg/kg/d divided doses every 4-6 h	Cefazolin 1-2 g IV every 8 h Cefuroxime 1.5 g IV every 8 h Ceftriaxone 1-2 g IV every 12-24 h Cefotaxime 1-2 g IV every 6-8 h Ciprofloxacin IV 400 mg every 12 h Levofloxacin IV 750 mg every 24 h Each in combination with metronidazole 500 mg IV every 8-12 h or 1500 mg IV every 24 h	4-7 days if source controlled/ abscess drained
Inpatient treatment of severe complicated diverticulitis, peritonitis (35, 36)	Imipenem-cilastatin 500 mg every 6 h or 1g IV every 8 h Meropenem 1 g IV every 8 h Doripenem 500 mg IV every 8 h Piperacillin-tazobactam 3.375 g IV every 6 h	Cefepime 2 g IV every 8 h Ceftazidime 2 g IV every 8 h Ciprofloxacin 400 mg IV every 12 h Levofloxacin 750 mg IV every 24 h Each in combination with metronidazole 500 mg IV every 8-12 h or 1500 mg IV every 24 h	4-7 days if source controlled/ abscess drained

DS = double-strength; IV = intravenous; PO = oral.

* Doses are for adult patients with normal renal and hepatic function.

† In our practice, an alternative regimen for mild infection includes lower-dose ciprofloxacin 500 mg PO every 12 h and metronidazole 500 mg PO every 8 h.

formed patients (40, 41). Surgical resection is usually necessary to relieve symptoms when diverticulitis is complicated by a fistula or chronic obstruction due to stricture.

Urgent surgical intervention is required for patients with sepsis and diffuse peritonitis (Hinchey stages III and IV) or those who remain ill despite adequate medical therapy (27). Highly selected patients with perforation but no significant sepsis or peritoneal findings may initially be managed medically to avoid urgent surgery, given its high associated morbidity (42). The approach for patients who require surgery remains controversial. Historically, sigmoid colectomy was performed with end colostomy and a Hartmann pouch (closure of the anorectal stump), but this approach is associated with a high rate of complications and permanent stomas. Alternatively, sigmoid colectomy with pri-

mary anastomosis and diverting loop ileostomy has been proposed. Although data suggest that this approach is associated with fewer complications and higher rates of stoma reversal (40, 43), studies are small and predominantly retrospective, and there is a high likelihood that patients with favorable risk profiles were selected for primary anastomosis. Therefore, this approach is used on a case-by-case basis according to individual factors, such as the degree of inflammation in the area of the proposed anastomosis and patient stability (40). Colonic resection with a Hartmann pouch is the procedure of choice in patients with generalized peritonitis who are critically ill or have multiple comorbidities (27).

Laparoscopic lavage has also been proposed as a means to control purulent (not feculent)

peritonitis (Hinchey stage III) and allow for an elective resection with primary anastomosis. This technique consists of pus aspiration, abdominal lavage, and drain placement. Data on this topic are conflicting.

In a meta-analysis of 7 studies (including 3 small randomized trials), the risks for postoperative intra-abdominal abscess and peritonitis and emergency reoperation were higher in patients undergoing laparoscopic lavage versus colonic resection (44). Subset analysis of the 3 randomized trials produced similar results. However, they have been criticized for several reasons, including nonconsecutive enrollment and nonstandardized surgical technique. One trial was stopped early because of greater major morbidity and mortality in the lavage group.

Guidelines based on data that predate the results of randomized trials state that surgery without resection is generally not an appropriate alternative to colectomy (27). Resection is consistently recommended in the case

of feculent peritonitis (Hinchey stage IV) (27).

Surgery is also considered on an elective basis for patients with recurrent, uncomplicated diverticulitis. In the past, surgery was recommended after 2 occurrences and potentially sooner in young persons. However, accumulating data on the natural history of the disease suggest that it is not progressive. Most complications (except fistulas and obstruction) occur during the first or second episode, and emergency surgery is rarely needed in the setting of recurrent disease (45). Furthermore, morbidity is common after elective resection (10%–15%), and surgery does not eliminate risk for recurrence (5%–8% risk at 8 years) (46). Data on quality of life after surgery for recurrence are conflicting. Therefore, elective surgery is recommended for recurrent, uncomplicated diverticulitis on a case-by-case basis, with consideration of such factors as severity and frequency of attacks, effect on quality of life, need for immunosuppression, surgical risk profile, and patient preference (27).

