Appendicitis, Diverticulitis, and Colitis

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- Appendicitis • Diverticulitis • Colitis
- Inflammatory bowel disease • Clostridium difficile
- Emergency medicine

APPENDICITIS

Overview and Epidemiology

Appendicitis is the most common cause of abdominal pain requiring surgical intervention. The lifetime risk of appendicitis is approximately 7%, with a current incidence of 86 per 100,000 patients per year. Rates of appendicitis are highest in the second decade of life, with a slightly higher incidence of appendicitis occurring in males (ratio 1.4:1). Appendiceal perforation rates also vary; patients at extremes of age are more likely to have perforated at their time of diagnosis. Early diagnosis of appendicitis is paramount, because patient morbidity is increased once appendicitis becomes complicated by abscess and perforation.

Pathophysiology

The appendix is located on the posteromedial surface of the cecum, approximately 3 cm from the ileocecal valve. Its length varies from 8 to 13 cm, and its anatomic location within the abdomen is variable. Although the appendix has no known function, recent studies propose that it acts as a reservoir for commensal bacteria in the colon.

Appendicitis occurs when the appendiceal lumen becomes obstructed by fecaliths, adhesions, enlarged lymph nodes, foreign bodies, parasites, or, less commonly, tumors. Once obstruction occurs, the intraluminal pressure within the appendix begins to increase as mucosal secretions accumulate, leading to appendiceal distension. This distension in turn stimulates visceral afferent nerves that enter the spinal cord at the T8 to T10 level, causing dull epigastric or periumbilical pain. As obstruction continues, pressures within the appendix impede venous and lymphatic drainage, allowing bacteria and neutrophils to invade the walls of the appendix. More localized
pain occurs after continued inflammation within the appendiceal serosa causes irritation of local somatic fibers on the parietal peritoneum. If this process remains unchecked, the appendix becomes gangrenous and is at risk for perforation, abscess formation, and peritonitis, often within 24 to 36 hours of symptom onset.7

**Clinical Presentation**

Classically, a patient with appendicitis presents with constant pain that is poorly localized to the periumbilical or epigastric region, and is accompanied by anorexia, nausea, and vomiting. Vomiting usually begins after the abdominal pain. Illness progression leads to migration of pain to the right lower quadrant at the area of the McBurney point, and can be accompanied by low-grade fever. A meta-analysis evaluating patients with abdominal pain reported an increased likelihood of appendicitis when the patient’s pain was located in the right lower quadrant, had migrated from the periumbilical region, and had been accompanied by fever.8

However, this classic clinical presentation is not always present, partly because of the variability of the appendiceal location within the abdomen. For example, the appendix may lie in a retrocecal, retroiliac, or pelvic location, leading to pain in the right flank, pelvis, testicle, suprapubic region, or even left lower quadrant if the appendix crosses the midline. Likewise, patients may experience dysuria, urinary frequency, diarrhea, or tenesmus depending on the location of the inflamed appendix. These varied positions of the appendix and their associated complaints can delay the early diagnosis of appendicitis and increase the risk of gangrene and perforation.9

Multiple physical examination findings exist to aid in the diagnosis of appendicitis. Pain with palpation is classically found at the McBurney point, located “exactly between an inch and a half and two inches from the anterior spinous process of the ileum on a straight line drawn from that process to the umbilicus.”10 A positive Rovsing sign is present when palpation of the left lower quadrant elicits tenderness in the right lower quadrant. Patients may also show rebound tenderness or guarding, which are responses to the inflamed parietal peritoneum, and, when present, have been found to be independent predictors of appendicitis.11

Additional signs can aid in the physical diagnosis. The psoas sign is performed either by having the patient flex at the right hip against resistance, or by extending the hip with the patient in the left lateral decubitus position, thereby irritating the iliopsoas muscle. A positive obturator sign is present when internal rotation of the flexed right hip with the knee in flexion exacerbates the patient’s pain. A rectal examination is often performed, although the sensitivity and specificity of rectal tenderness for appendicitis are weak.8

Temperature is either normal or slightly increased early in the course of appendicitis. Patients may develop fever as the disease state progresses toward perforation and abscess formation. Therefore, temperature increase alone cannot rule in the diagnosis of appendicitis, but the presence of a fever, when taken in concert with other history and physical examination findings, such as migration of pain, can make the diagnosis more likely.8

**Special populations**

**Pregnancy** In theory, the gravid uterus can displace the inflamed appendix cephalad and lead to right upper quadrant or right flank discomfort. However, most pregnant women with appendicitis present with right lower quadrant pain, regardless of their stage of pregnancy.12,13 There is a slightly higher incidence of appendicitis in the second trimester compared with the first and third.14 Although pregnant women are not at increased risk for appendicitis compared with nongravid controls, appendicitis
is the most common nonobstetric surgical emergency in pregnancy. Early recognition in the pregnant patient with appendicitis is important because complications such as peritonitis or abscess formation can affect fetal outcomes. Studies have shown high rates of fetal loss in both uncomplicated and complicated appendicitis (15% and 37%, respectively). Pregnant women are also at risk of early delivery, with some series showing rates reaching 45%, although recent data show improvement in these outcomes.15,16

**Children**  Young children and the aged are also at risk for delayed diagnosis of appendicitis and its complications, and therefore a high index of suspicion is necessary when evaluating these populations. Studies have found pediatric patients to be initially misdiagnosed with gastroenteritis, urinary tract infection, otitis media, or respiratory infections, ultimately increasing perforation rates (approximately 70%–80%) and hospital lengths of stay.17–19

