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In the Clinic: Acute Colonic Diverticulitis

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Mini-abstract

Acute colonic diverticulitis is a gastrointestinal condition frequently encountered by primary care practitioners, hospitalists, surgeons and gastroenterologists. The clinical presentation of acute diverticulitis ranges from mild abdominal pain to peritonitis with sepsis. The diagnosis can often be made based on clinical features alone, but imaging is necessary in more severe presentations to rule out complications such as abscess and perforation. The treatment of diverticulitis 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

Background

Acute colonic diverticulitis is a gastrointestinal condition frequently seen in the outpatient and inpatient settings. The prevalence of diverticulitis in the U.S. has increased dramatically over the past several decades and is estimated to be 180/100,000 persons per year.(1, 2) The majority of patients with diverticulitis are older than 50 years of age. However, diverticulitis is seen increasingly in younger individuals. Diverticulitis is more common in women than in men, particularly after the sixth decade of life, and in whites than in other racial groups.(1)

Diverticulosis is a condition in which outpouchings, or diverticula, develop in the colon. The majority of patients with diverticulosis are asymptomatic. However, 1–4% of patients with diverticulosis will develop diverticulitis.(3) Of those with incident disease, approximately 20% will have one 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 the acute or subacute onset of abdominal pain that is typically located in the left lower quadrant. Other common presenting signs and symptoms include nausea without vomiting, low-grade fever, change in bowel habits, and an elevation in white blood cell count and inflammatory markers.(4)

Diverticulitis can be categorized into uncomplicated and complicated disease. Uncomplicated diverticulitis involves thickening of the colon wall and peri-colonic inflammatory changes. Complicated diverticulitis additionally includes the presence of abscess, peritonitis, obstruction, and/or fistula. Approximately 12% of patients with diverticulitis present with complicated disease.(5) The management of diverticulitis depends on the severity of presentation, presence of complications and concomitant comorbid diseases as discussed in more detail below. Antibiotics have been the mainstay of therapy, although recent studies indicate that select patients with uncomplicated diverticulitis can be

safely managed without antibiotics. Patients with complicated diverticulitis often require surgical intervention.

Who is at risk for diverticulitis?

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.(6) Low dietary fiber intake and constipation have 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 and not the actual intake of individual patients and did not control for age and other important confounders. Two recent, cross-sectional studies indicate that low dietary fiber intake and constipation do not increase the risk of diverticulosis after controlling for a number of other potential risk factors.(6, 7)

Diet and lifestyle factors play an important role in the development of diverticulitis. Low dietary fiber intake, high red meat intake, obesity, physical inactivity and smoking are all associated with an increased risk of diverticulitis.(8–13) One study found that 50% of diverticulitis cases could be prevented with adherence to a healthy lifestyle including dietary fiber intake > 23g per day, red meat intake < 51g per day, vigorous physical activity 2 h per week, body mass index < 25 and no smoking. (Liu AJG 2017). Furthermore, dietary patterns appear to be important. A Western dietary pattern high in red meat, refined grains and high-fat dairy is associated with an increased risk of diverticulitis, whereas a prudent pattern high in fruits, vegetables and whole grains is associated with a decreased risk.(9) Alcohol use, particularly heavy use, may be a risk factor for diverticulitis, although the evidence is conflicting.(14) Consumption of nuts, corn and seeds is no longer felt to increase the risk of diverticulitis based on a large, prospective study of men.(15) Several medications are also associated with an increased risk of diverticulitis.(12, 16) Regular use (2 times/week) of non-aspirin nonsteroidal anti-inflammatory drugs (NSAIDs) is associated with a 70% increased risk of diverticulitis. Non-aspirin NSAIDs pose a greater risk than aspirin, particularly for complicated diverticulitis.(12) Corticosteroids and opiate analgesics also appear to increase the risk of diverticulitis.(16) 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,(17) although genetic markers for this disease are yet to be identified. In addition, low vitamin D levels may predispose to the development of diverticulitis.(18)

Diagnosis

What are the characteristic symptoms of diverticulitis?

