Acute colonic diverticulitis: Medical management

AUTHOR: John H Pemberton, MD
SECTION EDITORS: Martin Weiser, MD, Krishnan Raghavendran, MD, FACS
DEPUTY EDITOR: Wenliang Chen, MD, PhD

All topics are updated as new evidence becomes available and our peer review process is complete.

Literature review current through: **Sep 2023.**
This topic last updated: **Jun 07, 2023.**

INTRODUCTION

Diverticular disease of the colon is an important cause of hospital admissions and a significant contributor to health care costs in Western and industrialized societies [1,2]. In the United States, acute diverticulitis is the third most common gastrointestinal illness that requires hospitalization and the leading indication for elective colon resection [3,4].

The management of patients with acute colonic diverticulitis is discussed in this topic. The discussion pertains mostly to the treatment of sigmoid diverticulitis; a brief discussion of diverticulitis of the right colon can be found at the end of the topic (see 'Right-sided (cecal) diverticulitis' below). The epidemiology, pathophysiology, clinical manifestations, diagnosis, and surgical treatment of diverticulitis are discussed elsewhere:

- (See "Colonic diverticulosis and diverticular disease: Epidemiology, risk factors, and pathogenesis".)
- (See "Clinical manifestations and diagnosis of acute colonic diverticulitis in adults".)
- (See "Acute colonic diverticulitis: Surgical management".)
- (See "Diverticular fistulas".)
- (See "Colonic diverticular bleeding".)

INPATIENT VERSUS OUTPATIENT TREATMENT

Acute diverticulitis is suspected in patients with lower abdominal pain (typically in the left lower quadrant), abdominal tenderness on physical examination, and leukocytosis on laboratory testing. To exclude alternative conditions (eg, colon cancer, irritable bowel syndrome), the diagnosis is usually confirmed by an abdominopelvic computed tomography (CT) scan, which also distinguishes complicated from uncomplicated disease.

In the absence of complications (eg, frank perforation, obstruction, abscess, or fistulization), acute uncomplicated diverticulitis can be treated nonoperatively in most patients (70 to 100 percent) [5,6], regardless of the treatment setting (out- versus inpatient) [7-11]. In a systematic review of patients with uncomplicated diverticulitis, no differences in outcomes were found between outpatient and inpatient care [12].

Acute complicated diverticulitis requires treatment of both colonic inflammation (diverticulitis) and the specific complication (eg, frank perforation, obstruction, abscess, or fistulization), which typically requires hospitalization and/or surgery. (See 'Inpatient treatment of complications' below.)

Based upon findings from the history, physical examination, and CT scan, patients are triaged to receive either inpatient or outpatient treatment as discussed below and illustrated by the accompanying algorithm (algorithm 1). Given the significant heterogeneity in patient presentation, the decision ultimately depends on clinical judgement of the treating clinician.

Criteria for inpatient treatment — Patients with acute diverticulitis should receive inpatient treatment if [8,10,13] (table 1):

- CT shows **complicated** diverticulitis defined by the presence of frank perforation (eg, free air under the diaphragm with or without extravasation of contrast, or free air with significant amount of free fluid), abscess, obstruction, or fistulization.
- CT shows **uncomplicated** diverticulitis, but the patient has one or more of the following characteristics [14]:
  - Sepsis or systemic inflammatory response syndrome (SIRS) as defined by more than one of the following: Temperature >38 or <36° Celsius, heart rate >90 beats per minute (bpm), respiration rate >20 respirations per minute (rpm), white blood cell count >12,000/mL or <4000/mL, C-reactive protein >15 mg/dL.
  - Severe abdominal pain or diffuse peritonitis and/or failure to control abdominal pain in the emergency department to <5 on a visual analog scale (VAS).

- Microperforation (eg, a few air bubbles outside the colon without contrast extravasation) or phlegmon [15].
- Age >70 years.
- Significant comorbidities (eg, diabetes mellitus with organic involvement [eg, retinopathy, angiopathy, nephropathy], a recent cardiogenic event [eg, acute myocardial infarction, angina, heart failure], or recent decompensation of chronic liver disease [≥Child B] or end-stage renal disease).
- Immunosuppression (eg, poorly controlled diabetes mellitus, chronic high-dose corticosteroid use, use of other immunosuppressive agents, advanced human immunodeficiency virus [HIV] infection or acquired immunodeficiency syndrome [AIDS], B or T cell leukocyte deficiency, active cancer of hematologic malignancy, or organ transplant).
- Intolerance of oral intake secondary to bowel obstruction or ileus.
- Noncompliance with care/unreliability for return visits/lack of support system.
- Failed outpatient treatment.

Criteria for outpatient treatment — Patients may be able to receive outpatient treatment for diverticulitis if they do not meet any of the criteria for inpatient treatment listed above. (See 'Criteria for inpatient treatment' above.)

OUTPATIENT TREATMENT

The outpatient treatment of acute colonic diverticulitis typically consists of pain control with oral analgesics (eg, acetaminophen, ibuprofen, oxycodone) and a liquid diet. Patients are reassessed clinically two to three days after the initial presentation and weekly thereafter until the complete resolution of all symptoms. Repeat imaging studies are **not** indicated unless the patient fails to improve clinically. Patients who fail outpatient treatment are admitted for inpatient treatment. (See 'Inpatient treatment' below.)

Initial outpatient care

No oral antibiotics — Antibiotics used to be the cornerstone of diverticulitis treatment. However, such practice was largely based upon retrospective studies and clinical experience rather than high-quality evidence [16,17]. In an open-label randomized trial (DINAMO) of 480

patients with imaging-confirmed uncomplicated diverticulitis whose symptoms were adequately controlled in the emergency department, outpatient treatment with or without amoxicillin-clavulanic acid resulted in similarly low rates of unscheduled return visits (6.7 versus 7 percent) or hospitalization (6 versus 3 percent) [14].

The exclusion criteria used in the DINAMO trial were almost identical to the criteria used above to determine need for inpatient treatment. Thus, we suggest that patients with uncomplicated diverticulitis but without the characteristics suggestive of either severe disease or serious comorbidities can be managed initially with pain control and a liquid diet but without antibiotics [14]. However, patients who meet criteria for inpatient care may not always be admitted to the hospital, and some patients may be frail yet not meet criteria for inpatient care. Thus, clinicians may reasonably choose to use antibiotics for outpatients who they are concerned may be at higher risk for poor outcomes, such as those who have major medical comorbidities, have immunocompromising conditions, or show signs of systemic disturbance. If oral antibiotics are used in this setting, potential regimens are the same as those given for individuals after discharge. (See 'Criteria for discharge' below.)

Our suggestion for the selective use of antibiotics to treat uncomplicated diverticulitis is consistent with recommendations from the American Gastroenterological Association (AGA) [18,19], American Society of Colon and Rectal Surgeons (ASCRS) [10], European Association of Endoscopic Surgery (EAES)/Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) [20], and American College of Physicians (ACP) [21].

Outpatient diet — There is no evidence for dietary restrictions in acute uncomplicated diverticulitis. Some guidelines allow regular diet in patients who can tolerate it, while others endorse a "modified" diet [22]. One approach is to limit patients to a liquid diet until they can be reassessed in two to three days, after which their diet can be liberalized to soft or regular if they demonstrate clinical improvement.

Subsequent outpatient care — Outpatients should be reassessed clinically two to three days after the initial presentation and weekly thereafter until the resolution of all symptoms.

Patients who improve — Repeat imaging studies are **not** necessary in patients who continue to demonstrate clinical improvement. Upon resolution of all symptoms, patients should be monitored for any recurrence of symptoms and undergo colonoscopy in six to eight weeks if they have not done so within the previous year. (See 'Long-term management' below.)

Patients who do not improve — At two to three days after the initial presentation, patients who have no improvement in abdominal pain, fever, or inability to tolerate oral fluids should be

admitted for inpatient treatment. Abdominopelvic CT imaging may be repeated to rule out a new complication. (See 'Inpatient treatment' below.)

INPATIENT TREATMENT

Inpatient treatment of acute diverticulitis varies depending upon whether the patient has complicated or uncomplicated disease. Patients with complicated diverticulitis must undergo treatment specific to their complications. All patients undergo treatment for diverticulitis with intravenous antibiotics, fluids, and pain medications.

Initial inpatient care

Inpatient treatment of complications

Perforation — Acute diverticulitis can lead to frank perforation or microperforation in the inflamed colonic segment.

Frank perforation — Evidenced by free air under the diaphragm with or without extravasation of contrast or fluid, frank perforation of the colon results in diffuse peritonitis from intra-abdominal spread of feculent fluid and bacterial organisms. Acute diverticulitis that presents with frank perforation is life-threatening and mandates emergency surgery [23-26]. (See "Acute colonic diverticulitis: Surgical management", section on 'Free (frank) perforation'.)

Microperforation — Microperforation, also called contained perforation, is the presence of small amount of air bubbles but no oral contrast outside of the colon on abdominopelvic CT imaging. Most patients who have microperforation should be treated initially with intravenous antibiotics in a fashion that is similar to patients with uncomplicated diverticulitis (see 'Inpatient treatment of diverticulitis' below); the majority of them (94 percent) can be managed nonoperatively [27] but with the following caveats:

- Patients with pericolonic air bubbles only (referred to as Hinchey Ia by some authors) can be managed the same way as those with uncomplicated diverticulitis. The success rate of nonoperative management is from 85 to 99 percent [28,29]. (See 'Inpatient treatment of diverticulitis' below.)

- Patients with pericolonic air bubbles associated with an abscess should be managed according to the abscess. The expected success rate of nonoperative management is lower than that of uncomplicated diverticulitis. (See 'Abscess' below.)

- Patients with a small amount of distant intraperitoneal air bubbles (eg, over the liver, under the diaphragm) or distant retroperitoneal air bubbles require an individualized approach: those with a benign abdominal examination may be managed nonoperatively while those with peritonitis should undergo surgery. In these patients, the success rate of nonoperative management varies from 34 to 93 percent, depending on whether there is an associated abscess or pelvic fluid [5,28,30,31]. (See "Acute colonic diverticulitis: Surgical management", section on 'Free (frank) perforation'.)

Abscess — Abscesses occur in 16 to 40 percent of patients with complicated acute diverticulitis [32]. We suggest a stepwise approach to treating diverticular abscesses [20]:

- Antibiotics are the first-line treatment for all diverticular abscesses. (See 'Intravenous antibiotics' below.)

- Percutaneous drainage may be added, if feasible, for abscesses ≥4 cm, those that do not resolve with antibiotic therapy, or in the presence of clinical deterioration. (See 'Large abscess (≥4 cm)' below.)

The guidelines from the American Society of Colon and Rectal Surgeons (ASCRS) also advocate a stepwise approach to treating diverticular abscesses but with a different cutoff size of 3 cm for recommending percutaneous drainage [10]. This discrepancy may not be clinically significant.

The overall success rate of nonoperative management for diverticular abscess is about 80 percent regardless of approaches (antibiotics, percutaneous drainage, or both) [32]. The remaining 20 percent need surgery [33].