**Elderly**  Likewise, elderly patients tend to have a delay between symptom onset and treatment of appendicitis. This delay leads to increased rates of perforation. Mortality from appendicitis in the aged increases to 4% from 0.1% for younger patients, and is particularly high in those greater than 70 years of age (32%). Reasons for delay in diagnosing this population include misdiagnosis and atypical patient presentation,20,21 although more recent data show early computed tomography (CT) scanning and laparoscopy are improving outcomes.22

**Immunocompromise**  Immunocompromised patients, such as those with acquired immune deficiency syndrome (AIDS), are also at risk for complications from appendicitis, partly because of the similar symptoms that opportunistic infections can cause in this population. Although patients with AIDS have been found to present with typical symptoms of appendicitis, these symptoms may be misattributed to opportunistic infections or other AIDS complications. However, patients with AIDS are more likely than those without the disease to be perforated at the time of surgical intervention.23 Recent retrospective data suggest that antiretroviral therapy may play a protective role in the development of appendicitis in patients with AIDS.24

**Diagnosis**  Appendicitis should be considered in the differential diagnosis for all patients presenting with epigastric, periumbilical, or right-sided abdominal or flank pain. Although no single test is specific for appendicitis, some laboratory data may aid in the diagnosis. A urinary pregnancy test should be performed in all women of childbearing age, and pelvic examination should be performed in addition to the abdominal examination. Some women may have adnexal tenderness with inflamed pelvic appendices. A urinalysis should be performed as well, although it is important to keep in mind that hematuria or pyuria can be present in appendicitis if the inflamed appendix is in close proximity to the bladder or ureter.

**Laboratory**  The clinical usefulness of a white blood cell (WBC) count with differential remains uncertain. In one recent series, an increased WBC count of greater than 10,000 cells/mm³ had a sensitivity of 76% and specificity of 52%.25 This is similar to other data showing that leukocytosis alone is a poor predictor of appendicitis and does not distinguish between simple versus complicated cases.26 The inflammatory marker C-reactive protein (CRP) has been shown to have both a low sensitivity and low specificity when used alone in appendicitis evaluation.27,28 However, the combination of
leukocytosis, leftward shift, and increased CRP may be more useful than each test alone in the diagnosis of appendicitis. A recent meta-analysis showed an increased likelihood of appendicitis when 2 or more of these studies were increased and a decreased likelihood when all 3 were within normal limits. Therefore, laboratory testing should be seen as an adjunct to other elements of the history and physical examination when appendicitis is suspected, but cannot definitively make the diagnosis.

**Imaging**

Multiple imaging studies in the evaluation of appendicitis exist, although the usefulness of each study can vary. Plain films are seldom used in the diagnosis of appendicitis; however, they can help rule out other causes of abdominal pain (volvulus, intussusception, or nephrolithiasis) and may be performed rapidly at the bedside. Signs suggestive of appendicitis on radiograph include localized paralytic ileus, gas or fecalith in the appendix, blurring in the area of the right psoas muscle, and free air, although no sign is sensitive or specific in making the diagnosis, which limits the value of plain film in this disease.

**Ultrasound**

Ultrasound can be a useful test in the evaluation of appendicitis, particularly in children and pregnant women in whom there are particular concerns regarding ionizing radiation. The sensitivity of graded compression ultrasonography is as high as 98% (although these numbers vary widely between studies) and is considered positive for appendicitis when the diameter of the appendix is greater than 6 to 7 mm (Fig. 1). Inflammation surrounding the appendix, appendicoliths, or hyperemia of the appendiceal wall can also be visualized by ultrasound in the setting of acute appendicitis. False negatives can occur once the appendix has perforated, thus reducing the diameter of the appendix, or when the appendix is retrocecal or inflammation is confined to the tip of the appendix. Another challenge in using ultrasound is that the appendix cannot always be visualized. Even using skilled sonographers, the appendix is not visualized between 25% and 35% of the time, which can be partly caused by patient’s body habitus or bowel gas overlying the appendix. The negative predictive value of a nonvisualized appendix on ultrasound is 90%. Thus, although a positive ultrasound is diagnostic of appendicitis, a negative ultrasound in which the appendix is not seen cannot rule out the diagnosis of acute appendicitis, and other diagnostic tools should be used.

**CT**

CT has become widely used in the evaluation of suspected appendicitis. Advantages include its widespread availability as well as its capacity to detect other abdominal disorders. Disadvantages include patient radiation exposure, time delay to diagnosis if oral contrast is used, and risk of contrast-induced nephropathy or contrast reaction when intravenous contrast is used. Some investigators consider increased cost to be a disadvantage of this imaging modality, but data have suggested a decrease in the rates of unnecessary appendectomy since CT scan use has increased. Findings suggestive of acute appendicitis on CT scan include an enlarged appendix with diameter greater than 6 mm, appendiceal wall thickening, and pericecal inflammation (Fig. 2). An appendicolith alone is not sufficient to make a radiographic diagnosis of appendicitis. Some controversy exists about the use of contrast in the evaluation of appendicitis on CT. The sensitivity (83%–97%) and specificity (93%–98%) of CT in acute appendicitis vary with the presence or absence of contrast, as well as type of contrast used.

Fig. 2. Appendicitis. A CT scan shows an edematous appendix with a diameter greater than 1 cm (arrow), consistent with acute, uncomplicated appendicitis. (From Prather C. Inflammatory and anatomic diseases of the intestine, peritoneum, mesentery, and omentum. In: Goldman L, Ausiello DA, eds. Cecil medicine. 23rd edition. Philadelphia: Saunders, 2007; with permission.)
A recent review article found the sensitivity and negative predictive value of CT without oral contrast to be equal to that of CT with oral contrast; the specificity, accuracy, and positive predictive value of CT without oral contrast was superior to that of CT with oral contrast in this analysis. The implication of this review may have important ramifications on emergency department (ED) length of stay and may decrease time until surgical intervention for patients. Other studies have shown the sensitivity of noncontrast scans to be greatly inferior to those using contrast.