The clinical presentation of acute diverticulitis ranges from mild abdominal pain to peritonitis with hemodynamic instability depending on the severity of disease. The most common presenting symptom is abdominal pain, typically acute to subacute in onset (mean time to presentation is 2 days) and located in the left lower quadrant pain. The pain is constant in nature and tends to be worse with movement. The left-sided predominance of pain is due to the fact that most diverticulitis 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/anatomy of the sigmoid colon. Other common presenting symptoms include diarrhea, constipation and nausea without vomiting.(4) Rectal bleeding is an uncommon symptom and should prompt evaluation of other sources of pain. Some patients may 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 signify the presence of a colovesical fistula, and passage of gas and/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 and/or abscess, but is more commonly seen after one or more episodes as a result of scarring and stricture formation.(19)

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

Physical exam should include vital signs with close attention to temperature, heart rate, and blood pressure. The clinician should perform a careful abdominal examination to assess the location of pain (usually left lower quadrant and/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. A pelvic exam should be performed in women to evaluate potential gynecologic causes of pain. A rectal exam may reveal tenderness. Frank blood in the stool is uncommon. Mental status or respiratory impairment would indicate severe diverticulitis with sepsis.

What other conditions should clinicians consider when evaluating a patient with diverticulitis?

A number of other diseases have a similar presentation to diverticulitis (Table 1). Gastrointestinal diseases that can mimic diverticulitis include appendicitis, biliary disease, bowel obstruction, colon malignancy, 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 based on the more chronic onset of symptoms including progressive change in bowel habits and hematochezia. On abdominal imaging, bowel wall abnormalities tend to be focal and without peri-colonic 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 these ovarian conditions is generally acute in onset and intermittent. Abnormalities on pelvic exam and findings on abdominal imaging differentiate gynecologic causes from diverticulitis. Genitourinary etiologies of abdominal pain include nephrolithiasis and urinary tract infections. Pain in these conditions is most often located in the back or flank and is accompanied by dysuria.

Irritable bowel syndrome and symptomatic uncomplicated diverticular disease are two gastrointestinal disorders that can be difficult to distinguish from mild diverticulitis,

particularly since patients with both disorders may have a history of diverticulitis. The risk of functional bowel disorders and irritable bowel syndrome is increased in patients after an episode of diverticulitis perhaps due to visceral hypersensitivity.(20) Symptomatic uncomplicated diverticular disease is defined as chronic abdominal symptoms in a patient with diverticulosis without signs of diverticulitis.(21) However, evidence linking diverticulosis to chronic intestinal symptoms is poor. In a prospective study, there was no association between diverticulosis on colonoscopy and irritable bowel syndrome.(22) In general, patients with these conditions have chronic abdominal pain and altered bowel habits without other worrisome features. Laboratory tests including inflammatory markers and imaging are unremarkable. It is important to recognize these conditions to avoid unnecessary work up and antibiotic treatment for presumed acute diverticulitis.

What laboratory tests should be ordered when evaluating a patient with diverticulitis?

Patients with diverticulitis commonly present with an elevated white blood cell count and C-reactive protein (CRP). The white blood cell count is typically mildly elevated in uncomplicated diverticulitis, but can be higher in the setting of complications. In one study, the combination of an elevated white blood cell count and CRP was associated with a four times increased odds of diverticulitis vs other causes of abdominal pain.(23) In addition, an elevated CRP is associated with severity of disease and can help to identify patients with complications such as abscess.(24) Nonetheless, a normal white blood cell count and/or inflammatory markers do not exclude the possibility of uncomplicated diverticulitis. Clinicians should order a urinalysis to exclude urinary causes of pain and a pregnancy test in women of childbearing 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 rule out infectious etiologies.

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 of diverticulitis. Studies indicate that the clinical diagnosis of suspected diverticulitis is incorrect in 40–60% of patients.(23, 25) Several decision tools have been created to improve the accuracy of the clinical diagnosis of diverticulitis in patients presenting with acute abdominal pain.