Studies comparing elective open surgery versus laparoscopic resection for recurrent sigmoid diverticulitis have generally indicated that the laparoscopic approach decreases the incidence of major complications, length of hospital stay, and quality of life (40). A guideline from the American Society of Colon and Rectal Surgeons recommends that the laparoscopic approach be used for elective colectomy for diverticulitis if the expertise is available (27). In addition, the entire sigmoid colon and preferably all segments previously involved with diverticulitis should be removed to decrease risk for postsurgical recurrence (27).

What is the prognosis?

After a first episode of diverticulitis, risk for recurrence at 10 years is approximately 20%, risk at 10 years after the second episode is 55%, and risk at 3 years after the third episode is 40%. Risk for recurrence in patients with complicated disease treated medically seems to be similar to that of patients with uncomplicated disease (2). After an episode of uncomplicated diverticulitis, the short-term risk for abscess or perforation is only 2% (32). Approximately 40% of patients with uncomplicated diverticulitis report mild to moderate abdominal pain 1 year after resolution (31).

Because immunosuppression (such as from steroids and other immunosuppressive medications, organ transplant, or chemotherapy) is a risk factor for complicated diverticulitis, management differs in this subgroup (47). As noted, NSAID use is strongly associated with complicated diverticulitis, including perforation. Other medications associated with complicated diverticulitis include opiate analgesics and corticosteroids (16). Risk for complicated diverticulitis is highest during the first episode and decreases with subsequent episodes (45), so recommendations for prophylactic surgery are no longer predicated on the number of episodes (27).

Risk factors for recurrent disease include young age at onset, severity of the incident event, number of recurrences, extent of colon involvement during the incident event, and a family history of diverticulitis (2, 48). Unfortunately, these factors are not modifiable. The role of diet and lifestyle factors in recurrent diverticulitis is not clear. However, data from studies of incident disease suggest that a high-fiber diet and physical activity reduce the risk for recurrence and NSAID use increases the risk (46).

Are there medical options for prevention of recurrent diverticulitis?

There has been recent interest in medical prevention of recurrent diverticulitis in light of the increasingly less aggressive surgical approach and of new theories of disease pathogenesis involving the role of chronic intestinal inflammation and gut microbial dysbiosis. Three agents have been studied: mesalamine (an anti-inflammatory drug used in inflammatory bowel disease), rifaximin (a broad-spectrum, poorly absorbed antibiotic), and probiotics. Mesalamine is the best-studied of these agents; however, 6 randomized trials and a meta-analysis found no benefit of mesalamine over placebo in preventing recurrence (46). The American Gastroenterological Association recommends against using mesalamine to prevent recurrence on the basis of existing evidence (29). Rifaximin and probiotics have each been examined in 1 small trial. Therefore, the effect of these agents on recurrent diverticulitis is uncertain, and the American Gastroenterological Association guideline recommends against the use of these agents after uncomplicated diverticulitis in light of the uncertainty of the low-quality evidence (29).

Dietary and lifestyle factors are associated with risk for incident diverticulitis. Data extrapolated from studies of incident diverticulitis suggest that dietary and lifestyle interventions may also reduce risk for recurrent diverticulitis (46), and these interventions generally have positive effects on overall health. Therefore, patients with a history of diverticulitis should be advised to consume a high-fiber diet or take fiber supplements, minimize red meat consumption, avoid non-aspirin NSAIDs, stop smoking, maintain or achieve a healthy body weight, and exercise regularly if possible. Patients should not be

advised to stop aspirin (particularly if they are using it for secondary prevention in established cardiovascular disease) or to avoid consumption of nuts, seeds, or corn (29). Opiate analgesics and corticosteroids have also been associated with incident diverticulitis and should generally be avoided in patients with a history of the disease (16). Several studies suggest that patients with low vitamin D levels or those living in areas with low exposure to ultraviolet light have greater risk for diverticulitis (18). Therefore, monitoring vitamin D levels and supplementation could be considered in patients with recurrent diverticulitis.

How should clinicians manage diverticulitis in older or immunocompromised patients?

Although patients older than 80 years with newly diagnosed diverticulitis seem less likely to have recurrent disease and require surgical intervention less often than younger patients (49), both acute and elective surgery in elderly persons are associated with substantially increased morbidity and mortality. In 1 study, mortality was 5 times higher in inpatients older than 85 years having urgent surgery and 12 times higher in patients having elective surgery than in those aged 65–69 years. Elderly

patients were also at greater risk for intestinal diversion and hospital readmission (50). Therefore, a non-surgical approach is recommended when possible in older patients. A low threshold for hospitalizing older patients is also reasonable.