Another promising option uses rectal contrast only. In a series of 100 patients, CT with rectal contrast had a sensitivity, specificity, positive and negative predictive values, and accuracy of 98% in diagnosing acute appendicitis. More recent prospective data have shown more modest outcomes for this modality, but imply that rectal contrast studies can be useful in the evaluation of acute appendicitis. Perhaps the best approach to the use of contrast in patients suspected of having appendicitis should take into account the breadth of the differential diagnosis. Oral and intravenous contrast may help better delineate other causes of abdominal pain (particularly in young women) and should be considered when the diagnosis of appendicitis is uncertain. Establishing an institutional protocol with respect to contrast administration may also aid in the decision of whether contrast should be used, and by what route.

Magnetic resonance imaging
Magnetic resonance imaging (MRI) may also have a limited role in the work-up of appendicitis. Unlike CT, MRI does not expose patients to ionizing radiation. It is therefore considered safe in pregnancy. Gadolinium crosses the placenta and should therefore be avoided, particularly in the first trimester. Disadvantages include limited availability, high cost, and lengthy scan times. If obtainable, MRI may be a good second-line imaging study when a pregnant patient has an indeterminate ultrasound.

Clinical scoring
Several scoring systems have been developed in an attempt to assist in the diagnosis of acute appendicitis. The most often cited is the MANTRES system, which has a mnemonic that uses 8 different variables on a total 10-point scale. These variables include migration of pain, anorexia, nausea or vomiting, tenderness in the right lower quadrant, rebound tenderness, elevation of temperature, leukocytosis, and leftward shift. The score may aid clinicians in deciding which patients can be observed and which require operative intervention. It has also been shown to be helpful in discriminating between patients who require imaging for suspected appendicitis and those who may be discharged without imaging.

Treatment
Patients with appendicitis should receive intravenous hydration, symptomatic relief, and antibiotics. Electrolyte imbalances should be corrected and crystalloids administered for patients with dehydration or sepsis. Antiemetics should be considered in patients with vomiting. Narcotic pain medication can be administered to maximize patient comfort.

A recent review article confirms that antibiotics can prevent postoperative wound infection in uncomplicated appendicitis and minimize abscess formation in cases of perforation. Antibiotic therapy should include coverage for enteric gram-negative organisms as well as anaerobes, and should be considered in conjunction with the consulting surgeon. Possible regimens include a second-generation or third-generation cephalosporin for uncomplicated cases. In the event of abscess formation or perforation, broader-spectrum coverage with a medication
such as piperacillin-tazobactam or a 3-drug regimen including a cephalosporin and aminoglycoside along with metronidazole is warranted.

A study investigating antibiotic and medical management versus appendectomy showed that, although most patients improved in the short term with medical management, greater than one-third of patients required surgery for recurrent appendicitis within a year. Therefore, operative intervention remains the definitive treatment of acute appendicitis, and early surgical consultation is necessary. In cases of abscess formation at time of presentation, surgeons may opt for initial percutaneous abscess drainage initially, followed by interval appendectomy.

DIVERTICULITIS

Overview and Epidemiology

Diverticular disease is commonly seen in the adult population. The overall prevalence of diverticulosis has been reported to be roughly 27% and increases with advancing age. Of those patients with symptoms from diverticular disease, 3% are less than 40 years of age, whereas each decade between the ages of 50 and 70 years accounts for approximately 25% to 30% of cases. The prevalence is much higher in developed countries, and is believed to be partly the result of physical inactivity and a low-fiber diet. Symptomatic disease, including diverticular pain and diverticulitis, occurs in roughly 10% to 25% of patients with diverticulosis.

Pathophysiology

Diverticula are small outpouchings or herniations that form at areas of weakness in the wall of the colon. In general, they are located at the vulnerable areas in which the vasa recta enters the muscularis. Except for diverticula of the cecum, which comprise all 3 layers of the colonic wall, most acquired diverticula contain mucosa and submucosa only. Diverticular disease affects the left-sided and sigmoid colon more than 90% of the time. Although many causes of diverticulosis have been proposed, the exact cause of the condition is not known. Problems of colonic motility and muscular abnormalities of the colon wall are possible causes. Another hypothesis is that diverticulosis is a disorder arising from increased intraluminal pressure. Although diverticulosis is largely an asymptomatic condition, these areas can perforate and become inflamed, leading to diverticulitis.

Patients can have either complicated or uncomplicated episodes of diverticulitis, which has ramifications for treatment as well as patient morbidity. Complicated cases are those in which there is perforation, obstruction, abscess, or fistula formation.

Clinical Presentation

Patients with diverticulitis typically present with constant left lower quadrant or suprapubic pain. Patients may also complain of fever, malaise, constipation, diarrhea, tenesmus, and urinary symptoms if the bladder becomes irritated by the inflamed colon. On examination, patients typically have left lower-quadrant tenderness, which may be accompanied by localized guarding or rebound. At times, a palpable abdominal mass caused by an underlying abscess may be appreciated.

Patients with acute diverticulitis may also present with right-sided abdominal symptoms. This possibility applies particularly to Asian and younger patients, who are more likely to have proximal colonic disease. In addition, redundant sigmoid colon may be present on the right side of the abdomen, leading to right-sided symptoms in patients with distal colonic disease.