The recurrence rate after successful nonoperative management is 15 to 25 percent [32,34] and is higher for abscesses >5 cm [35]. Whether all asymptomatic patients with a healed diverticular abscess require elective surgery is controversial and discussed elsewhere. (See "Acute colonic diverticulitis: Surgical management", section on 'Healed diverticular abscess'.)

Small abscess (<4 cm) — For smaller abscesses, antibiotic therapy alone and percutaneous drainage have similar success rates, morbidity, and mortality [32]. One study that treated 23 abscesses <3 cm with antibiotics alone reported a treatment failure rate of 0 percent [33]. In another study, 93 of 107 diverticular abscesses <4 cm were successfully treated with antibiotics alone [36].

Patients who respond to antibiotics are followed with serial CT scans until the resolution of the abscess; patients who deteriorate or fail to improve after two to three days of antibiotic therapy may require surgery if percutaneous drainage is not an option.

Abscesses may not be amenable to percutaneous drainage because they are too small (ie, <2 cm) or there are important structures (eg, small bowel) adjacent to them that preclude percutaneous access [33,35,37].

Large abscess (≥4 cm) — The benefit of percutaneous drainage is greater for larger abscesses than for smaller ones. As the size of the abscess increases from ≤3 cm to 3 to 10 cm and 3 to 18 cm, the success rate of antibiotics-alone therapy decreases from 100 to 82 and 66 percent [32]. By contrast, 80 percent of diverticular abscesses >4 cm resolve after percutaneous drainage [20]. In order to maximize the success rate of nonoperative management, we suggest percutaneous drainage of diverticular abscesses ≥4 cm, whenever feasible, in additional to antibiotic therapy.

CT-guided drainage is typically performed for abscesses that are amenable to percutaneous drainage. An approach through the anterior abdominal wall is favored for most abscesses, while abscesses deep in the pelvis or obscured by other organs are drained transgluteally. Transrectal or transvaginal approaches to abscess drainage have also been described but are rarely used [38,39]. Once a drainage catheter is placed, it is left until the output is minimal, a process which can take as long as 30 days [40].

After percutaneous drainage of a diverticular abscess, patients typically defervesce within 24 to 48 hours. For patients who do not improve within that time frame, surgery is indicated.

Obstruction — In patients with suspected colonic obstruction from diverticulitis, radiographic differentiation of acute diverticulitis from colon cancer can be difficult (image 1). Thus, surgical resection of the involved bowel segment is mandatory to relieve the bowel obstruction and rule out cancer. (See "Acute colonic diverticulitis: Surgical management", section on 'Obstruction'.)

Fistula — A fistula can develop between the colon and bladder, vagina, uterus, other bowel segments, and abdominal wall. Diverticular fistulas rarely close spontaneously, and a resection of the affected bowel segment is generally required. However, diverticular fistulas do not usually present acutely. The management of a diverticular fistula is discussed separately. (See "Diverticular fistulas".)

Inpatient treatment of diverticulitis — Inpatient treatment of acute colonic diverticulitis typically begins with administration of intravenous antibiotics, fluids, and pain medications. Patients can be made nil per os (NPO) to allow for complete bowel rest or be offered a clear liquid diet depending upon their clinical status. Patients without complications typically show a clinical response within two to three days, at which point their diet can be advanced further.

Patients who continue to improve are discharged to complete a course of oral antibiotics; those who fail to improve are referred for surgery.

Intravenous antibiotics — Patients requiring hospitalization should begin intravenous antibiotics with activities against gram-negative rods and anaerobic organisms. The choice of agents depends upon the severity of the illness (table 2 and table 3). In rare occasions when acute diverticulitis develops in patients who are already hospitalized or have undergone percutaneous drainage, antibiotic coverage should be broadened to also include nosocomial organisms (table 4). If a culture has been taken at the time of percutaneous abscess drainage or surgery, the antibiotic regimen should be revised based upon susceptibility results. Anaerobic coverage should be continued if polymicrobial infection is identified. Detailed discussion of antibiotic therapy for intra-abdominal infections can be found in another topic. (See "Antimicrobial approach to intra-abdominal infections in adults".)

Intravenous antibiotics should be continued until the inflammation is stabilized, evidenced by resolving abdominal pain and tenderness. This process typically takes three to five days. The patient is then transitioned to oral antibiotics (most commonly ciprofloxacin plus metronidazole or amoxicillin-clavulanate) to complete a 10 to 14 day course (inclusive of intravenous and oral antibiotic therapy). (See 'Criteria for discharge' below.)

The duration of intravenous antibiotic therapy in patients who undergo procedures for definitive source control (percutaneous abscess drainage or surgery) is discussed separately. (See "Antimicrobial approach to intra-abdominal infections in adults", section on 'Duration of therapy'.)

The need for intravenous antibiotics for acute uncomplicated diverticulitis treated as inpatient has been studied in two European trials and one Oceanic trial [41]:

- In the Swedish trial (AVOD), 623 patients with CT-confirmed uncomplicated left-sided diverticulitis were treated with or without antibiotics as inpatients [42]. Complication rates (1.9 versus 1.0 percent), hospital length of stay (three days in both groups), and recurrence rates (16 percent in both groups) were similar. Ten patients initially treated without antibiotics subsequently received antibiotics due to increasing abdominal pain, fever, or increasing C-reactive protein (CRP). A subsequent study, which followed 556 of the original participants for a median of 11 years, reported similar outcomes between the antibiotic and no-antibiotic groups in the rates of recurrences, complications, surgery for diverticulitis, and colorectal cancer [43].

- A second Dutch trial (DIABOLO) randomly assigned 528 patients with first-episode, CT-proven, left-sided acute diverticulitis to observation or 10 days of antibiotics (Augmentin in

most, ciprofloxacin plus metronidazole in the rest) [44]. Patients with complicated diverticulitis, with the exception of a small (<5 cm) abscess, were excluded. Most (93 percent) of the trial participants were admitted to the hospital. The median times to recovery without (14 [interquartile range 6 to 35] days) or with antibiotics (12 [7 to 30] days) were similar. At six months, the outcomes were similar in terms of complicated diverticulitis (3.8 percent observation versus 2.6 percent antibiotics), smoldering diverticulitis (7.3 versus 4.1 percent), recurrent diverticulitis (3.4 versus 3 percent), need for sigmoid resection (3.8 versus 2.3 percent), need for readmission (17.6 versus 12.0 percent), adverse events (48.5 versus 54.5 percent), or mortality (1.1 versus 0.4 percent).

- A double-blind, placebo-controlled Australian/New Zealand trial (STANDARD) randomly assigned 180 patients with CT-proven uncomplicated (Hinchey Ia) diverticulitis to either intravenous cefuroxime/Flagyl followed by Augmentin or placebo for seven days [45]. All patients were initially admitted to the hospital. There was no significant difference in hospital stay (40 hours antibiotics versus 46 hours placebo), adverse event rate, or 7 or 30 day readmission rate.

Given that these trials used different exclusion criteria, CT imaging is not perfect in detecting complicated diverticular disease, and most patients admitted for inpatient treatment of acute diverticulitis have either severe disease or serious comorbid conditions, we suggest treating all inpatients with antibiotics rather than selectively based on whether the disease is complicated. This issue remains controversial [46,47], however, particularly between providers based in Europe versus North America [20,22].

Intravenous fluid — Patients who are admitted for inpatient treatment of acute diverticulitis should be given intravenous fluid (eg, Ringer's lactate or normal saline) to correct volume deficits. Intravenous fluid is typically continued until patients are tolerating adequate liquids.

Pain control — Patients who are admitted for acute diverticulitis often have severe abdominal pain from localized peritonitis. For such patients, parenteral analgesics (eg, acetaminophen, ketorolac, morphine, or hydromorphone) are administered when patients are taking nothing by mouth, while oral analgesics (eg, acetaminophen, ibuprofen, oxycodone) are appropriate when patients are consuming an oral diet.

Inpatient diet — Patients requiring hospitalization should initially be kept on complete bowel rest with intravenous hydration. Patients without complications typically show a clinical response within two to three days, at which point they can be started on a liquid diet and advanced as tolerated.

Subsequent inpatient care — Patients are assessed daily and typically show improvement after two to three days of antibiotics. Failure to improve should prompt repeat imaging. Patients who show continued improvement can be discharged.

Repeat imaging — Disease progression with or without new complications should be suspected in patients with clinical deterioration and those who fail to improve after two to three days of intravenous antibiotic therapy. Repeat imaging may be required in such patients.

The purpose of repeat imaging, typically with an abdominopelvic CT scan, is to look for new complications (eg, abscess or perforation) that may require further intervention (eg, percutaneous drainage or surgery).

Criteria for discharge — Most patients with uncomplicated diverticulitis have significant clinical improvement after two to three days of intravenous antibiotics. They are then reassessed daily to determine if they are eligible to be discharged from the hospital. The patient must meet all criteria listed below before they can be discharged:

- Normalization of vital signs (ie, resolution of high fever, tachycardia, or hypotension)
- Resolution of severe abdominal pain
- Resolution of significant leukocytosis
- Tolerance of oral diet

Patients are discharged with oral antibiotics to complete a course of 10 to 14 days (inclusive of both intravenous and oral antibiotics). We use one of the following oral antibiotic regimens in adult patients with normal renal and hepatic function (table 5):

- Ciprofloxacin (500 mg every 12 hours) plus metronidazole (500 mg every 8 hours)
- Levofloxacin (750 mg daily) plus metronidazole (500 mg every 8 hours)
- Trimethoprim-sulfamethoxazole (1 double-strength tablet [sulfamethoxazole 800 mg; trimethoprim 160 mg] every 12 hours) plus metronidazole (500 mg every 8 hours)
- Amoxicillin-clavulanate (1 tablet [875 mg amoxicillin; 125 mg clavulanic acid] every 8 hours) [48-50] or Augmentin XR (2 tablets [each tablet containing 1 g amoxicillin; 62.5 mg clavulanic acid] every 12 hours)
- Moxifloxacin (400 mg daily; use in patients intolerant of both metronidazole and beta-lactam agents)

The local antibiogram should be consulted to avoid prescribing a regimen to which bacterial resistance exceeds 10 percent. As an example, in areas where the prevalence of *Escherichia coli*

resistance to fluoroquinolones exceeds 10 percent, amoxicillin-clavulanate or trimethoprim-sulfamethoxazole plus metronidazole are the preferred agents. Moxifloxacin is reserved for those who cannot use the other regimens because of high rates of resistance among anaerobes [51]. There is also clinical evidence that fluoroquinolones plus metronidazole were associated with a higher rate of *Clostridioides difficile* than amoxicillin-clavulanate at one year [52].

After discharge, patients should be reassessed within one week and then weekly until all symptoms have resolved. In a retrospective cohort study of over 200,000 patients, the readmission rate for treatment failure was 6.6 percent, with complicated diverticulitis being the strongest predictor of readmissions [53].