In a prospective study of patients presenting to the emergency department, three predictors of diverticulitis were identified - absence of vomiting, localized left lower quadrant tenderness and an elevated CRP > 50 mg/L.(25) These 3 features were present in 25% of patients, and the positive predictive value (PPV) of the combination was 97%. However, in an external validation study, the PPV was 81% and a misdiagnosis would have delayed treatment in 5 of 11 patients without diverticulitis. In addition, 7 patients diagnosed correctly with diverticulitis had complicated disease requiring further intervention.(26)

In a retrospective study of patients admitted to the hospital for suspected acute diverticulitis, signs and symptoms that distinguished patients with diverticulitis from other diagnoses. In a multivariable analysis, factors associated with diverticulitis were age > 50 years, localization of the pain in the left lower abdomen, left lower quadrant tenderness on exam, aggravation

of pain with movement, absence of vomiting, temperature ≥ 38.5 , one or more previous episodes of diverticulitis and an elevated CRP ≥ 50 mg/L.(23) The area under the receiver operator characteristic curve (AUC) was 86% representing good ability to discriminate between diverticulitis and other causes of pain. The AUCs were 84% and 89% in two separate validation cohorts.(26) Using a scoring nomogram, patients with $>90\%$ probability of diverticulitis had a PPV of 92% and 89% for diverticulitis.

Given their high specificity and PPV, these tools may aid in the identification of patients with possible diverticulitis. Unfortunately, the proportion of patients who meet criteria for these rules is small, and the sensitivities are low so these rules are not useful for excluding diverticulitis. Furthermore, patients with these risk factors, particularly those with an elevated CRP, 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 in the 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 obtaining imaging tests?

As noted above, it can be difficult to make a diagnosis of diverticulitis based on clinical findings alone. In addition, complications of diverticulitis 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, it is recognized that sometimes the diagnosis of diverticulitis can be made on clinical grounds, particularly in patients with a history of diverticulitis,(27) and in some settings imaging may be difficult to obtain.

Abdominal imaging is generally useful for patients presenting for the first time with suspected diverticulitis to confirm the diagnosis. For subsequent episodes, imaging may not be necessary if the presentation and severity are similar to prior events. However, in patients with multiple recurrent episodes, documentation of the location of diverticulitis during at least two episodes is useful if prophylactic surgery is considered. The likelihood of recurrent episodes after surgery is minimized when all previously involved segments are resected, and 30% of recurrent episodes occur in a different segment of colon.

Imaging is required in patients who present with severe signs and symptoms such as severe pain, hemodynamic and/or respiratory compromise, diffuse tenderness and guarding on exam, abdominal rigidity, and markedly elevated WBC and/or CRP. Imaging should also be obtained in patients who fail to respond to medical treatment to assess for the development of complications. Immunocompromised patients are at higher risk of complications and may not mount an inflammatory response. Therefore, the threshold for imaging is low in this subgroup.

The imaging modality of choice in diverticulitis is a multi-detector row abdominal CT with intravenous and luminal contrast.(27) In a systematic review and meta-analysis, abdominal CT had a sensitivity of 95% and specificity of 96% for diverticulitis.(28) Low radiation dose protocols appear to perform similarly. Abdominal ultrasound (US) is another modality that

can be used to evaluate patients with suspected diverticulitis with a reported sensitivity and specificity of approximately 90%.(28) Ultrasound has the advantage of reducing contrast and radiation exposure, and can be performed at the bedside in critically ill patients. However, US is more operator dependent than CT and provides more limited views particularly in obese patients.(27) Magnetic resonance imaging (MRI) is also associated with high sensitivity and specificity and can be considered in patients who are not candidates for CT or US. Plain abdominal radiography can be helpful in assessing pneumoperitoneum and in ruling out other diagnoses such as bowel obstruction, but cannot be used to confirm the diagnosis of diverticulitis or abscess.

When should clinicians consider consultation with a gastroenterologist or surgeon for diagnosis?

Most cases of diverticulitis can be diagnosed based on physical examination and abdominal imaging and do 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 undergo a 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 in the recent past.(29)

In patients with chronic or recurrent symptoms without 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 completing 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.

Clinical bottom line: 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 of diverticulitis include age > 50 years, left-sided tenderness on exam, aggravation of pain with movement, absence of vomiting, fever (usually low-grade), a prior history of diverticulitis and an elevated CRP. An abdominal CT scan should be obtained in patients with a severe presentation to assess for complications and in those who are immunocompromised or do not respond to initial therapy. A CT scan can also be useful in confirming the diagnosis in patients without a prior history of imaging confirmed diverticulitis. US or MRI are alternative imaging modalities.