A high index of suspicion is necessary when evaluating patients who are elderly or immunocompromised. These groups may present with less-impressive symptoms.
and physical examination findings. As a result, they are more likely to have perforation at the time of diagnosis.56,57

Patients may also complain of symptoms related to fistula formation, which may occur between the bowel and bladder, leading to pneumaturia or fecaluria, or between the bowel and vagina, with women complaining of a feculent vaginal discharge. In addition, enterocolonic fistulas may occur and lead to copious diarrhea.

**Diagnosis**

Patients with acute diverticulitis often have an increased WBC count and may also have a leftward shift. Other laboratory abnormalities may be present in patients with vomiting and diarrhea or in those with more advanced sepsis.

Imaging options are available when the diagnosis of diverticulitis is uncertain, or if suspicion exists for complications of diverticular disease. Contrast enema has typically been considered the gold standard in diagnosis, although it is falling out of favor as a first-line study. Although contrast enema is able to diagnose diverticulitis, it is unable to assess for the presence of an abscess and cannot determine the severity of inflammation.58 Thickened colonic folds, contrast extravasation, and localized mass effect may be seen on contrast radiography.59 Fistula formation may also be evident. The use of non-water-soluble contrast material in colonic contrast studies can also lead to problems associated with intraperitoneal barium when perforation is present, and should therefore be avoided in patients with signs of local peritonitis on examination. If this type of imaging is used, it is best to use water-soluble contrast.

CT is the study most used for the diagnosis of diverticulitis. CT with both oral and intravenous contrast has the advantage of being able to evaluate the colonic walls as well as extraluminal areas, in addition to being able to assess for other causes of abdominal pain. The sensitivity of CT for diagnosis of diverticulitis ranges from 85% to 97%.60 Positive findings of diverticulitis include thickening of the bowel wall and fascia, pericolic fat stranding, and local abscess formation (Fig. 3).61

Ultrasound also has a role in the radiologic evaluation of diverticulitis. Findings compatible with the disease include a thickened colon wall with protrusions consistent with diverticula. Pericolic inflammation may also be evident. Although the sensitivity of ultrasound in diverticulitis is modest (91%), its specificity was almost 100% in a study evaluating patients with right-sided abdominal pain.62 As with the use of ultrasound for other diseases, its accuracy is highly operator dependent.

![Fig. 3. CT scan of a patient with acute diverticulitis showing colon wall thickening, a mass adjacent to the sigmoid, and stranding of the fat. (From Brandt LJ, Feuerstat P. Intestinal ischemia. In: Feldman M, Friedman LS, Brandt LJ, eds. Sleisenger & Fordtran's gastrointestinal and liver disease. 8th edition. Philadelphia: Saunders, 2010; with permission.)](image)
Treatment

The treatment of diverticulitis is largely dependent on the severity of illness and overall health status of the patient. Young immunocompetent patients with uncomplicated diverticulitis may be managed as outpatients with oral antibiotics. Regimens should cover both gram-negative aerobes and anaerobes, and include a combination of ciprofloxacin and metronidazole, trimethoprim-sulfamethoxazole and metronidazole, or amoxicillin-clavulanic acid alone. Patients should be instructed to follow a liquid diet with advancement to solids as tolerated after 2 to 3 days. These patients should receive prompt follow-up to assess for response to treatment, and may require hospitalization if symptoms do not improve. Surgical referral should be given to those patients experiencing a recurrence of diverticulitis. In addition, it is generally recommended that patients presenting with a first episode of diverticulitis undergo a colonoscopy about 6 weeks after the resolution of symptoms to evaluate for neoplasm and other diseases of the colon.

Patients who have failed outpatient treatment, who require intravenous analgesia, the elderly or immunocompromised, and those with complications of diverticulitis should be hospitalized. Antibiotic options include intravenous ciprofloxacin and metronidazole, or single-drug regimens of β-lactamase inhibitor combinations such as ampicillin-sulbactam or ticarcillin-clavulanate. Severe infections may necessitate the use of imipenem alone or the use of gentamicin or ciprofloxacin in combination with ampicillin and metronidazole. These patients warrant urgent surgical evaluation to determine the need for CT-guided percutaneous drainage or surgical resection.63

In general, between 15% and 30% of patients presenting with acute diverticulitis require operative intervention. An equal number have recurrences of their disease.64,65

Colitis

Inflammatory Bowel Disease

Overview and epidemiology

The term inflammatory bowel disease (IBD) refers to 2 types of chronic intestinal disorders, Crohn disease (CD) and ulcerative colitis (UC). These diseases differ in their pathophysiology, but are similar in their clinical presentation. Both diseases are characterized by a relapsing and remitting course of alimentary tract inflammation, and both diseases require intensive chronic medical management during both exacerbations and periods of remission.

IBD has a peak onset between 15 and 30 years of age, with a second small peak later in life that is more consistently seen with UC than with CD.66 IBD affects more than 1 million Americans, with CD and UC represented roughly equally. Worldwide, IBD prevalence varies with geographic location, with higher rates occurring in more industrialized countries and lower rates occurring in Asia, Africa, and South America. IBD is more common among the Jewish population, and studies have shown higher rates in white people than African Americans and Asians.67

Pathophysiology

Although the exact cause of IBD remains unknown, a complex interplay of multiple factors likely contributes to the development of these diseases. At present, the best evidence points to an inflammatory response to intestinal microbes occurring in a host who is genetically susceptible to IBD.68 Numerous environmental factors have also been shown to affect IBD. Cigarette smoking lowers the risk of UC for current smokers, but the risk for those who stop smoking is higher than for those who never smoked.69 Conversely, smoking doubles the risk of Crohn disease.70
Diet, oral contraceptives, and nonsteroidal antiinflammatory agents have also been shown to influence IBD. The role of genetics in IBD is supported by twin studies that show a definite genetic predisposition that is stronger in CD than in UC. It is thought that microbes also play a role, with inflammation believed to be the result of a dysfunctional response to infection. However, no particular bacterium has been identified in studies as the pathogenic cause of IBD. The immune system clearly plays a significant role in IBD, and many agents used for the treatment of disease are immunosuppressive or specifically target certain aspects of immune system dysregulation.