Failure of inpatient medical treatment — Surgery is indicated at any point during admission if the patient's condition deteriorates (eg, increased abdominal pain or leukocytosis, or development of diffuse peritonitis). (See "Acute colonic diverticulitis: Surgical management".)

Patients who fail to improve with two to three days of intravenous antibiotics should undergo repeat imaging to identify new-onset complications of diverticulitis (eg, abscess or perforation). Certain complications may require surgery. (See 'Repeat imaging' above and 'Inpatient treatment of complications' above.)

In addition, surgery may be warranted in patients who fail to improve after another one to two days of medical management, even if no complications are identified with repeat imaging.

LONG-TERM MANAGEMENT

At around six to eight weeks, patients with acute diverticulitis who have resolution of all symptoms should undergo colonoscopy to rule out colon cancer if they have not had a colonoscopy within the previous year. Those who have colon cancer require further evaluation and treatment (see "Overview of the management of primary colon cancer"). Patients with persistent or recurrent symptoms require surgical evaluation as they may have chronic smoldering diverticulitis.

Symptomatic patients after initial attack — A small proportion of patients who develop acute diverticulitis do not follow the classic pattern of disease progression. Such patients have been described as having "smoldering" diverticulitis [54,55]. Patients who have chronic smoldering diverticulitis typically have subacute but protracted symptoms of left lower quadrant abdominal pain, alteration in bowel habits, and/or rectal bleeding. These symptoms are chronic and may last for longer than six months.

Patients with chronic smoldering diverticulitis are referred for elective surgery [56]. In a systematic review, elective surgery reduced recurrence in patients with prior complicated or smoldering or frequently recurrent diverticulitis [57].

In a two-year longitudinal study of patients participating in the DIABOLO trial [44], over one-third reported persistent symptoms such as flatulence (39 percent), rumblings (31 percent), many stools (30 percent), bloating (28 percent), fullness (28 percent), and severe urgency for defecation (27 percent) [58]. However, the absolute quality-of-life scores for several of such symptoms were actually comparable to those for healthy individuals in other studies, and only 22 percent of patients with ongoing abdominal complaints experienced a recurrent episode of diverticulitis within 24 months. Thus, for patients with persistent complaints after acute diverticulitis, it is important to distinguish between true recurrent diverticulitis and other disease entities such as inflammatory bowel disease or irritable bowel syndrome before pursuing surgical intervention. (See "Clinical manifestations and diagnosis of irritable bowel syndrome in adults" and "Acute colonic diverticulitis: Surgical management", section on 'Persistent symptoms'.)

Asymptomatic patients after initial attack — Patients who are symptom-free at around six to eight weeks should undergo colonoscopy to rule out colon cancer. Most asymptomatic patients who do not have colon cancer require no further treatment. Some patients, however, may benefit from elective surgery because they are at a high risk of developing serious complications or dying from a recurrent diverticulitis attack. (See 'Elective surgery for high-risk patients' below.)

Colonoscopy for all patients — After the complete resolution of symptoms associated with acute diverticulitis (typically in six to eight weeks), we suggest that a colonoscopy be performed to assess the extent of a patient's diverticular disease and exclude a concomitant colonic cancer, unless it has been performed within the previous year.

The cancer detection rate by colonoscopy is consistently much higher after complicated diverticulitis than after uncomplicated diverticulitis [57]. In two meta-analyses, colorectal cancer was detected by colonoscopy in 8.3 to 10.8 percent of patients with complicated diverticulitis but only in 0.5 to 0.7 percent of those with uncomplicated diverticulitis [59,60]. Thus, there is no controversy that colonoscopy should be performed after any episode of complicated diverticulitis.

It is controversial, however, whether colonoscopy is necessary after an episode of uncomplicated diverticulitis. In this cohort of patients, the detection rate of colorectal cancer varies by study. In a single-center retrospective study of 978 patients who underwent

colonoscopy or gastrointestinal surgery after CT diagnosis of diverticulitis, 2.7 percent were found to have colorectal cancer and 5 percent to have advanced adenoma [61]. In two retrospective studies of 545 and 185 patients with uncomplicated diverticulitis, however, routine colonoscopy did not detect any colorectal cancer [42,62].

The 2018 European Association for Endoscopic Surgery (EAES)/Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) guidelines failed to reach a consensus, with American experts in favor of routine colonoscopy but European experts against colonoscopy for patients with uncomplicated diverticulitis [20]. The 2020 American Society of Colon and Rectal Surgeons (ASCRS) guidelines recommended colonoscopy after all complicated diverticulitis and after uncomplicated diverticulitis with imaging abnormalities or atypical courses [10]. The 2022 American College of Physicians (ACP) guidelines recommended colonoscopy after complicated diverticulitis [56].

Given the low risk of colonoscopy, we, along with other major societies [18], recommend colonoscopy for **all** patients after an episode of diverticulitis, unless they have had one in the previous year. (See "Clinical manifestations and diagnosis of acute colonic diverticulitis in adults", section on 'Exclusion of an underlying malignancy'.)

Elective surgery for high-risk patients — After successful nonoperative management of acute diverticulitis, elective surgery should be offered to patients who are at high risk of developing serious complications or dying from recurrent diverticulitis, including those with complicated diverticulitis and those who are immunosuppressed.

Complicated first attack — The 2020 ASCRS guidelines [10] recommend elective surgery for patients with one prior episode of complicated diverticulitis (including abscess) because some studies show that such patients are at greater risk of developing complications or dying from a recurrent attack and therefore would benefit from early elective surgery [63,64].

Whereas surgery is almost always indicated for severe complications such as fistula, obstruction, stricture, and free perforation, the optimal management of a healed diverticular abscess is less certain [65] as some evidence suggests that it is not as significant a risk factor for future complicated recurrence. Thus, for patients with a healed diverticular abscess, we suggest basing the decision to operate on the persistence of symptoms and effect on quality of life, rather than mandating surgery solely to avoid recurrent attacks. This is especially true if the patient is medically complicated. This area, however, is controversial and continues to evolve [66]. (See "Acute colonic diverticulitis: Surgical management", section on 'Patients with prior complicated attack'.)

Immunosuppression — Compared with the general population, patients who are immunosuppressed are more likely to develop acute diverticulitis (0.02 versus 1 percent), more likely to require emergency surgery if they developed diverticulitis (10 to 25 versus 40 percent), and more likely to die if they underwent emergency surgery for diverticulitis (<5 versus 30 percent) [25,67-69].

In a retrospective study of 1332 immunosuppressed and 25,655 immunocompetent patients undergoing surgery for acute diverticulitis, immunosuppression was associated with a higher mortality rate after emergency surgery (odds ratio [OR] 1.79, 95% CI 1.17-2.75) but not elective surgery. After elective surgery, immunosuppressed patients were more likely to develop major complications (OR 1.46, 95% CI 1.17-1.83) or wound dehiscence (OR 2.69, 95% CI 1.63-4.42) compared with immunocompetent patients [70].

Acute diverticulitis is more severe in immunocompromised patients because their presentation is atypical and often delayed. Thus, most surgeons would offer elective surgery to immunocompromised patients who are medically fit after a single attack of diverticulitis because elective surgery carries much lower morbidity and mortality rates compared with emergency surgery [71]. The decision to pursue elective surgery, however, needs to be individualized as some immunosuppressed patients are poor surgical candidates due to comorbid conditions [10]. (See "Acute colonic diverticulitis: Surgical management", section on 'Patients who are immunocompromised'.)

Patients can become immunocompromised from chemotherapy; immunosuppression for organ transplant; long-term glucocorticoid therapy; or chronic medical conditions such as diabetes, renal failure, or collagen-vascular disorders such as lupus [72,73].

Patients with diabetes who present with acute diverticulitis have a higher incidence of complicated episodes but similar success with nonoperative management compared with patients without diabetes [20]. Patients with HIV infection that is well controlled have similar postoperative complications to those of the general population; those with AIDS have higher morbidities and mortality [74]. Patients who are planning to undergo a limited course of chemotherapy should have their elective surgery delayed until after its completion.

Observation for low-risk patients — Immunocompetent patients with a history of uncomplicated diverticulitis do **not** require elective surgery, regardless of the number of attacks they have had in the past. The following are exceptions: patients who travel extensively, especially internationally, and patients who live in remote areas of the country without ready access to medical care should be offered resection of their disease to preclude life-threatening complications caused by being unable to quickly access good-quality medical and surgical care.

Patients with a history of colonic diverticulitis may benefit from dietary and behavioral modifications to lower their risk of future recurrence [18]:

Dietary modification and supplements — In order to prevent recurrence, patients with a history of colonic diverticulitis should consume a high-fiber diet [18]. However, they do not need to avoid seeds, corn, and nuts. Further studies are required before mesalamine or other agents (eg, rifaximin, probiotics) can be recommended for routine use in patients with diverticulitis [18].

- **Healthy lifestyle** – Patients should be advised to lead a healthy lifestyle, which entails tobacco cessation, physical activities and weight loss, and reduced meat intake [75,76]. A high-fiber diet is also recommended once the acute phase of diverticulitis has resolved [77]. This recommendation is based upon observational studies that suggested long-term fiber supplementation may reduce the incidence of recurrent diverticulitis [78,79]. Indirect support for fiber supplementation also comes from studies that demonstrated the protective effect of a high-fiber diet on the development of diverticular disease [80]. However, although a healthy lifestyle has been shown to prevent the first attack of diverticulitis, its role in secondary prevention in patients who already had diverticulitis is less clear [81,82].

- **Seeds, corn, and nuts** – Patients with diverticular disease have historically been advised to avoid consuming seeds, corn, and nuts out of concern that undigested fragments of such food items could become lodged within the diverticulum and incite diverticulitis. However, this theory is completely unproven. In a large prospective study of 47,228 patients, nut, corn, and popcorn consumption did not increase the risk of developing diverticulitis or its associated complications (eg, bleeding) [83]. Thus, we do not counsel patients with a history of diverticulitis against consuming seeds, corn, and nuts.

- Mesalamine – Based upon the theory that chronic inflammation plays a role in diverticulitis, anti-inflammatory agents, such as mesalamine, have been used to treat diverticulitis [84-88]. A 2017 Cochrane systematic review and meta-analysis of seven randomized trials, however, found no evidence of an effect when comparing mesalamine with control for prevention of recurrent diverticulitis (31.3 versus 29.8 percent; relative risk 0.69, 95% CI 0.43-1.09; very low quality of evidence) [89]. Therefore, we do not suggest mesalamine to prevent recurrent diverticulitis [20,56,57]. There is even less evidence to support the use of other agents such as rifaximin [90] and probiotics [91].

Recurrent diverticulitis — Following nonoperative management of a first attack, approximately one-third of patients will have a second attack, after which one-third will have a

third attack [10]. However, prior uncomplicated attacks predict neither a higher incidence nor a higher severity of recurrence. Thus, the number of prior attacks is no longer used as a criterion for surgery [10,18]. Instead, surgery should be offered to patients with recurrent diverticulitis who develop symptoms that can be convincingly attributed to the disease and to those at a higher risk of developing complications or dying from recurrent attacks. (See 'Elective surgery for high-risk patients' above.)