Treatment

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

The treatment approach to patient with diverticulitis depends on the severity of the presentation, presence of complications and underlying comorbid conditions. The first step in management involves determining whether the patient has complicated or uncomplicated

disease. Uncomplicated diverticulitis can often be managed medically and in the outpatient setting, whereas complicated diverticulitis requires more aggressive care and often urgent or elective surgery. Antibiotics are the mainstay of therapy for most patients with diverticulitis, although select patients with uncomplicated disease may be managed without antibiotics.

How can the Hinchey classification scheme help guide management decisions?

A number of diverticulitis classification systems have been developed to categorize disease severity and guide management. Table 2 outlines a widely used Modified Hinchey classification based on CT findings.(30) Patients with stage 0 and stage 1a diverticulitis have uncomplicated diverticulitis. Patients with stage Ib, II, III and IV disease have complicated diverticulitis. The management of patients with stage Ib disease depends on the size of the abscess and 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 classifications systems do not account for chronic manifestations of diverticulitis such as stricture, fistula and recurrence, and therefore, are largely helpful in guiding management in the acute setting.

What is the role of antibiotics in treatment of diverticulitis?

Historically, all cases of diverticulitis were treated with antibiotics.

Two randomized trials as well as several observational studies have indicated that many patients with uncomplicated diverticulitis (Hinchey stage 0, 1a and 1b with abscess < 5cm) can be treated safely without antibiotics.(31, 32) In these studies, time to recovery, complications and recurrence were not statistically different in those treated with and without antibiotics. However, the numbers of patients with complications and recurrence were small, and therefore, 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.(29) Of note, all patients in these studies underwent abdominal CT to rule out complicated disease and were briefly admitted to the hospital. Patients with signs of severe infection or sepsis, or patients with comorbidities including immunocompromise were excluded. Based on existing data and guidelines, it is reasonable to manage stable, immunocompetent, compliant patients with CT-proven uncomplicated diverticulitis without antibiotics. Similarly, patients with recurrent diverticulitis presenting with mild, typical manifestations may be managed conservatively. These patients can be instructed to consume a clear liquid diet and take acetaminophen for pain relief. If there is no improvement within two to three days, antibiotics can be initiated. Antibiotics remain first-line therapy for patients with complicated diverticulitis, and those with severe presentations, multiple comorbid conditions or immunocompromise.

If antibiotics are given, oral antibiotics are considered adequate for stable, immunocompetent patients with uncomplicated diverticulitis. Several prospective randomized and open-label trials have found no benefit of intravenous vs oral antibiotics in this setting.(33) Likewise, a short 4-day course may be equivalent to a 7-day course.(34)

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 is achieved. Patients with perforation, large abscesses, sepsis or bowel obstruction or patients who cannot tolerate liquid intake or have significant comorbid disease should be managed in the inpatient setting with intravenous antibiotics.

Trials comparing specific antibiotics for the treatment of diverticulitis are limited. In general, broad spectrum antibiotics with gram-negative and anaerobic coverage should be prescribed (see Table 3). Commonly used antibiotics for stable outpatients include the combination of a fluoroquinolone or trimethoprim-sulfamethoxazole with metronidazole, or moxifloxacin or amoxicillin plus clavulanate as single agents. For inpatients with moderate disease, intravenous treatment with a fluoroquinolone plus metronidazole, ticarcillin-clavulanic acid, ertapenem or moxifloxacin are recommended. Meropenem, imipenem-cilastatin, piperacillin-tazobactam or doripenem may be needed for severely ill patient especially those with immunocompromise.(35, 36)

How should diet be managed during an episode of acute diverticulitis?

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 eat an unrestricted diet and found that this was well-tolerated. However, 8% of patients experienced serious events.(37) 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 symptom resolution. After the patient's symptoms resolve, a diet high in fiber and low in red meat is recommended. Patients hospitalized with severe disease should abstain from oral intake until their disease has stabilized.

How should pain be managed during an episode of acute diverticulitis?