Crohn disease is characterized by involvement of any part of the gastrointestinal tract, but most frequently involves the distal small intestine and colon. The inflammation is transmural, sometimes leading to the development of fistulas, abscesses, or strictures. The mucosa often assumes a cobblestone appearance, and granulomatous disease is commonly present. The lesions may be discontinuous (skip lesions), which may help to distinguish between forms of IBD. Perianal involvement, with fistula formation and perianal abscess formation, is common in CD.

UC leads to inflammation of the mucosa and submucosa of the colon. Transmural involvement is rare, leading to little, if any, perianal disease or fistula formation. UC generally appears as a continuous lesion confined to the colon, and the absence of skip lesions can help distinguish this disease from CD. Rectal involvement is the rule, with inflammation extending a variable distance into the colon. The inflammation of UC often takes the appearance of ulceration, and cobblestoning of the mucosa is rare.

Clinical presentation

Patients with IBD typically present with diarrhea and varying amounts of crampy abdominal pain. Diarrhea in UC may be bloody and is typically frequent and small in volume. Tenesmus or fecal incontinence may also occur. These diarrheal features are also typical of CD with colonic involvement. However, in CD limited to the small intestine, stools may be less frequent and larger in volume, and tenesmus is absent. Vomiting may be present, and, if significant, should lead to the consideration of bowel obstruction.

Abdominal pain and tenderness in IBD are variable based on the anatomic location of disease. Tenderness may be isolated to the rectum or the left lower quadrant, as is often the case in UC. In other cases, it may be localized to the right lower quadrant, such as in patients with ileal CD. Pain and tenderness may be diffuse in patients with significant areas of bowel involvement. Thickened bowel loops or an abscess may lead to a palpable mass and tenderness at the affected location. Patients may present with frank peritonitis if bowel perforation has occurred.

Patients with CD are prone to fistula and abscess formation because of the transmural nature of disease. The location of fistula and abscess formation correlates with the location of disease. Patients with isolated small intestine involvement are more prone to internal fistula formation, whereas perianal disease presents more commonly in patients with ileocolic disease.

Patients with IBD may present with systemic complaints, such as fever, fatigue, and weight loss. Often, symptoms are gradually progressive and, more frequently in CD, may be intermittently present for a long period of time before diagnosis. Some degree of dehydration and malnutrition may also be present.

In most cases, the severity of IBD flares can be classified as mild, moderate, or severe. Mild flares are classified as having no systemic toxicity, fewer than 4 bowel movements per day with little or no blood, and an erythrocyte sedimentation rate (ESR) of less than 20 mm/h. Severe flares are classified as having systemic toxicity, 6 or more bowel
movements per day with blood, and ESR greater than 30 mm/h. Moderate flares have symptoms that are between the criteria for mild and severe. Some patients may present with serious complications of IBD (see Serious Complications of IBD).

**Diagnosis**

Many patients present to the ED with a known diagnosis of IBD. It has previously been shown that compliance with maintenance therapy reduces the risk of acute attacks, and thus patients should be queried as to medication compliance.

No specific testing routinely available in the ED can reliably diagnose IBD, and endoscopy with biopsy is generally necessary to confirm the diagnosis. Patients presenting with IBD may be anemic because of chronic disease or bloody stools. Electrolyte abnormalities may occur because of significant diarrhea or vomiting or because of malabsorption. Nonspecific markers of inflammation, such as the ESR or CRP, are frequently increased.

Plain radiography may be useful in cases in which bowel obstruction, perforation, or toxic megacolon (see Serious Complications of IBD) are suspected. However, in most IBD cases presenting to the ED, plain radiography is unlikely to be of benefit. CT may be helpful to identify extraluminal complications such as nephrolithiasis, abscess, obstruction, or perforation, but severity of disease does not otherwise correlate well with radiographic findings.

**Treatment**

Medical therapy in the treatment of IBD is centered on supportive care as well as a variety of antiinflammatory and immunosuppressive agents. In patients with known IBD, treatment should be decided in concert with the patient’s physician, because IBD management is a chronic, ongoing process tailored on a patient-by-patient basis. Medications commonly used to treat IBD are discussed later. An ED approach to treatment of IBD follows this description.

**Supportive care**

Dehydration and electrolyte imbalance should be treated with intravenous fluids and electrolyte supplementation as needed. Anemia caused by serious hemorrhage should be addressed with blood transfusion if necessary. Pain medications should be used as needed, but opiates are discouraged as part of the chronic management of IBD. Nonsteroidal antiinflammatory medications may exacerbate IBD and should be avoided. Antidiarrheal agents may be useful in mild IBD to decrease the number of stools and improve rectal urgency, but they should be avoided in severe disease because of the risk of precipitating toxic megacolon.

**Aminosalicylates**

These agents are the cornerstone of therapy for UC, and although they are less effective in CD, they are also often used as maintenance therapy for patients with CD. The choice of preparation and route of these 5-aminosalicylic acid (5-ASA) derivatives is based on the location of disease. Suppositories are often useful in patients with rectal disease, and retention enemas treat the rectum and descending colon. For patients with diffuse disease, oral controlled-release formulations are most successful, sometimes in combination with suppositories or enemas.