Overall, between 16 and 42 percent of patients have one or more recurrent attack(s) after nonoperative management of acute diverticulitis [63,92-94]. Thus, most patients (58 to 84 percent) do not develop recurrent diverticulitis. Two large cohort studies followed tens of thousands of patients for four years after their first episode of acute diverticulitis and documented low rates of both hospital readmission and surgery:

- In an English study of over 65,000 patients managed nonoperatively for their first episode of diverticulitis, the readmission rate for recurrent diverticulitis after a minimum follow-up of four years was 11.2 percent; 0.9 and 0.75 percent required emergency and elective colectomy. Female sex, young age, smoking, obesity, and complicated initial disease were risk factors for readmission and emergency surgery by regression analyses [95].

- In a Canadian study of over 14,000 patients followed for a median of almost four years, the readmission rate was 9 percent, and 1.9 and 1.7 percent required emergency and elective colectomy. In regression analyses, complicated initial disease was a risk factor for both readmission and emergency surgery, while age <50 was a risk factor for readmission but not emergency surgery [96].

Studies show that recurrence diverticulitis is usually **not** more severe, or "virulent," than the initial episode:

- In 672 patients who were followed for five years after nonoperative management of diverticulitis, 36 percent had a recurrence at five years, but only 4 percent had a complicated recurrence (eg, abscess, perforation, or fistula) [92].

- In a retrospective study of 1300 patients with acute diverticulitis, frank perforation occurred in 25 percent of patients with their first episode, 12 percent with their second episode, 6 percent with their third episode, and only 1 percent thereafter [97].

Although surgery was once advised for patients who have had two or more uncomplicated attacks of diverticulitis, there is increasing evidence that such arbitrary guidelines should be abandoned [98-100]. The guidelines from the ASCRS called for an individualized approach to recommending elective sigmoid colectomy after recovery from uncomplicated diverticulitis [10].

Considering the risk of colostomies associated with elective resection, the risk of ostomy is not lower after surgery than without surgery (4 versus 1.6 percent) [101]. The complication and colostomy rates associated with surgery after four episodes were no higher than after one episode [10]. Furthermore, more episodes of diverticulitis were not associated with a higher rate of conversion from laparoscopic to open surgery [102].

Surgery, however, may be indicated in patients with recurrent diverticulitis who develop symptoms. In a systematic review of 80 studies, 20 to 35 percent of patients managed nonoperatively developed chronic abdominal pain, compared with 5 to 25 percent of patients treated surgically [24]. Overall, approximately 15 percent of patients with acute diverticulitis will require surgical intervention at some time during the course of their disease [24], nearly all of whom have had either a complicated episode or several uncomplicated episodes of diverticulitis [10].

Recurrence after surgery for uncomplicated diverticulitis occurs in 6 percent of patients at one year and 16 percent at five years [101]; patients with a colosigmoid anastomosis had four times as many recurrences as those with a colorectal anastomosis [103,104]. It is therefore extremely important that the distal level of resection be in the rectum and not the sigmoid colon.

Special patient groups

Young patients (age <40) — Although some studies have reported more frequent and severe recurrences in patients younger than 40 years of age and some have advocated early elective surgery in such patients [93,105-108], other studies have suggested that the risk of recurrence is better predicted by the severity of the initial attack than the age of onset [109,110]. In our practice, we do not offer elective surgery to patients who have a history of diverticulitis simply because they are young, which is in concordance with the ASCRS practice parameters for sigmoid diverticulitis [10].

Surgery was traditionally offered to young patients after one episode of acute diverticulitis based upon two premises: that young patients have more virulent disease and that young patients are more likely to develop recurrent diverticulitis that ultimately requires surgical intervention. Both premises have been refuted by contemporary data [109].

Right-sided (cecal) diverticulitis — In Western countries, acute colonic diverticulitis is primarily left sided (72 percent sigmoid, 33 percent descending, 3 percent transverse, 5 percent ascending colon). Right-sided (cecal) diverticula account for only 1.5 percent of diverticulitis cases in Western countries but 38 to 75 percent of diverticulitis cases in Asian countries [111].

Patients with right-sided diverticulitis tend to be younger than those with left-sided disease [112]. Right-sided diverticulitis is less likely to be complicated. Several studies form both Western and Asian countries have reported lower complication rates, lower mortality rates, and lower recurrence rates to be associated with right-sided, as compared with left-sided, diverticulitis [92,112].

The management of right-sided diverticulitis ranges from medical therapy to surgery, depending upon patient presentation. When the diagnosis is made nonoperatively, medical management with antibiotics is usually sufficient. In a systematic review and meta-analysis of 11 studies, the pooled recurrence rate after nonoperative management was 12 percent (95% CI 10 to 15 percent) with a median follow-up of 34 months [113]. Only 10 percent of those who recurred required urgent surgery at the first recurrence, and there was no mortality.

Patients who are diagnosed with right-sided diverticulitis during exploratory operations for abdominal discomfort can undergo an appendectomy if the base of the appendix and the cecum are not inflamed [114-116]. This is then followed by antibiotic therapy. Diverticulectomy can be performed if there is a localized perforation of the involved diverticulum [114,117]. One prospective nonrandomized study associated diverticulectomy with similar success and complication rates but lower recurrence rates than medical management [118]. Most commonly, a right hemicolectomy is performed if there is inflammation of the area or a mass suggestive of a carcinoma [116].

SOCIETY GUIDELINE LINKS

Links to society and government-sponsored guidelines from selected countries and regions around the world are provided separately. (See "Society guideline links: Colonic diverticular disease" and "Society guideline links: Intra-abdominal infections in adults".)

INFORMATION FOR PATIENTS

UpToDate offers two types of patient education materials, "The Basics" and "Beyond the Basics." The Basics patient education pieces are written in plain language, at the 5th to 6th grade reading level, and they answer the four or five key questions a patient might have about a given condition. These articles are best for patients who want a general overview and who prefer short, easy-to-read materials. Beyond the Basics patient education pieces are longer, more sophisticated, and more detailed. These articles are written at the 10th to 12th grade reading

level and are best for patients who want in-depth information and are comfortable with some medical jargon.

Here are the patient education articles that are relevant to this topic. We encourage you to print or e-mail these topics to your patients. (You can also locate patient education articles on a variety of subjects by searching on "patient info" and the keyword(s) of interest.)

- Basics topics (see "Patient education: Diverticulitis (The Basics)")
- Beyond the Basics topics (see "Patient education: Diverticular disease (Beyond the Basics)")

SUMMARY AND RECOMMENDATIONS

- **Decision on outpatient versus inpatient care** – Based upon findings on the history, physical examination, and abdominopelvic CT scan, patients with acute colonic diverticulitis are triaged to receive either inpatient or outpatient treatment. The criteria for out- versus inpatient care are discussed (table 1 and algorithm 1). (See 'Inpatient versus outpatient treatment' above.)

- **Outpatient care** – For most patients who are appropriate for outpatient management of acute colonic diverticulitis, we suggest against antibiotic treatment (**Grade 2C**). However, clinicians may choose to use antibiotics in patients who have major medical comorbidities, have immunocompromising conditions, or show signs of systemic disturbance.

  Patients are initially managed with pain control with oral analgesics (eg, acetaminophen, ibuprofen, or oxycodone) and a liquid diet and are reassessed clinically in two to three days and weekly thereafter until the complete resolution of all symptoms. Repeat imaging studies are usually not necessary unless the patient fails to progress clinically. Patients who do not improve with outpatient therapy are admitted for inpatient treatment. (See 'Outpatient treatment' above.)

- **Inpatient care** – For patients for whom inpatient management of acute colonic diverticulitis is appropriate, we suggest administering intravenous antibiotics (**Grade 2C**). The choice of agents depends on disease severity (table 2 and table 3 and table 4). Patients should initially be kept on complete bowel rest. Clinical response is typically seen within two to three days, at which point a liquid diet can be started and advanced as tolerated. Patients who continue to improve are discharged with oral antibiotics to complete a total of 10 to 14 days of antibiotic therapy (table 5). Patients who fail inpatient treatment require surgery. (See 'Inpatient treatment of diverticulitis' above.)

- **Treating complications** – Patients with complicated diverticulitis must undergo treatments specific to their complications (eg, frank perforation, abscess, obstruction, fistulization). Diverticular abscesses ≥4 cm should be drained percutaneously if feasible. Frank perforation or obstruction requires surgery. (See 'Inpatient treatment of complications' above and "Acute colonic diverticulitis: Surgical management".)

- **Follow-up care** – After successful out- or inpatient treatment of acute diverticulitis, patients are reassessed in six to eight weeks. Those who have persistent symptoms may have chronic smoldering diverticulitis and are referred for surgical evaluation. Those who are symptom free should undergo colonoscopy to rule out colon cancer, unless performed in the previous year. (See 'Symptomatic patients after initial attack' above and 'Colonoscopy for all patients' above.)

- **Indications for elective surgery** – (See 'Long-term management' above.)

  - **Uncomplicated episode** – Elective resection is no longer recommended solely based on the number of attacks or young age at presentation. An individualized approach to elective surgical resection should be adopted in patients recovering from uncomplicated diverticulitis. Patients who reside in or frequently travel to remote areas that lack medical resources may benefit from elective surgery to reduce the risk of recurrences. Others may be observed with dietary and behavioral modifications to reduce the risk of recurrence. (See 'Observation for low-risk patients' above and 'Young patients (age <40)' above.)

  - **Complicated episode or immunosuppressed patients** – For patients who have had complicated diverticulitis (with the exception of some patients with a healed diverticular abscess and no symptoms) or who are immunosuppressed, we suggest elective colon resection (**Grade 2C**). (See 'Elective surgery for high-risk patients' above.)

ACKNOWLEDGMENT

The editorial staff at UpToDate acknowledge Tonia Young-Fadok, MD, who contributed to earlier versions of this topic review.