As with diet, there are few data to guide pain management in diverticulitis, and most guidelines do not address this issue. Nonsteroidal anti-inflammatory drug (NSAIDs) use is associated with incident and complicated diverticulitis.(12) Therefore, these agents should be avoided in patients with acute diverticulitis. Similarly, opiate narcotics have been associated with an increased risk of perforated diverticulitis.(16) However, in studies of diverticulitis these agents are often used for pain control, and can be prescribed if pain is refractory to other measures. Tylenol and antispasmodics such 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 1b disease (small peridiverticular abscess) in the absence of severe clinical presentation, unstable comorbid conditions, immunosuppression, oral intake intolerance, or lack of follow-up or social support.(27)

In a randomized trial of 132 patients with uncomplicated, Hinchey stage 1a diverticulitis, no differences were seen in readmission rates or the need for emergency surgery or percutaneous drainage in patients hospitalized for treatment vs those treated in the outpatient setting.(38) In addition to the criteria above, patients were excluded if they had persistence of pain or fever after receiving one dose of antibiotics and analgesic.

When should clinicians consider consultation with a gastroenterologist or surgeon or other specialists for management?

Surgical consultation should be obtained in patients with large abscesses, peritonitis or those with significant signs and symptoms that are not improving with medical management. In addition, an interventional radiology consultation should be requested in patients with large abscesses (>3–4 cm) as percutaneous drainage may be necessary. Surgical input is also necessary in patients with diverticulitis complicated by obstruction and fistula. Patients with frequent and/or severe recurrent diverticulitis may benefit from surgical consultation.

A gastroenterologist should be consulted in patients with frequent, recurrent episodes and in those with chronic symptoms but without clear recurrent diverticulitis. In addition, patients in whom the diagnosis is uncertain such as those with possible inflammatory bowel disease or colon cancer should see a gastroenterologist. Lastly, it is recommended that all patients undergo a colonoscopy 4–8 weeks after the incident episode of diverticulitis if a recent colonoscopy has not been performed.

What is the role of surgery in management of acute diverticulitis

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

The most common complication of diverticulitis is abscess (approximately 10% of patients). Patients with small abscesses (< 3–4 cm), phlegmons and/or small amounts of extraluminal air can usually be managed with antibiotics alone (Hinchey stage 0 and 1).(39) Larger abscesses are generally treated with percutaneous drainage, particularly if there is insufficient response to antibiotics alone. 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. Repeat abdominal CT should be considered in any patient who deteriorates or fails to respond. After medical treatment of a large abscess, elective segmental colectomy is recommended based on retrospective studies which indicate a high rate of recurrence in this population.(5) Successful non-operative treatment has also been reported and may be appropriate for well-selected and informed patients.(40, 41) Surgical resection is usually necessary to relieve symptoms when diverticulitis is complicated by fistula or chronic obstruction due to stricture.

Urgent surgical intervention is required for patients with sepsis and diffuse peritonitis (Hinchey Stage III and IV) or those who remain ill despite adequate medical therapy.(27) Highly selected patients with perforation without significant sepsis or peritoneal findings

may be managed medically initially and avoid urgent surgery given its high associated morbidity.(42) In patients who require surgery, the surgical approach remains controversial. Historically, a sigmoid colectomy was performed with end colostomy and Hartmann's pouch (closure of the anorectal stump), but this approach is associated with a high rate of complications and permanent stomas. Alternatively, sigmoid colectomy with primary anastomosis and diverting loop ileostomy has been proposed. Although some data suggest this approach is associated with fewer complications and higher rates of stoma reversal (40, 43), existing studies are small and predominantly retrospective, with 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 stability of the patient.(40) Colonic resection with a Hartmann's pouch is currently the surgery 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 aspiration of pus, abdominal lavage, and placement of drains. Data on this topic are conflicting.

In a meta-analysis of 7 studies(including 3 small randomized trials), the risks of postoperative intra-abdominal abscess and peritonitis and emergency reoperation were higher in patients undergoing laparoscopic lavage vs colonic resection.(44) Subset analysis of the three randomized studies produced similar results. These trials have been criticized for a number of reasons including nonconsecutive enrollment and non-standardized operative technique. One trial was terminated prematurely due to greater major morbidity and mortality in the lavage arm.

Current guidelines, based on data prior to the results of randomized trials, state that operative therapy 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 individuals. However, accumulating natural history data suggests that diverticulitis is not a progressive disease. Most complications occur during the first or second episode (except fistula), and emergent 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 the risk of recurrence (5–8% risk at 8 years).(46) Data on quality of life following surgery for recurrence is conflicting. Therefore, elective surgery is recommended for recurrent, uncomplicated diverticulitis on a case-by-case basis that considers factors, such as severity and frequency of attacks, impact on quality of life, need for immunosuppression, surgical risk profile and patient preference.(27)

Studies comparing elective open vs 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) The ASCRS guideline

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 the risk of recurrence after surgery.(27)

What is the prognosis of diverticulitis?