**Corticosteroids**

Corticosteroids are often used as first-line agents in CD, and are used in UC which is refractory to 5-ASA preparations. Oral steroids are effective in the management of mild-to-moderate exacerbations of disease, with parenteral steroids reserved for more severe disease requiring hospital admission. The typical dose of prednisone used is 40 mg/d, and therapy can be slowly tapered once symptoms begin to diminish. The many known adverse effects of long-term corticosteroid use limit the role of steroids in maintenance therapy.
**Immunomodulators** Azathioprine and mercaptopurine (6-MP) are immunomodulators that have been shown to be effective in CD and, to a lesser degree, in UC. These drugs are useful in patients who are refractory to corticosteroids, or to help reduce corticosteroid dependence in those who are unsuccessful in weaning from steroids.

**Antibiotics** Antibiotics have a limited role in UC, but have shown some usefulness in CD and in infectious complications of CD such as perianal fistula and abscess. Metronidazole and ciprofloxacin are the 2 most commonly used agents.

**Anti–TNF-α antibody** Infliximab is effective in managing moderate-to-severe Crohn disease, as well as in healing fistula disease associated with CD. A recent Cochrane review also showed usefulness in patients with difficult-to-treat UC.

**Initial ED treatment of IBD** Supportive therapy should be instituted as indicated for all patients. If possible, the patient’s treating physician should be contacted to ensure appropriate therapy based on the type of IBD, location of disease, and previous response to therapy.

In general, first-line therapy for patients with mild-to-moderate UC should be with oral 5-ASA derivatives, whereas enemas or foams are appropriate for those with proctitis only. For those with UC who are failing several weeks of 5-ASA agents, corticosteroids are the next therapeutic step. Patients who are failing steroids may be stepped up to another therapy, but this should always be done at the discretion of the patient’s gastroenterologist.

First-line therapy for mild-to-moderate CD usually involves oral corticosteroids or antibiotics. If the patient has significant abdominal pain, fever, or increased leukocyte count, an abdominal CT should be strongly considered to rule out abscess or perforation before instituting steroid therapy. To increase the likelihood of success of steroid withdrawal, 5-ASA preparations are often added, but they are not generally considered first-line therapy for CD.

Patients with severe IBD from either UC or CD should receive aggressive supportive care. Parenteral corticosteroids are often necessary, but only after suppurative disease has been ruled out (predominantly in CD). Care should be taken to ensure that no serious complications of IBD are present (see Serious Complications of IBD). Other causes of colitis should be considered, including enteric infection (especially *Clostridium difficile* infection), radiation colitis, and ischemic colitis. Appropriate consultation with a gastroenterologist should occur as soon as possible, and the patient should be admitted to the appropriate level of care based on clinical presentation.

**Serious complications of IBD**

**Complications associated with UC** Acute fulminant colitis occurs when inflammation extends beyond the colonic mucosa. Patients present with overt signs of systemic toxicity in addition to abdominal pain and bloody diarrhea. Leukocytosis and metabolic acidosis are often present. Plain radiography may show an edematous colon with thumbprinting. This condition may progress to toxic megacolon. These patients require aggressive supportive care, and enteric infections should be ruled out with stool studies. Broad-spectrum antibiotics should be considered, especially if perforation is suspected, and gastroenterologic and surgical consultation should occur emergently.

Toxic megacolon results as the bowel becomes paralyzed and begins to dilate. Signs of systemic toxicity are present, and the colon is generally more than 6 cm in diameter (Fig. 4). When the colon reaches 12 to 15 cm, perforation is likely imminent. Enteric
infection should be ruled out, as in fulminant colitis. Gastrointestinal decompression with a nasogastric tube should occur, and aggressive resuscitation and supportive care should be instituted. Although the initial management is often medical, surgical consultation is necessary to evaluate the need for urgent operative intervention.

Lower gastrointestinal bleeding is common in IBD, although life-threatening bleeding is uncommon. Aggressive supportive care should occur, as in other causes of lower gastrointestinal bleeding, and surgical treatment is often necessary.79

Complications associated with CD In patients with CD, intra-abdominal and perirectal abscesses are common. In CD, perforation often creates a walled-off abscess rather than acute peritonitis because of seepage of bacteria through sinus tracts.79 The signs and symptoms of acute CD exacerbation may be difficult to distinguish from an intra-abdominal abscess. CT scanning is often necessary to clarify the diagnosis. Management of intra-abdominal abscess includes broad-spectrum antibiotics and early consultation for operative or percutaneous drainage.

Perirectal abscess may be treated as in patients without CD. Antibiotics should be initiated. The choice of metronidazole and ciprofloxacin is often used, because they may also aid in fistula healing, although there is no strong evidence to support this common practice.

Bowel obstruction is a common problem in CD, with the most common location being the terminal ileum. Most patients have repeated partial small bowel obstructions rather than complete obstructions, and thus may respond to supportive management with bowel rest and nasogastric suction. Surgical consultation should be requested, but most patients improve without operative intervention.79
Extraintestinal manifestations

Extraintestinal manifestations of IBD may occur simultaneously with flares of bowel disease, or may be temporally unrelated to the course of bowel disease. Common extraintestinal manifestations include arthritides such as ankylosing spondylitis, hepatic manifestations including hepatitis, pericholangitis, sclerosing cholangitis (UC), and gallstones or renal stones (CD). Other complications may be dermal (pyoderma gangrenosum and erythema nodosum) or ocular (uveitis and episcleritis). For reasons that are unclear, thromboembolic disease is more common in patients with IBD. Most of these thromboembolic events manifest as thrombophlebitis, lower extremity deep venous thrombosis, or pulmonary embolus. Thromboembolism may also affect the portal vein, leading to variceal bleeding. Many other sites of thromboembolism can also occur, including cerebral vascular occlusions.