REFERENCES

1. Everhart JE, Ruhl CE. Burden of digestive diseases in the United States part II: lower gastrointestinal diseases. Gastroenterology 2009; 136:741.
2. Shaheen NJ, Hansen RA, Morgan DR, et al. The burden of gastrointestinal and liver diseases, 2006. Am J Gastroenterol 2006; 101:2128.
3. Peery AF, Dellon ES, Lund J, et al. Burden of gastrointestinal disease in the United States: 2012 update. Gastroenterology 2012; 143:1179.
4. Anaya DA, Flum DR. Risk of emergency colectomy and colostomy in patients with diverticular disease. Arch Surg 2005; 140:681.
5. Dharmarajan S, Hunt SR, Birnbaum EH, et al. The efficacy of nonoperative management of acute complicated diverticulitis. Dis Colon Rectum 2011; 54:663.
6. Buchs NC, Konrad-Mugnier B, Jannot AS, et al. Assessment of recurrence and complications following uncomplicated diverticulitis. Br J Surg 2013; 100:976.
7. Janes SE, Meagher A, Frizelle FA. Management of diverticulitis. BMJ 2006; 332:271.
8. Alonso S, Pera M, Parés D, et al. Outpatient treatment of patients with uncomplicated acute diverticulitis. Colorectal Dis 2010; 12:e278.
9. Moya P, Arroyo A, Pérez-Legaz J, et al. Applicability, safety and efficiency of outpatient treatment in uncomplicated diverticulitis. Tech Coloproctol 2012; 16:301.
10. Hall J, Hardiman K, Lee S, et al. The American Society of Colon and Rectal Surgeons Clinical Practice Guidelines for the Treatment of Left-Sided Colonic Diverticulitis. Dis Colon Rectum 2020; 63:728.
11. Rueda JC, Jimenez A, Caro A, et al. Home treatment of uncomplicated acute diverticulitis. Int Surg 2012; 97:203.
12. Balk EM, Adam GP, Bhuma MR, et al. Diagnostic Imaging and Medical Management of Acute Left-Sided Colonic Diverticulitis : A Systematic Review. Ann Intern Med 2022; 175:379.
13. Etzioni DA, Chiu VY, Cannom RR, et al. Outpatient treatment of acute diverticulitis: rates and predictors of failure. Dis Colon Rectum 2010; 53:861.
14. Mora-López L, Ruiz-Edo N, Estrada-Ferrer O, et al. Efficacy and Safety of Nonantibiotic Outpatient Treatment in Mild Acute Diverticulitis (DINAMO-study): A Multicentre, Randomised, Open-label, Noninferiority Trial. Ann Surg 2021; 274:e435.
15. Sirany AE, Gaertner WB, Madoff RD, Kwaan MR. Diverticulitis Diagnosed in the Emergency Room: Is It Safe to Discharge Home? J Am Coll Surg 2017; 225:21.
16. Schechter S, Mulvey J, Eisenstat TE. Management of uncomplicated acute diverticulitis: results of a survey. Dis Colon Rectum 1999; 42:470.

17. Salzman H, Lillie D. Diverticular disease: diagnosis and treatment. Am Fam Physician 2005; 72:1229.
18. Stollman N, Smalley W, Hirano I, AGA Institute Clinical Guidelines Committee. American Gastroenterological Association Institute Guideline on the Management of Acute Diverticulitis. Gastroenterology 2015; 149:1944.
19. Shah SD, Cifu AS. JAMA clinical guidelines synopsis: Management of acute diverticulitis. JAMA 2017; 318:291.
20. Francis NK, Sylla P, Abou-Khalil M, et al. EAES and SAGES 2018 consensus conference on acute diverticulitis management: evidence-based recommendations for clinical practice. Surg Endosc 2019; 33:2726.
21. Qaseem A, Etxeandia-Ikobaltzeta I, Lin JS, et al. Diagnosis and Management of Acute Left-Sided Colonic Diverticulitis: A Clinical Guideline From the American College of Physicians. Ann Intern Med 2022; 175:399.
22. Vennix S, Morton DG, Hahnloser D, et al. Systematic review of evidence and consensus on diverticulitis: an analysis of national and international guidelines. Colorectal Dis 2014; 16:866.
23. Krobot K, Yin D, Zhang Q, et al. Effect of inappropriate initial empiric antibiotic therapy on outcome of patients with community-acquired intra-abdominal infections requiring surgery. Eur J Clin Microbiol Infect Dis 2004; 23:682.
24. Morris AM, Regenbogen SE, Hardiman KM, Hendren S. Sigmoid diverticulitis: a systematic review. JAMA 2014; 311:287.
25. Regenbogen SE, Hardiman KM, Hendren S, Morris AM. Surgery for diverticulitis in the 21st century: a systematic review. JAMA Surg 2014; 149:292.
26. Stocchi L. Current indications and role of surgery in the management of sigmoid diverticulitis. World J Gastroenterol 2010; 16:804.
27. van Dijk ST, Doelare SAN, van Geloven AAW, Boermeester MA. A Systematic Review of Pericolic Extraluminal Air in Left-Sided Acute Colonic Diverticulitis. Surg Infect (Larchmt) 2018; 19:362.
28. Sallinen VJ, Mentula PJ, Leppäniemi AK. Nonoperative management of perforated diverticulitis with extraluminal air is safe and effective in selected patients. Dis Colon Rectum 2014; 57:875.
29. Vogels S, Frouws M, Morks AN, et al. Treating acute colonic diverticulitis with extraluminal pericolic air: An Acute Care Surgery in the Netherlands (ACCSENT) multicenter retrospective cohort study. Surgery 2021; 169:1182.

30. Titos-García A, Aranda-Narváez JM, Romacho-López L, et al. Nonoperative management of perforated acute diverticulitis with extraluminal air: results and risk factors of failure. Int J Colorectal Dis 2017; 32:1503.
31. Thorisson A, Nikberg M, Andreasson K, et al. Non-operative management of perforated diverticulitis with extraluminal or free air - a retrospective single center cohort study. Scand J Gastroenterol 2018; 53:1298.
32. Gregersen R, Mortensen LQ, Burcharth J, et al. Treatment of patients with acute colonic diverticulitis complicated by abscess formation: A systematic review. Int J Surg 2016; 35:201.
33. Siewert B, Tye G, Kruskal J, et al. Impact of CT-guided drainage in the treatment of diverticular abscesses: size matters. AJR Am J Roentgenol 2006; 186:680.
34. Kaiser AM, Jiang JK, Lake JP, et al. The management of complicated diverticulitis and the role of computed tomography. Am J Gastroenterol 2005; 100:910.
35. Gaertner WB, Willis DJ, Madoff RD, et al. Percutaneous drainage of colonic diverticular abscess: is colon resection necessary? Dis Colon Rectum 2013; 56:622.
36. Mali J, Mentula P, Leppäniemi A, Sallinen V. Determinants of treatment and outcomes of diverticular abscesses. World J Emerg Surg 2019; 14:31.
37. Brandt D, Gervaz P, Durmishi Y, et al. Percutaneous CT scan-guided drainage vs. antibiotherapy alone for Hinchey II diverticulitis: a case-control study. Dis Colon Rectum 2006; 49:1533.
38. Kuligowska E, Keller E, Ferrucci JT. Treatment of pelvic abscesses: value of one-step sonographically guided transrectal needle aspiration and lavage. AJR Am J Roentgenol 1995; 164:201.
39. Schiller VL, Schreiber L, Seaton C, Sarti DA. Transvaginal sonographic diagnosis of sigmoid diverticulitis. Abdom Imaging 1995; 20:253.
40. Neff CC, vanSonnenberg E, Casola G, et al. Diverticular abscesses: percutaneous drainage. Radiology 1987; 163:15.
41. Dichman ML, Rosenstock SJ, Shabanzadeh DM. Antibiotics for uncomplicated diverticulitis. Cochrane Database Syst Rev 2022; 6:CD009092.
42. Chabok A, Påhlman L, Hjern F, et al. Randomized clinical trial of antibiotics in acute uncomplicated diverticulitis. Br J Surg 2012; 99:532.
43. Isacson D, Smedh K, Nikberg M, Chabok A. Long-term follow-up of the AVOD randomized trial of antibiotic avoidance in uncomplicated diverticulitis. Br J Surg 2019; 106:1542.
44. Daniels L, Ünlü Ç, de Korte N, et al. Randomized clinical trial of observational versus antibiotic treatment for a first episode of CT-proven uncomplicated acute diverticulitis. Br J

Surg 2017; 104:52.

45. Jaung R, Nisbet S, Gosselink MP, et al. Antibiotics Do Not Reduce Length of Hospital Stay for Uncomplicated Diverticulitis in a Pragmatic Double-Blind Randomized Trial. Clin Gastroenterol Hepatol 2021; 19:503.
46. Desai M, Fathallah J, Nutalapati V, Saligram S. Antibiotics Versus No Antibiotics for Acute Uncomplicated Diverticulitis: A Systematic Review and Meta-analysis. Dis Colon Rectum 2019; 62:1005.
47. van Dijk ST, Chabok A, Dijkgraaf MG, et al. Observational versus antibiotic treatment for uncomplicated diverticulitis: an individual-patient data meta-analysis. Br J Surg 2020; 107:1062.
48. Biondo S, Golda T, Kreisler E, et al. Outpatient versus hospitalization management for uncomplicated diverticulitis: a prospective, multicenter randomized clinical trial (DIVER Trial). Ann Surg 2014; 259:38.
49. Ribas Y, Bombardó J, Aguilar F, et al. Prospective randomized clinical trial assessing the efficacy of a short course of intravenously administered amoxicillin plus clavulanic acid followed by oral antibiotic in patients with uncomplicated acute diverticulitis. Int J Colorectal Dis 2010; 25:1363.
50. Balasubramanian I, Fleming C, Mohan HM, et al. Out-Patient Management of Mild or Uncomplicated Diverticulitis: A Systematic Review. Dig Surg 2017; 34:151.
51. Brook I, Wexler HM, Goldstein EJ. Antianaerobic antimicrobials: spectrum and susceptibility testing. Clin Microbiol Rev 2013; 26:526.
52. Gaber CE, Kinlaw AC, Edwards JK, et al. Comparative Effectiveness and Harms of Antibiotics for Outpatient Diverticulitis : Two Nationwide Cohort Studies. Ann Intern Med 2021; 174:737.
53. Al-Masrouri S, Garfinkle R, Al-Rashid F, et al. Readmission for Treatment Failure After Nonoperative Management of Acute Diverticulitis: A Nationwide Readmissions Database Analysis. Dis Colon Rectum 2020; 63:217.
54. Horgan AF, McConnell EJ, Wolff BG, et al. Atypical diverticular disease: surgical results. Dis Colon Rectum 2001; 44:1315.
55. Boostrom SY, Wolff BG, Cima RR, et al. Uncomplicated diverticulitis, more complicated than we thought. J Gastrointest Surg 2012; 16:1744.
56. Qaseem A, Etxeandia-Ikobaltzeta I, Lin JS, et al. Colonoscopy for Diagnostic Evaluation and Interventions to Prevent Recurrence After Acute Left-Sided Colonic Diverticulitis: A Clinical Guideline From the American College of Physicians. Ann Intern Med 2022; 175:416.