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

Risk factors for complicated diverticulitis include immunosuppression (e.g. steroids and other immunosuppressive medications, organ transplantation, and chemotherapy), and therefore management differs in this subgroup.(47) As noted above, NSAID use is strongly associated with complicated diverticulitis including perforation. Other medications associated with complicated diverticulitis include opiate analgesics and corticosteroids.(16) The risk of complicated diverticulitis is highest during the first episode and decreases with subsequent episodes.(45) Therefore, recommendations for prophylactic surgery are no longer predicated on the number of diverticulitis episodes.(27)

Risk factors for recurrent diverticulitis include young age at onset, severity of the incident event, the number of recurrences, the extent of the colon involved 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, using data from studies of incident disease, it is estimated that a high fiber diet and physical activity reduce the risk of recurrence and NSAID use increases the risk.(46)

Are there medical options for the prevention of recurrent diverticulitis?

There has been recent interest in medical means of preventing 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 including 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. Unfortunately, six randomized trials and a meta-analysis indicate no benefit of mesalamine over placebo in prevention of recurrence.(46) The American Gastroenterological Association (AGA) recommends against the use of mesalamine in the prevention of recurrence based on the existing evidence.(29) Rifaximin and probiotics have been examined in one small trial each. Therefore, the effect of these agents on recurrent diverticulitis is uncertain, and the AGA guideline recommends against the use of these agents after uncomplicated diverticulitis based on the uncertainty of the low-quality evidence.(29)

Diet and lifestyle factors are associated with the risk of incident diverticulitis. Data extrapolated from studies of incident diverticulitis suggest that dietary and lifestyle interventions may also reduce the risk of recurrent diverticulitis,(46) and these interventions generally have positive impacts 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/achieve a healthy body weight, and exercise regularly if possible. Patients should not be advised to stop aspirin particularly if 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 diverticulitis.(16) Several studies suggest that patients with low vitamin D levels or those living in areas with low UV light exposure are at higher risk of diverticulitis.(18) Therefore, vitamin D level monitoring and supplementation could be considered in patients with recurrent diverticulitis.

How should clinicians manage diverticulitis in patients who are older or those who are immunocompromised?

Older patients (> 80 years) with newly diagnosed diverticulitis appear to be less likely to experience recurrent diverticulitis and require operative intervention less often than younger patients.(49) However, both acute and elective surgery in the elderly is associated with substantially increased morbidity and mortality. In one study, inpatient mortality was five times higher in patients > 85 years of age undergoing urgent surgery and 12 times higher in those undergoing elective surgery compared to patients aged 65–69 years old. In addition, elderly patients were at greater risk of intestinal diversion and hospital readmission.(50) Therefore, a non-operative approach is recommended when possible in older patients. It is also reasonable to have a low threshold for hospitalization in older patients.

There is considerable uncertainty regarding the role of immunosuppression in diverticulitis as most studies are small, retrospective and heterogeneous with respect to the definition of immunosuppression. However, the increased risk of 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. Immunocompromised patients should receive antibiotics even for uncomplicated disease, and there should be a low-threshold for hospitalization. Post-operative morbidity and mortality are also increased in immunosuppressed patients, but whether immunocompromised patients are at increased risk of recurrence is uncertain.(47, 51) The decision to recommend elective surgery in immunocompromised patients must balance the risk of complicated recurrence with the operative risk. Current surgical guidelines recommend a lower threshold for prophylactic surgery in these patients.(27, 40)

How should patients be monitored after they recover from an episode of acute diverticulitis?

Colonoscopy is recommended in patients after the incident episode of diverticulitis to rule out other pathology such as colon cancer and inflammatory bowel disease. Based on data from a randomized controlled trial of antibiotics treatment for diverticulitis, it is estimated that 1 in 100 patients with imaging confirmed diverticulitis would have a missed colon cancer in the area of diverticulitis, and therefore a misdiagnosis; this figure may be an overestimate given that patients with diagnostic uncertainty are more likely to be referred for colonoscopy.(32) The risk of missed colon cancer is higher in patients presenting with perforated diverticulitis. Because colonoscopy theoretically may increase the risk of perforated diverticulitis, it is recommended that colonoscopy be delayed 4 to 8 weeks after diverticulitis resolves. Colonoscopy may not be necessary in patients who have had a recent, high-quality colonoscopic exam.