Disposition

Most patients with mild-to-moderate IBD exacerbation may ultimately be discharged to follow-up closely with their physician. Alterations in therapy should be discussed whenever possible with the physician managing the patient’s disease. Patients with severe disease, or ill-appearing patients who are failing outpatient steroid therapy, require hospitalization. In addition to hospital admission, patients with severe complications of IBD also require emergent consultation with gastroenterology and surgery.

C difficile Colitis

Overview and epidemiology

C difficile is a highly transmissible, gram-positive, spore-forming anaerobic bacterium that colonizes about 3% of healthy adults and 16% to 35% of hospitalized patients. This organism is identified as the cause in 10% to 25% of cases of antibiotic-associated diarrhea, 50% to 75% of antibiotic-associated colitis, and more than 90% of antibiotic-associated pseudomembranous colitis. The epidemiology of C difficile is changing rapidly, with a recent large increase in disease frequency, severity, and rate of treatment failure. This has correlated with the emergence of a new and highly virulent strain designated NAP1.

Antibiotics are the most widely recognized risk factor, and almost all cases are associated with prior use. The antibiotics most commonly associated with C difficile include clindamycin, fluoroquinolones, and the third-generation cephalosporins, although any antibiotic may predispose patients to colonization. Increased duration of therapy, use of multiple agents, and broader-spectrum antibiotic use all increase the incidence, although even single perioperative doses of antibiotics have been implicated.

Other established risk factors include hospitalization, advanced age, and severe underlying illness. Acid suppression, gastrointestinal surgery, and chemotherapy have also been implicated in C difficile–associated disease. The incidence of community-associated infection, although low, is rising, and infection may occur in the absence of risk factors.

Pathophysiology

Most commonly, antibiotic exposure alters the gut flora, allowing C difficile to multiply. C difficile releases 2 toxins that cause colitis and diarrhea, an enterotoxin termed toxin A and a cytotoxin termed toxin B. In addition, the NAP1 strain produces binary toxin, which is not present in other strains. These toxins act through a variety of mechanisms to cause neutrophil activation and chemotaxis, cell retraction, apoptosis, and disruption of intercellular tight junctions. This process leads to watery diarrhea, colitis, and the formation of pseudomembranes. Severity of disease is correlated with stool toxin levels.
Clinical presentation
The clinical presentation of *C. difficile* colitis is highly variable. Most patients report a previous history of antibiotic exposure, and most of those either present during the course of antibiotics or within several weeks of completion. Symptoms may begin as late as months after antibiotic completion. Patients may present with diarrhea, mild colitis, pseudomembranous colitis, fulminant colitis, or toxic megacolon.

Patients with mild-to-moderate disease generally present with lower abdominal cramping and nonbloody, watery diarrhea, but lack systemic symptoms. Patients with more severe colitis present with profuse watery diarrhea that may have occult blood, crampy abdominal pain and bloating, and systemic signs and symptoms such as dehydration and fever. Patients with fulminant colitis present with severe abdominal pain, fever, diarrhea, bloating, and appear clinically ill. Physical examination findings are variable based on severity of disease, but may range from isolated mild lower abdominal tenderness to severe tenderness, peritonitis, distention, fever, and signs of shock.

Diagnosis
The gold standard test for diagnosis is the cell cytotoxicity assay. It is a sensitive assay but is labor intensive, not widely available, and results are slow to return. In clinical practice, most institutions are using commercially available enzyme immunoassay (EIA) kits. These tests are easy to use, can be batched, and results are available within hours. EIA kits may test for toxin A alone or for both toxins A and B, but testing for both toxins is preferred. EIA testing is less sensitive than the cytotoxicity assay; however, the yield may be increased by as much as 10% if serial testing is performed.

Other laboratory testing may be suggestive, but not diagnostic. Fecal leukocytes are usually present and may help to distinguish between mild *C. difficile* and other antibiotic-associated diarrhea. Patients with more severe disease often have a leukocytosis, which may be profound in patients with fulminant colitis. Sigmoidoscopy may also help make the diagnosis if classic pseudomembranes are visualized. When the disease is particularly severe, thickening of the wall of the colon may be seen on CT scan, but it is not diagnostic of *C. difficile*. Plain radiography is not widely useful, but should be obtained if toxic megacolon or perforation is suspected.

Treatment
Whenever possible, the offending antibiotic should be stopped or, if this is not possible, switched to an agent less commonly associated with *C. difficile* infection. Supportive management with fluid and electrolyte repletion should be given as indicated, and contact precautions should be instituted if infection is proved or suspected. Patients with typical symptoms and a positive EIA should receive antibiotics, and treatment may be started pending EIA results if clinical suspicion is high.

Antibiotic treatment of mild-to-moderate disease is generally with oral metronidazole or oral vancomycin. Most recommendations favor metronidazole as first-line therapy because of lower cost and similar efficacy. The recommended regimen is 500 mg 3 times daily or 250 mg 4 times daily for 14 days. If oral vancomycin is used, the dosage is 125 mg 4 times daily for 14 days. Intravenous metronidazole may be used if oral therapy cannot be given, but intravenous vancomycin has no clinical effect on *C. difficile* colitis.

Relapse occurs in roughly 14% of patients after treatment. Relapse does not necessarily indicate metronidazole resistance, and most patients respond to another course of metronidazole. The addition of the probiotic *Saccharomyces boulardii* to oral
antibiotics has been shown to decrease the number of recurrences in patients with relapse, but it did not prove beneficial in the first episode of disease. Patients with severe C. difficile disease require antibiotic therapy, aggressive supportive care, and close monitoring. The possibility of toxic megacolon should be considered. Oral vancomycin (at 500 mg 4 times daily) is preferred for severe cases, and showed a significantly higher cure rate in a head-to-head study with metronidazole. Patients with ileus may benefit from the addition of intravenous metronidazole. Some severely ill patients may require surgery for toxic megacolon, perforation, necrotizing colitis, or severe disease with systemic toxicity refractory to treatment. Surgical consultation should be considered in the severely ill patient with C. difficile–associated disease.