57. Balk EM, Adam GP, Cao W, et al. Evaluation and Management After Acute Left-Sided Colonic Diverticulitis : A Systematic Review. Ann Intern Med 2022; 175:388.
58. van Dijk ST, Daniels L, de Korte N, et al. Quality of Life and Persistent Symptoms After Uncomplicated Acute Diverticulitis. Dis Colon Rectum 2019; 62:608.
59. Rottier SJ, van Dijk ST, van Geloven AAW, et al. Meta-analysis of the role of colonoscopy after an episode of left-sided acute diverticulitis. Br J Surg 2019; 106:988.
60. Sharma PV, Eglinton T, Hider P, Frizelle F. Systematic review and meta-analysis of the role of routine colonic evaluation after radiologically confirmed acute diverticulitis. Ann Surg 2014; 259:263.
61. Tehranian S, Klinge M, Saul M, et al. Prevalence of colorectal cancer and advanced adenoma in patients with acute diverticulitis: implications for follow-up colonoscopy. Gastrointest Endosc 2020; 91:634.
62. Brar MS, Roxin G, Yaffe PB, et al. Colonoscopy following nonoperative management of uncomplicated diverticulitis may not be warranted. Dis Colon Rectum 2013; 56:1259.
63. Rose J, Parina RP, Faiz O, et al. Long-term Outcomes After Initial Presentation of Diverticulitis. Ann Surg 2015; 262:1046.
64. Devaraj B, Liu W, Tatum J, et al. Medically Treated Diverticular Abscess Associated With High Risk of Recurrence and Disease Complications. Dis Colon Rectum 2016; 59:208.
65. Young-Fadok TM. Diverticulitis. N Engl J Med 2018; 379:1635.
66. Bendl RF, Bergamaschi R. Do Patients Mandate Resection After a First Episode of Acute Diverticulitis of the Colon with a Complication? Adv Surg 2017; 51:179.
67. Biondo S, Trenti L, Elvira J, et al. Outcomes of colonic diverticulitis according to the reason of immunosuppression. Am J Surg 2016; 212:384.
68. Brandl A, Kratzer T, Kafka-Ritsch R, et al. Diverticulitis in immunosuppressed patients: A fatal outcome requiring a new approach? Can J Surg 2016; 59:254.
69. He S, Lu P, Etzioni D, et al. Management of Acute Diverticulitis in Immunocompromised Patients-The Mayo Clinic Experience. Dis Colon Rectum 2023; 66:434.
70. Al-Khamis A, Abou Khalil J, Demian M, et al. Sigmoid Colectomy for Acute Diverticulitis in Immunosuppressed vs Immunocompetent Patients: Outcomes From the ACS-NSQIP Database. Dis Colon Rectum 2016; 59:101.
71. McKechnie T, Lee Y, Kruse C, et al. Operative management of colonic diverticular disease in the setting of immunosuppression: A systematic review and meta-analysis. Am J Surg 2021; 221:72.

72. Mpofu S, Mpofu CM, Hutchinson D, et al. Steroids, non-steroidal anti-inflammatory drugs, and sigmoid diverticular abscess perforation in rheumatic conditions. Ann Rheum Dis 2004; 63:588.

73. Young-Fadok T, Sgambati S, Wolff B. Increased morbidity and mortality after colectomy in patients with lupus: A case-matched series (abstract). Dis Colon Rectum 2000; 43:A57.

74. Gahagan JV, Halabi WJ, Nguyen VQ, et al. Colorectal Surgery in Patients with HIV and AIDS: Trends and Outcomes over a 10-Year Period in the USA. J Gastrointest Surg 2016; 20:1239.

75. Strate LL, Keeley BR, Cao Y, et al. Western Dietary Pattern Increases, and Prudent Dietary Pattern Decreases, Risk of Incident Diverticulitis in a Prospective Cohort Study. Gastroenterology 2017; 152:1023.

76. Liu PH, Cao Y, Keeley BR, et al. Adherence to a Healthy Lifestyle is Associated With a Lower Risk of Diverticulitis among Men. Am J Gastroenterol 2017; 112:1868.

77. Aune D, Sen A, Norat T, Riboli E. Dietary fibre intake and the risk of diverticular disease: a systematic review and meta-analysis of prospective studies. Eur J Nutr 2020; 59:421.

78. Maconi G, Barbara G, Bosetti C, et al. Treatment of diverticular disease of the colon and prevention of acute diverticulitis: a systematic review. Dis Colon Rectum 2011; 54:1326.

79. Ünlü C, Daniels L, Vrouenraets BC, Boermeester MA. A systematic review of high-fibre dietary therapy in diverticular disease. Int J Colorectal Dis 2012; 27:419.

80. Aldoori WH, Giovannucci EL, Rockett HR, et al. A prospective study of dietary fiber types and symptomatic diverticular disease in men. J Nutr 1998; 128:714.

81. Aune D, Sen A, Leitzmann MF, et al. Tobacco smoking and the risk of diverticular disease - a systematic review and meta-analysis of prospective studies. Colorectal Dis 2017; 19:621.

82. Aune D, Sen A, Leitzmann MF, et al. Body mass index and physical activity and the risk of diverticular disease: a systematic review and meta-analysis of prospective studies. Eur J Nutr 2017; 56:2423.

83. Strate LL, Liu YL, Syngal S, et al. Nut, corn, and popcorn consumption and the incidence of diverticular disease. JAMA 2008; 300:907.

84. Stollman N, Magowan S, Shanahan F, et al. A randomized controlled study of mesalamine after acute diverticulitis: results of the DIVA trial. J Clin Gastroenterol 2013; 47:621.

85. Raskin JB, Kamm MA, Jamal MM, et al. Mesalamine did not prevent recurrent diverticulitis in phase 3 controlled trials. Gastroenterology 2014; 147:793.

86. Parente F, Bargiggia S, Prada A, et al. Intermittent treatment with mesalazine in the prevention of diverticulitis recurrence: a randomised multicentre pilot double-blind placebo-controlled study of 24-month duration. Int J Colorectal Dis 2013; 28:1423.

87. Kruis W, Kardalinos V, Eisenbach T, et al. Randomised clinical trial: mesalazine versus placebo in the prevention of diverticulitis recurrence. Aliment Pharmacol Ther 2017; 46:282.

88. Kruis W, Meier E, Schumacher M, et al. Randomised clinical trial: mesalazine (Salofalk granules) for uncomplicated diverticular disease of the colon--a placebo-controlled study. Aliment Pharmacol Ther 2013; 37:680.

89. Carter F, Alsayb M, Marshall JK, Yuan Y. Mesalamine (5-ASA) for the prevention of recurrent diverticulitis. Cochrane Database Syst Rev 2017; 10:CD009839.

90. Festa V, Spila Alegiani S, Chiesara F, et al. Retrospective comparison of long-term ten-day/month rifaximin or mesalazine in prevention of relapse in acute diverticulitis. Eur Rev Med Pharmacol Sci 2017; 21:1397.

91. Dughera L, Serra AM, Battaglia E, et al. Acute recurrent diverticulitis is prevented by oral administration of a polybacterial lysate suspension. Minerva Gastroenterol Dietol 2004; 50:149.

92. Hall JF, Roberts PL, Ricciardi R, et al. Long-term follow-up after an initial episode of diverticulitis: what are the predictors of recurrence? Dis Colon Rectum 2011; 54:283.

93. Binda GA, Arezzo A, Serventi A, et al. Multicentre observational study of the natural history of left-sided acute diverticulitis. Br J Surg 2012; 99:276.

94. Mäkelä JT, Kiviniemi HO, Laitinen ST. Spectrum of disease and outcome among patients with acute diverticulitis. Dig Surg 2010; 27:190.

95. El-Sayed C, Radley S, Mytton J, et al. Risk of Recurrent Disease and Surgery Following an Admission for Acute Diverticulitis. Dis Colon Rectum 2018; 61:382.

96. Li D, de Mestral C, Baxter NN, et al. Risk of readmission and emergency surgery following nonoperative management of colonic diverticulitis: a population-based analysis. Ann Surg 2014; 260:423.

97. Ritz JP, Lehmann KS, Frericks B, et al. Outcome of patients with acute sigmoid diverticulitis: multivariate analysis of risk factors for free perforation. Surgery 2011; 149:606.

98. Janes S, Meagher A, Frizelle FA. Elective surgery after acute diverticulitis. Br J Surg 2005; 92:133.

99. Chapman JR, Dozois EJ, Wolff BG, et al. Diverticulitis: a progressive disease? Do multiple recurrences predict less favorable outcomes? Ann Surg 2006; 243:876.

100. Klarenbeek BR, Samuels M, van der Wal MA, et al. Indications for elective sigmoid resection in diverticular disease. Ann Surg 2010; 251:670.

101. Thornblade LW, Simianu VV, Davidson GH, Flum DR. Elective Surgery for Diverticulitis and the Risk of Recurrence and Ostomy. Ann Surg 2021; 273:1157.

102. Colorectal Writing Group for the SCOAP-CERTAIN Collaborative. The impact of delaying elective resection of diverticulitis on laparoscopic conversion rate. Am J Surg 2015; 209:913.
103. Thaler K, Baig MK, Berho M, et al. Determinants of recurrence after sigmoid resection for uncomplicated diverticulitis. Dis Colon Rectum 2003; 46:385.
104. Choi KK, Martinolich J, Canete JJ, et al. Elective Laparoscopic Sigmoid Colectomy for Diverticulitis-an Updated Look at Recurrence After Surgery. J Gastrointest Surg 2020; 24:388.
105. Pautrat K, Bretagnol F, Huten N, de Calan L. Acute diverticulitis in very young patients: a frequent surgical management. Dis Colon Rectum 2007; 50:472.
106. Chautems RC, Ambrosetti P, Ludwig A, et al. Long-term follow-up after first acute episode of sigmoid diverticulitis: is surgery mandatory?: a prospective study of 118 patients. Dis Colon Rectum 2002; 45:962.
107. Broderick-Villa G, Burchette RJ, Collins JC, et al. Hospitalization for acute diverticulitis does not mandate routine elective colectomy. Arch Surg 2005; 140:576.
108. Hupfeld L, Burcharth J, Pommergaard HC, Rosenberg J. Risk factors for recurrence after acute colonic diverticulitis: a systematic review. Int J Colorectal Dis 2017; 32:611.
109. Ritz JP, Lehmann KS, Stroux A, et al. Sigmoid diverticulitis in young patients--a more aggressive disease than in older patients? J Gastrointest Surg 2011; 15:667.
110. Vignati PV, Welch JP, Cohen JL. Long-term management of diverticulitis in young patients. Dis Colon Rectum 1995; 38:627.
111. Imaeda H, Hibi T. The Burden of Diverticular Disease and Its Complications: West versus East. Inflamm Intest Dis 2018; 3:61.
112. Oh HK, Han EC, Ha HK, et al. Surgical management of colonic diverticular disease: discrepancy between right- and left-sided diseases. World J Gastroenterol 2014; 20:10115.
113. Lee YF, Tang DD, Patel SH, et al. Recurrence of Acute Right Colon Diverticulitis Following Nonoperative Management: A Systematic Review and Meta-analysis. Dis Colon Rectum 2020; 63:1466.
114. Ngoi SS, Chia J, Goh MY, et al. Surgical management of right colon diverticulitis. Dis Colon Rectum 1992; 35:799.
115. Sugihara K, Muto T, Morioka Y, et al. Diverticular disease of the colon in Japan. A review of 615 cases. Dis Colon Rectum 1984; 27:531.
116. Hildebrand P, Kropp M, Stellmacher F, et al. Surgery for right-sided colonic diverticulitis: results of a 10-year-observation period. Langenbecks Arch Surg 2007; 392:143.