Considerable uncertainty surrounds the role of immunosuppression in diverticulitis because most studies are small, retrospective, and heterogeneous with respect to the definition of immunosuppression. However, the increased risk for complicated disease with corticosteroid use is well-defined (16). Other forms of immunosuppression that have been associated with complicated diverticulitis include chemotherapy, organ transplant, and chronic renal failure (47). In general, patients who are immunocompromised tend to present with more aggressive disease and are more likely to require surgical intervention (47). Therefore, it is recommended that immunocompromised patients with suspected diverticulitis undergo imaging to confirm the diagnosis and rule out complications. Antibiotics are recommended for these patients, even if they have uncomplicated disease, and the threshold for hospitalization should be low. Postsurgical morbidity and mortality are

also increased in immunocompromised patients, but whether they are at increased risk for recurrence is uncertain (47, 51). Decisions on performing elective surgery in immunocompromised patients must balance the risk for complicated recurrence with the surgical risk. Current guidelines recommend a lower threshold for prophylactic surgery in these patients (27, 40).

How should patients be monitored after recovery from an acute episode?

Colonoscopy is recommended in patients after the incident episode to rule out other pathologic conditions, such as colon cancer and inflammatory bowel disease. A randomized controlled trial of antibiotic treatment for diverticulitis estimated that 1 in 100 patients with imaging-confirmed diverticulitis would have occult colon cancer in the area of diverticulitis, and thus a missed diagnosis of cancer. However, this may be an overestimate given that patients with diagnostic uncertainty are more likely to be referred for colonoscopy (32). Risk for missed colon cancer is higher in patients presenting with perforated diverticulitis. Because colonoscopy may increase risk for perforated diverticulitis, it should be delayed until 4–8 weeks after the episode resolves. Colonoscopy may not be necessary in patients who have recently had a high-quality colonoscopy.

An estimated 80% of patients with diverticulitis have only 1 episode. In addition, recurrences tend to be of the same or lesser severity, and complications, such as perforation, are generally seen during the first or second episode (40, 45). Therefore, most patients require no special monitoring beyond a postrecovery colonoscopy.

Treatment... The treatment approach to acute diverticulitis depends on the presence of complications (such as abscess or perforation), severity of presentation, and burden of comorbid disease. Stable, immunocompetent patients with uncomplicated diverticulitis can often be treated in the outpatient setting and sometimes without antibiotics. For uncomplicated diverticulitis, a clear liquid diet is recommended for several days, with advancement to a low-fiber diet until symptoms resolve. Patients with large abscesses require intravenous antibiotics and percutaneous drainage, usually followed by elective surgical resection; those with perforation and peritonitis require intravenous antibiotics and emergency surgery; and those with complicated disease should receive nothing by mouth until the diverticulitis is controlled. Colonoscopy should be performed 4–8 weeks after recovery from incident diverticulitis if it has not been done recently.

CLINICAL BOTTOM LINE

Practice Improvement

What do professional organizations recommend with regard to prevention, diagnosis, and management of diverticulitis?

Recent U.S. clinical guidelines include those from the American

Gastroenterological Association and the American Society of Colon and Rectal Surgeons.

The **Box** summarizes the key points of these guidelines.

Professional Societies' Recommendations on Evaluation and Management of Patients With Diverticulitis

American Gastroenterological Association Institute Guidelines, 2015

- Antibiotics should be used selectively
- Colonoscopy should be performed after resolution of acute diverticulitis if a high-quality examination has not been done recently
- Prophylactic colonic resection in uncomplicated diverticulitis should be done on a case-by-case basis
- A fiber-rich diet or fiber supplementation is recommended after resolution
- Physical activity (ideally daily, rigorous exercise) is recommended after resolution
- Aspirin use can be continued after resolution, particularly if it is being used for secondary prevention
- Nuts and popcorn do not need to be avoided in patients with diverticulosis or diverticulitis
- Nonaspirin nonsteroidal anti-inflammatory drugs should be avoided if possible
- Mesalamine, rifaximin, and probiotics are not recommended to prevent recurrence

American Society of Colon and Rectal Surgeons Practice Parameters, 2014

- Initial evaluation should include a history and physical examination, complete blood count, urinalysis, and abdominal radiography in selected clinical scenarios
- Computed tomography of the abdomen and pelvis is the most appropriate initial imaging method
- Ultrasonography and magnetic resonance imaging can be useful imaging alternatives
- Nonsurgical treatment includes oral or intravenous antibiotics and diet modification
- Image-guided percutaneous drainage is usually the most appropriate treatment for stable patients with large diverticular abscesses
- After resolution of incident diverticulitis, colonoscopy should be performed if it has not been done recently
- The decision regarding elective sigmoid colectomy should be individualized
- Elective colectomy should be considered after recovery from complicated diverticulitis
- Routine elective resection based on young age (<50 years) is not recommended
- Urgent sigmoid colectomy is required for diffuse peritonitis or when nonsurgical management fails
- The decision to restore bowel continuity after resection must incorporate patient factors, intraoperative factors, and surgeon preference