An estimated 80% of patients with diverticulitis will have only one episode. In addition, recurrent events 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 post-recovery colonoscopy.

Clinical bottom line: Treatment

The treatment approach to acute diverticulitis depends on the presence of complications (abscess, 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 and advanced to a low-fiber diet until symptoms resolve. Patients with large abscesses require IV antibiotics and percutaneous drainage usually followed by elective surgical resection. Patients with perforation and peritonitis require IV antibiotics and emergent surgical treatment. Patients with complicated disease should receive nothing by mouth until the diverticulitis is controlled. A colonoscopy should be performed 4–8 weeks after recovery in patients with incident diverticulitis if one has not been recently performed.

Practice improvement

What do professional organizations recommend with regard to the 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 Rectum Surgeons. The box summarizes the key points from these guidelines.

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Professional society's 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 exam has not been performed recently.
- Prophylactic colonic resection in uncomplicated diverticulitis should be done on a case-by-case basis.
- A fiber-rich diet or fiber supplementation are recommended after resolution of diverticulitis.
- Physical activity, ideally daily, rigorous, is recommended after resolution of diverticulitis.
- Aspirin use can be continued after resolution of diverticulitis particularly if for secondary prevention.
- Nut and popcorn consumption do not need to be avoided in patients with diverticulosis or diverticulitis.
- Non-aspirin NSAIDs should be avoided if possible following resolution of diverticulitis.
- Mesalamine, rifaximin, and probiotics are not recommended for prevention of recurrence.

American Society of Colon and Rectal Surgeons Practice Parameters, 2014

- The initial evaluation should include a history and physical examination, complete blood count, urinalysis, and abdominal radiographs in selected clinical scenarios.
- CT scan of the abdomen and pelvis is the most appropriate initial imaging modality.
- Ultrasound and magnetic resonance imaging can be useful imaging alternatives.
- Non-operative 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 not done in the recent past.
- The decision to recommend elective sigmoid colectomy should be individualized.
- Elective colectomy should be considered after recover 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 non-operative management fails.
- The decision to restore bowel continuity after resection must incorporate patient factors, intraoperative factors, and surgeon preference.

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 pericolonic inflammation on imaging
Ischemic colitis	Acute onset of abdominal pain followed by the development of diarrhea and hematochezia	Increased 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, 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
Eppilic 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, meet 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 genitals; 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

Table 2.

Management of Acute Complicated and Uncomplicated Diverticulitis

Stage of Modified Hinchey Classification	Clinical Category	Management
0	Uncomplicated	Clear liquid diet for 2-3 days Advance to low fiber diet until pain improves Antibiotics on case-by-case basis Tylenol and antispasmodics for pain
Ia	Uncomplicated	Clear liquid diet for 2-3 days Advance to low-fiber diet until pain improves Antibiotics on case-by-case basis Tylenol and antispasmodics for pain
IIb	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 Tylenol and opiate analgesics if needed Elective surgical resection if large abscess
II	Complicated	Hospitalization NPO until stable and improving Intravenous antibiotics until improving/source control Percutaneous drainage of abscess Tylenol and opiate analgesics if needed Surgical consultation Elective surgical resection
III	Complicated	Hospitalization Nothing by mouth Intravenous antibiotics Urgent surgical evaluation and resection; laparoscopic lavage in highly selected patients Tylenol and opiate analgesics if needed
IV	Complicated	Hospitalization Nothing by mouth Intravenous antibiotics Urgent surgical evaluation and resection; laparoscopic lavage inappropriate Tylenol and opiate analgesics if needed

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)	Moxifloxacin 400 mg PO every 24 h Amoxicillin-clavulanic acid 875 mg/125 mg PO every 12 h or 1000/62.5 mg tab 2 PO every 12 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)	Ertapenem 1g 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 Cefoaxime 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 3.375g IV every 6 h	Cefepime 2g IV every 8 h Ceftazidime 2g 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

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.