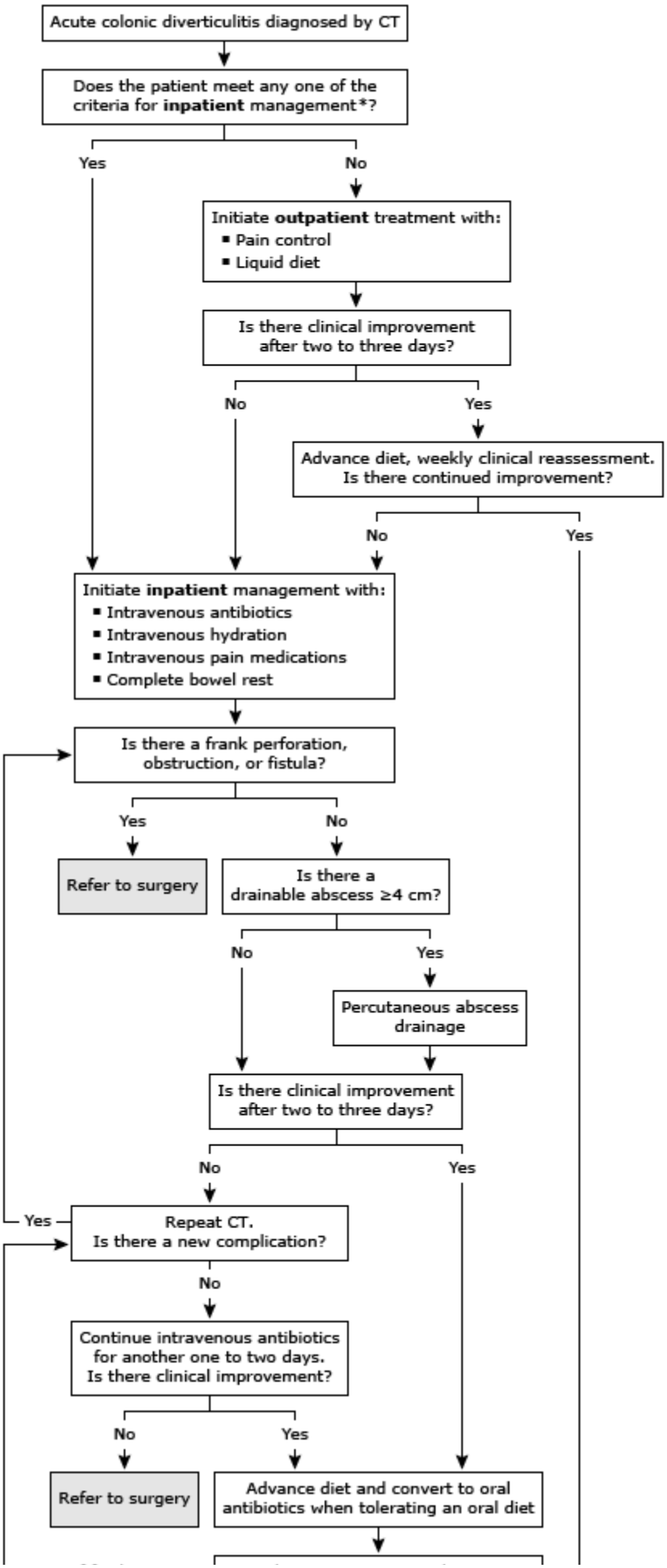
117. Monari F, Cervellera M, Pirrera B, et al. Right-sided acute diverticulitis: A single Western center experience. Int J Surg 2017; 44:128.

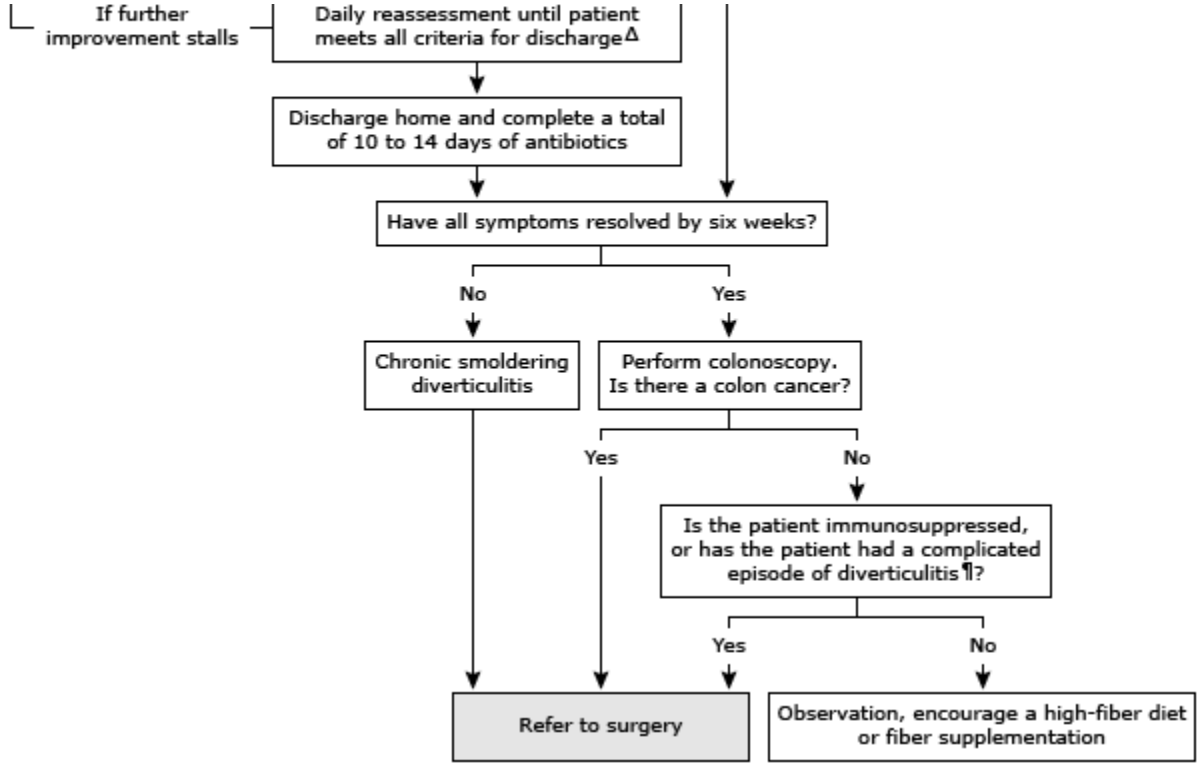
118. Luu LH, Vuong NL, Yen VTH, et al. Laparoscopic diverticulectomy versus non-operative treatment for uncomplicated right colonic diverticulitis. Surg Endosc 2020; 34:2019.

Topic 1380 Version 75.0

GRAPHICS

Management of acute colonic diverticulitis


Acute colonic diverticulitis diagnosed by CT
Does the patient meet any one of the criteria for **inpatient** management*?
Yes
No
Initiate **outpatient** treatment with:
▪ Pain control
▪ Liquid diet
Is there clinical improvement after two to three days?
No
Yes
Advance diet, weekly clinical reassessment. Is there continued improvement?
No
Yes
Initiate **inpatient** management with:
▪ Intravenous antibiotics
▪ Intravenous hydration
▪ Intravenous pain medications
▪ Complete bowel rest
Is there a frank perforation, obstruction, or fistula?
Yes
No
Refer to surgery
Is there a drainable abscess ≥4 cm?
No
Yes
Percutaneous abscess drainage
Is there clinical improvement after two to three days?
No
Yes
Yes
Repeat CT. Is there a new complication?
No
Continue intravenous antibiotics for another one to two days. Is there clinical improvement?
No
Yes
Refer to surgery
Advance diet and convert to oral antibiotics when tolerating an oral diet



CT: computed tomography.

* Criteria for inpatient management (only need to meet one):
- Complicated diverticulitis (refer to the ¶ footnote below)
- Sepsis or systemic inflammatory response syndrome (SIRS) evidenced by more than one of the following: Temperature >38° or <36° Celsius, heart rate >90 beats per minute (bpm), respiration rate >20 respirations per minute (rpm), white blood cell count >12,000/mL or <4000/mL, C-reactive protein >15 mg/dL
- Severe abdominal pain or diffuse peritonitis, and/or failure to reduce abdominal pain in the emergency department to <5 on a visual analog scale (VAS)
- Microperforation (eg, a few air bubbles outside of the colon without contrast extravasation or phlegmon)
- Age >70 years
- Significant comorbidities (eg, diabetes mellitus with organic involvement [eg, retinopathy, angiopathy, nephropathy], a recent cardiogenic event [eg, acute myocardial infarction, angina, heart failure], or recent decompensation of chronic liver disease [≥Child B] or end-stage renal disease)
- Immunosuppression (eg, poorly controlled diabetes mellitus, chronic high-dose corticosteroid use, use of other immunosuppressive agents, advanced human immunodeficiency virus [HIV] infection or acquired immunodeficiency syndrome [AIDS], B or T cell leukocyte deficiency, active cancer of hematologic malignancy, or organ transplant)
- Intolerance of oral intake secondary to bowel obstruction or ileus
- Noncompliance with care/unreliability for return visits/lack of support system
- Failure of outpatient treatment

¶ Complications of acute diverticulitis:
- Frank perforation

- Abscess (asymptomatic patients with a healed diverticular abscess may not need surgery due to a lower risk of complicated recurrence)
- Obstruction
- Fistulization

Δ Criteria for discharge (all must be met):

- Normalization of vital signs
- Resolution of severe abdominal pain
- Resolution of significant leukocytosis
- Tolerance of oral diet

Graphic 107989 Version 7.0

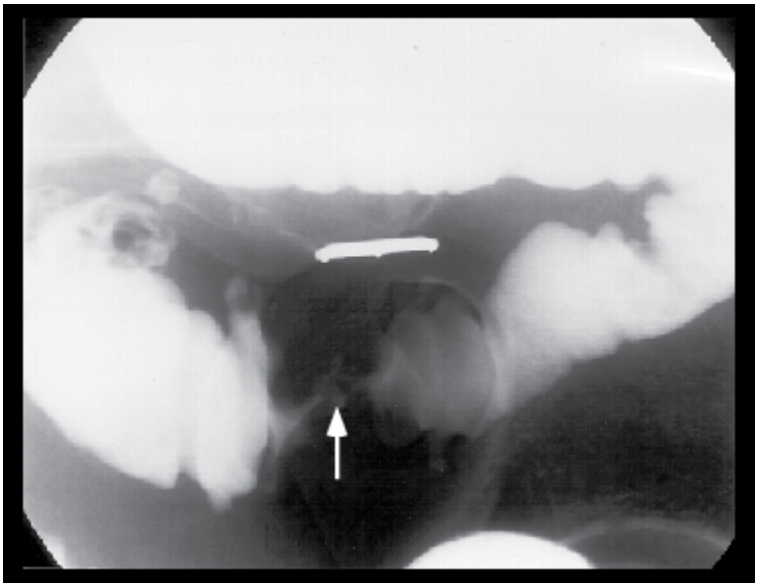
Indications for hospital admission for acute colonic diverticulitis

▪ Complicated diverticulitis (ie, frank perforation, abscess, obstruction, fistula)
▪ Sepsis or SIRS (>1 of temperature >38° or <36° Celsius, heart rate >90 beats per minute, respiration rate >20 respirations per minute, white blood cell count >12,000/mL or <4000/mL, C-reactive protein >15 mg/dL)
▪ Severe abdominal pain or diffuse peritonitis, and/or failure to reduce abdominal pain in the emergency department to <5 on a VAS
▪ Microperforation (eg, a few air bubbles outside of the colon without contrast extravasation or phlegmon)
▪ Age >70 years
▪ Significant comorbidities (eg, diabetes mellitus with organ involvement [eg, retinopathy, angiopathy, nephropathy], recent cardiogenic event [eg, acute myocardial infarction, angina, heart failure], or recent decompensation of chronic liver disease [≥ Child B] or end-stage kidney disease)
▪ Immunosuppression (eg, poorly controlled diabetes mellitus, chronic high-dose corticosteroid use, use of other immunosuppressive agents, advanced HIV infection or AIDS, B or T cell leukocyte deficiency, active cancer of hematologic malignancy, or organ transplant)
▪ Intolerance of oral intake secondary to bowel obstruction or ileus
▪ Nonadherence with care/unreliability for return visits/lack of support system
▪ Failure of outpatient treatment

SIRS: systemic inflammatory response syndrome; VAS: visual analog scale.