In the Clinic Tool Kit

Acute Colonic Diverticulitis

Clinical Guidelines

www.gastro.org/guidelines/acute-diverticulitis
Recommendations from the American Gastroenterological Association on treatment and diagnosis.

www.worldgastroenterology.org/guidelines/global-guidelines/diverticular-disease/diverticular-disease-english

Guidance from the World Gastroenterology Organisation.
www.fascrs.org/sites/default/files/downloads/publication/practice_parameters_for_the_treatment_of_sigmoid.2.pdf

American Society of Colon and Rectal Surgeons guideline for treatment of sigmoid diverticulitis.

Patient Information

www.niddk.nih.gov/health-information/digestive-diseases/diverticulosis-diverticulitis

Detailed information on all aspects of diverticulitis, informative for both patients and caregivers, from the National Institute of Diabetes and Digestive and Kidney Diseases.

www.ucsfhealth.org/education/diverticular_disease_and_diet

Basic patient information from the University of California, San Francisco.

<http://patients.gi.org/topics/diverticulosis-and-diverticulitis>

Basic and in-depth patient information from the American College of Gastroenterology.

<https://medlineplus.gov/diverticulosisanddiverticulitis.html>

Information on diverticulosis and diverticulitis from MedlinePlus.

In the Clinic

WHAT YOU SHOULD KNOW ABOUT ACUTE DIVERTICULITIS

In the Clinic
Annals of Internal Medicine

What Is Diverticulitis?

Diverticulitis is common, especially in adults older than 50 years. Small pouches can form in the colon (the lower part of your intestinal tract), and if they become inflamed or infected, it's called diverticulitis.

What Are the Symptoms?

Patients with diverticulitis have symptoms that can range from mild to severe and may include:

- Stomach pain, especially in the lower left part of your belly
- Nausea
- Fever
- A change in your bowel habits, like sudden diarrhea or constipation

Who Is at Risk?

Diverticulitis affects older adults, usually those over 50. Other risk factors include:

- Obesity
- Smoking
- A low-fiber diet
- Eating red meat
- Not getting enough exercise
- Heavy alcohol use
- Taking certain medicines, such as nonsteroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and opiates
- Low vitamin D levels
- A family history

How Is It Diagnosed?

- Your doctor will ask you about your symptoms and perform a physical examination. This will include touching and pressing on your stomach and abdomen.
- Some women might need a pelvic examination to check for other reasons for pain.
- You may need to give a blood or urine sample to check for other causes of your symptoms.
- You may also have an imaging test, like an ultrasound or a CT scan, to learn more about your condition.

How Is It Treated?

- Most people are treated with antibiotics. However, if your condition is mild, you might not need them.
- You should drink only clear liquids and take acetaminophen (Tylenol) for pain. It's best not to take NSAIDs (such as ibuprofen [Advil])



because they can hurt your stomach and colon.

- When your symptoms start to get better, you can eat a low-fiber diet until you feel completely better. This includes canned or cooked fruits without skin, green beans, carrots, potatoes, eggs, fish, poultry, white bread, dairy products, and low-fiber cereals.
- If you have severe diverticulitis or diverticulitis that keeps coming back, you might need to be hospitalized or have surgery.
- After your diverticulitis goes away, your doctor might suggest a colonoscopy to monitor the health of your colon.

How Can I Prevent Diverticulitis?

- Eat a healthy, balanced, high-fiber diet. This includes lots of whole grains, fruits, and vegetables. Limit your intake of red meat.
- Don't take NSAIDs, such as ibuprofen.
- Don't smoke.
- Maintain a healthy body weight, or lose weight if you are overweight.

Questions for My Doctor

- How long will it take for my diverticulitis to go away?
- What caused my diverticulitis?
- Should I eat a special diet after my diverticulitis goes away?
- Do I need follow-up treatment?
- What medicines should I avoid while being treated for diverticulitis?
- What happens if my diverticulitis comes back?
- When will I start to feel better?

For More Information



MedlinePlus

<https://medlineplus.gov/diverticulosisanddiverticulitis.html>

American College of Gastroenterology

<http://patients.gi.org/topics/diverticulosis-and-diverticulitis>