Disposition
Most patients with mild symptoms caused by C. difficile infection may be discharged to home, with close follow-up with their primary care provider. If EIA results are not available at the time of discharge, appropriate follow-up of test results with appropriate treatment must be ensured. Patients with severe disease require admission to the appropriate level of inpatient care.

Ischemic Colitis

Overview and epidemiology
Intestinal ischemia is rare. However, ischemic colitis is the most frequent type of mesenteric ischemia, and predominantly affects the elderly. Most patients have non-gangrenous ischemia, which is generally transient and resolves without long-term complications. Ischemic colitis may present insidiously, and often no cause is identified. In addition to age, several risk factors exist for colonic ischemia, including recent aortoiliac surgery, myocardial infarction or heart failure, extreme exercise (such as marathon running or triathlon competitions), and prothrombotic conditions.

Pathophysiology
The colon has considerable collateral blood supply, which is weakest at the splenic flexure and the rectosigmoid junction. As such, these 2 areas are at greatest risk for ischemia during systemic hypoperfusion events. Most episodes are secondary to systemic low-flow states and rarely occur as a result of large artery disease. Colonic injury from an ischemic event may be caused by either hypoxia or subsequent reperfusion injury, or both.

Clinical presentation
Manifestations of colonic ischemia are variable based on the extent and duration of the ischemic event. Patients generally present with acute onset of mild, crampy abdominal pain, usually on the left side. Rectal bleeding or bloody diarrhea are common and develop within 24 hours of the onset of pain. Ischemic colitis differs from mesenteric ischemia of the small bowel in that the pain is generally less severe and often located laterally, rectal bleeding is usually an earlier finding, and patients do not typically appear severely ill. When more severe pain, peritonitis, fever, or systemic toxicity is present, colonic infarction with gangrene or perforation should be considered.

Diagnosis
No accurate laboratory markers exist to diagnose ischemic colitis. However, markers of hypoperfusion, such as the serum lactate and anion gap, may be increased in significant disease. Lower endoscopy often clarifies the diagnosis but is rarely performed in
Plain radiography may show signs of colonic dilation, but more specific signs such as thumbprinting of the bowel wall because of submucosal edema or hemorrhage were present in only 30% of patients with mesenteric infarction in one series.93 A CT scan with intravenous contrast is generally the first imaging test in patients presenting with suspected colonic ischemia. However, early scans may be normal, and findings such as bowel wall thickening are nonspecific. Pneumatosis may be seen in advanced disease. Angiography is rarely diagnostic. Often, blood flow has normalized at the time of the study and ischemia is rarely caused by large vessel occlusion.

**Treatment**
In cases of suspected nonocclusive ischemia, aggressive supportive care is the mainstay of therapy. Patients should receive intravenous fluids to improve perfusion, and cardiac status and oxygenation should be maximized. Bowel rest should be implemented, and nasogastric suction may be necessary if an ileus is present. Careful monitoring should be instituted to detect signs of clinical deterioration early.

In cases of suspected or documented infarction, aggressive supportive care is necessary, and broad-spectrum antibiotics should be initiated. A surgeon should be consulted for likely operative intervention, because bowel necrosis can lead to perforation, peritonitis, and sepsis.

**Disposition**
Patients with mild symptoms from a detectable, reversible cause such as extreme exercise may be managed on an outpatient basis if symptoms improve with treatment in the ED. However, the diagnosis of colonic ischemia is rarely confirmed in the ED, and disposition is generally based on the presenting clinical picture. Most patients do not ultimately require surgery, but all ill-appearing patients with suspected colonic ischemia should be hospitalized.

**Radiation Proctocolitis**
The gastrointestinal epithelium has a high cell turnover rate, making it susceptible to free radical injury from radiation therapy. As such, sloughed endothelium is not replaced at the normal rate, leading to ulcerations, edema, and inflammatory changes. Radiation proctocolitis can manifest either early (during or soon after completion of a course of radiation therapy), or late (usually months to years after therapy).

Acute radiation proctocolitis presents with abdominal pain, diarrhea, malaise, and bleeding. Tenesmus may be present if the rectum is involved. The diagnosis is made clinically based on the history of radiation therapy and the symptoms involved. Treatment is symptomatic, and should be decided in conjunction with the physician performing the radiation therapy.

Chronic radiation proctocolitis may present with a variety of symptoms. In patients with ulcerative disease, these include pain, bleeding, and tenesmus. In cases of stricture formation, patients may present with constipation, decreased stool caliber, or signs of partial or complete obstruction. Patients may also present with fistula disease or signs of pancolitis. Some patients with fistula disease or stricture ultimately require surgery, but this is often not performed emergently. Treatment of chronic radiation proctocolitis is symptomatic and based on the presenting clinical picture.

**SUMMARY**
Appendicitis, diverticulitis, and colitis are diseases that commonly present to the ED. Acute appendicitis may present classically, but often the diagnosis is difficult because of variable symptoms and examination findings, as well as the lack of a perfect laboratory
or imaging test. Diverticulitis usually presents with left-sided abdominal symptoms, but right-sided disease occurs in a minority of patients and should be considered in younger patients and those of Asian descent. Colitis may be caused by IBD, infection, ischemia, or radiation therapy. The treatment of colitis varies based on its cause.

REFERENCES

8. Wagner JM, McKinney WP, Carpenter JL. Does this patient have appendicitis? JAMA 1996;276:1592.