Graphic 130400 Version 2.0

Diverticular obstruction on hypaque enema



A hypaque enema in a 74-year-old woman with bloating and ribbon-like stools for several years reveals a persistent area of narrowing (arrow) in the mid-sigmoid colon measuring 2 cm in length. It is not possible to distinguish between a diverticular stricture and carcinoma radiographically; resection of the affected segment is mandatory.

Graphic 67258 Version 2.0

Empiric antibiotic regimens for low-risk community-acquired intra-abdominal infections in adults

	Dose
Single-agent regimen	
Piperacillin-tazobactam*	3.375 g IV every 6 hours
Combination regimen with metronidazole*	
One of the following:	
Cefazolin	1 to 2 g IV every 8 hours
or	
Cefuroxime	1.5 g IV every 8 hours
or	
Ceftriaxone	2 g IV once daily
or	
Cefotaxime	2 g IV every 8 hours
or	
Ciprofloxacin	400 mg IV every 12 hours or 500 mg PO every 12 hours
or	
Levofloxacin	750 mg IV or PO once daily
Plus:	
Metronidazole¶	500 mg IV or PO every 8 hours

For empiric therapy of low-risk community-acquired intra-abdominal infections, we cover streptococci, Enterobacteriaceae, and anaerobes. Low-risk community-acquired intra-abdominal infections are those that are of mild to moderate severity (including perforated appendix or appendiceal abscess) in the absence of risk factors for antibiotic resistance or treatment failure. Such risk factors include recent travel to areas of the world with high rates of antibiotics-resistant organisms, known colonization with such organisms, advanced age, immunocompromising conditions, or other major medical comorbidities. Refer to other UpToDate content on the antimicrobial treatment of intra-abdominal infections for further discussion of these risk factors.

The antibiotic doses listed are for adult patients with normal renal function. The duration of antibiotic therapy depends on the specific infection and whether the presumptive source of infection has been controlled; refer to other UpToDate content for details.

IV: intravenously; PO: orally.

* When piperacillin-tazobactam or one of the combination regimens in the table cannot be used, ertapenem (1 g IV once daily) is a reasonable alternative.

¶ For most uncomplicated biliary infections of mild to moderate severity, the addition of metronidazole is not necessary.

Graphic 106948 Version 13.0

Empiric antibiotic regimens for high-risk community-acquired intra-abdominal infections in adults

	Dose
Single-agent regimen	
Imipenem-cilastatin	500 mg IV every 6 hours
Meropenem	1 g IV every 8 hours
Doripenem	500 mg IV every 8 hours
Piperacillin-tazobactam	4.5 g IV every 6 hours
Combination regimen with metronidazole	
ONE of the following:	
Cefepime	2 g IV every 8 hours
OR	
Ceftazidime	2 g IV every 8 hours
PLUS:	
Metronidazole	500 mg IV or orally every 8 hours

High-risk community-acquired intra-abdominal infections are those that are severe or in patients at high risk for adverse outcomes or antimicrobial resistance. These include patients with recent travel to areas of the world with high rates of antibiotics-resistant organisms, known colonization with such organisms, advanced age, immunocompromising conditions, or other major medical comorbidities. Refer to the UpToDate topic on the antimicrobial treatment of intra-abdominal infections for further discussion of these risk factors.

For empiric therapy of high-risk community-acquired intra-abdominal infections, we cover streptococci, Enterobacteriaceae resistant to third-generation cephalosporins, *Pseudomonas aeruginosa*, and anaerobes. Empiric antifungal therapy is usually not warranted but is reasonable for critically ill patients with an upper gastrointestinal source.

Local rates of resistance should inform antibiotic selection (ie, agents for which there is >10% resistance among Enterobacteriaceae should be avoided). If the patient is at risk for infection with an extended-spectrum beta-lactamase (ESBL)-producing organism (eg, known colonization or prior infection with an ESBL-producing organism), a carbapenem should be chosen. When beta-lactams or carbapenems are chosen for patients who are critically ill or are at high risk of infection with drug-resistant pathogens, we favor a prolonged infusion dosing strategy. Refer to other UpToDate content on prolonged infusions of beta-lactam antibiotics.

The combination of vancomycin, aztreonam, and metronidazole is an alternative for those who cannot use other beta-lactams or carbapenems (eg, because of severe reactions).

The antibiotic doses listed are for adult patients with normal renal function. The duration of antibiotic therapy depends on the specific infection and whether the presumptive source of infection

has been controlled; refer to other UpToDate content for details.

IV: intravenous.

Graphic 106949 Version 12.0

Empiric antibiotic regimens for health care-associated intra-abdominal infections in adults

	Dose
Single-agent regimen	
Imipenem-cilastatin	500 mg IV every 6 hours
Meropenem	1 g IV every 8 hours
Doripenem	500 mg IV every 8 hours
Piperacillin-tazobactam	4.5 g IV every 6 hours
Combination regimen	
ONE of the following:	
Cefepime	2 g IV every 8 hours
OR	
Ceftazidime	2 g IV every 8 hours
PLUS:	
Metronidazole	500 mg IV or orally every 8 hours
PLUS ONE of the following (in some cases*):	
Ampicillin	2 g IV every 4 hours
OR	
Vancomycin	15 to 20 mg/kg IV every 8 to 12 hours

For empiric therapy of health care-associated intra-abdominal infections, we cover streptococci, enterococci, Enterobacteriaceae that are resistant to third-generation cephalosporins and fluoroquinolones, *Pseudomonas aeruginosa*, and anaerobes. We include coverage against methicillin-resistant *Staphylococcus aureus* (MRSA) with vancomycin in those who are known to be colonized, those with prior treatment failure, and those with significant prior antibiotic exposure. Empiric antifungal coverage is appropriate for patients at risk for infection with *Candida* spp, including those with upper gastrointestinal perforations, recurrent bowel perforations, surgically treated pancreatitis, heavy colonization with *Candida* spp, and/or yeast identified on Gram stain of samples from infected peritoneal fluid or tissue. Refer to other UpToDate content on treatment of invasive candidiasis.

If the patient is at risk for infection with an extended-spectrum beta-lactamase (ESBL)-producing organism (eg, known colonization or prior infection with an ESBL-producing organism), a carbapenem should be chosen. For patients who are known to be colonized with highly resistant gram-negative bacteria, the addition of an aminoglycoside, polymyxin, or novel beta-lactam combination (ceftolozane-tazobactam or ceftazidime-avibactam) to an empiric regimen may be warranted. In such cases, consultation with an expert in infectious diseases is advised.

When beta-lactams or carbapenems are chosen for patients who are critically ill or are at high risk of infection with drug-resistant pathogens, we favor a prolonged infusion dosing strategy. Refer to other UpToDate content on prolonged infusions of beta-lactam antibiotics.

The combination of vancomycin, aztreonam, and metronidazole is an alternative for those who cannot use other beta-lactams or carbapenems (eg, because of severe reactions).

The antibiotic doses listed are for adult patients with normal kidney function. The duration of antibiotic therapy depends on the specific infection and whether the presumptive source of infection has been controlled; refer to other UpToDate content for details.

IV: intravenous.

* We add ampicillin or vancomycin to a cephalosporin-based regimen to provide enterococcal coverage, particularly in those with postoperative infection, prior use of antibiotics that select for *Enterococcus*, immunocompromising condition, valvular heart disease, or prosthetic intravascular materials. Coverage against vancomycin-resistant enterococci (VRE) is generally not recommended, although it is reasonable in patients who have a history of VRE colonization or in liver transplant recipients who have an infection of hepatobiliary source.

Graphic 106950 Version 12.0

Oral antibiotics for acute colonic diverticulitis in adults

Ciprofloxacin (500 mg every 12 hours) **plus** metronidazole (500 mg every 8 hours)
Levofloxacin (750 mg once daily) **plus** metronidazole (500 mg every 8 hours)
Trimethoprim-sulfamethoxazole (1 double-strength tablet [contains sulfamethoxazole 800 mg and trimethoprim 160 mg] every 12 hours) **plus** metronidazole (500 mg every 8 hours)
Amoxicillin-clavulanate (1 tablet [contains 875 mg amoxicillin and 125 mg clavulanic acid] every 8 hours) **or** amoxicillin-clavulanate extended-release (2 tablets [each tablet contains 1 g amoxicillin and 62.5 mg clavulanic acid] every 12 hours)
Moxifloxacin (400 mg once daily) for use in patients intolerant of both metronidazole and beta-lactam agents

- The local antibiogram should be consulted to avoid prescribing a regimen to which bacterial resistance exceeds 10%.
- Doses may need to be adjusted for kidney impairment or other factors; refer to Lexicomp drug monographs included within UpToDate for additional detail.
- The total duration of treatment is 10 to 14 days (inclusive of both IV, if any, and oral antibiotics).

Graphic 134487 Version 3.0

Contributor Disclosures

John H Pemberton, MD No relevant financial relationship(s) with ineligible companies to disclose. **Martin Weiser, MD** Consultant/Advisory Boards: PrecisCa [Gastrointestinal surgical oncology]. All of the relevant financial relationships listed have been mitigated. **Krishnan Raghavendran, MD, FACS** No relevant financial relationship(s) with ineligible companies to disclose. **Wenliang Chen, MD, PhD** No relevant financial relationship(s) with ineligible companies to disclose.

Contributor disclosures are reviewed for conflicts of interest by the editorial group. When found, these are addressed by vetting through a multi-level review process, and through requirements for references to be provided to support the content. Appropriately referenced content is required of all authors and must conform to UpToDate standards of evidence.

Conflict of interest policy

→