

Acute Diverticulitis: From Basic Concepts to Current Treatment

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ABSTRACT

Acute diverticulitis (AD) is a common gastrointestinal disease characterized by abdominal symptoms that can lead to complications such as perforation, peritonitis, and sepsis. Risk factors include a low-fiber diet, high intake of red meat, obesity, sedentarism, alcoholism, and smoking. Computed tomography (CT) imaging is considered key for diagnosis and staging. Different scoring systems help guide treatment decisions, The Hinchey Classification, has been adapted for imaging interpretation. This system categorizes the severity of the disease into stages and helps predict postoperative morbidity and mortality rates, as well as the likelihood of recurrence in patients who are not managed operatively, therefore it's the most used classification worldwide. Management of acute diverticulitis depends on disease severity. Antibiotics are recommended for mild cases to reduce recovery time and complications, especially for patients with multiple risk factors and comorbidities. On the other hand, complicated cases require surgical treatment based on the presence of abscesses, perforation, obstruction, or fistulas.

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INTRODUCTION

Acute diverticulitis (AD) is a common gastrointestinal disease that incurs high expenses and has high mortality and morbidity rates worldwide as a consequence of a complicated diverticular disease. ⁽¹⁾ It can cause mild to severe abdominal symptoms that lead to perforation with peritonitis and sepsis ^(1, 3)

The pathophysiology of AD is related to gut motility, increased luminal pressure, and a disordered colonic microenvironment caused by multiple factors including diet, microbiome, lifestyle, and genetics. ^(2,3) The disease is

characterized by thickening of lamina propria, loss of mucin, and hyperplasia of Paneth cells. Some cases may develop crypt abscesses and ulceration. ⁽³⁾

ANATOMY AND PATHOPHYSIOLOGY

The colon is covered anteriorly by the visceral peritoneum, whereas about 50% of the large bowel is retroperitoneal and has an adventitial layer. ⁽¹⁾ The ascending colon begins at the ileocecal junction and extends toward the hepatic flexure. ⁽⁴⁾ The transverse and sigmoid colon has a mesentery formed from a double layer of visceral peritoneum. ⁽¹⁾

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The outer colonic *muscularis propria* is formed by two layers, the inner circular and outer longitudinal with the myenteric Auerbach nerve between. The intraperitoneal colon is covered by mesenteric serosa, subserosal caecal, and sigmoid fat accumulates to form the epiploic appendages that may encase diverticula in the sigmoid. ⁽¹⁾

The blood supply of the proximal colon comes from the superior mesenteric artery. In contrast, the distal colon is supplied by the left colic, sigmoid, and superior rectal branches of the inferior mesenteric artery. On the other hand, veins and lymphatics follow the course of the arteries draining into the portal vein, and coeliac nodes. ^(1,4)

The anatomic and physiologic changes in the colon are caused by segmental spasms of the muscular layer contributing to the development of diverticulosis. Then, AD begins when the diverticulum suffers from micro-perforation

caused by increased intraluminal or direct local pressure that results in erosion and inflammatory changes. ⁽⁵⁾

EPIDEMIOLOGY

The diverticular disease develops in about 10 to 25% of adults, and 4 to 5% of these patients will develop AD over time. ^(6,7) On the other hand, acute diverticulitis is more common in men than women in the first five decades of life with a change of incidence after the sixth decade. ⁽⁶⁾

The prevalence of AD changes according to the geographic location, for instance, Mexico has a prevalence of 1.92 to 9.2%, whereas in Africa the prevalence goes from 2 to 8%, and in Asian countries from 12.5% to 70%. ⁽⁷⁾

According to different studies, the risk factors for developing diverticular diseases include a low-fiber diet, high intake of red meat, obesity, sedentarism, alcoholism, and smoking. ⁽⁸⁾

Table 1. Acute diverticulitis risk factors.

RISK FACTORS	
MODIFIABLE	UNMODIFIABLE
<ol style="list-style-type: none"> 1. Low fiber diet: consumption of less than 14 grams per day. 2. Diet high in red meat. 3. Obesity: significant risk of developing complicated diverticulitis. 4. Sedentary lifestyle. 5. Smoking. 6. Alcoholism. 	<ol style="list-style-type: none"> 1. Age >60 years. 2. Gender: greater predominance of males. 3. Genetics: Syndromes that have a defect in the components of the extracellular matrix or in connective tissue fibers such as: Marfan syndrome, Ehlers-Danlos syndrome, Williams-Beuren syndrome, Coffin-Lowry syndrome and polycystic kidney disease. 4. Colonic motility: neuronal degeneration in the mesenteric plexus and hypersensitivity to denervation can cause uncoordinated contractions that would lead to the formation of diverticula.

There is also evidence that shows that the chronic use of non-steroidal anti-inflammatory drugs (NSAIDs) may increase the risk of diverticular hemorrhage, whereas opioids, steroids, and immunosuppression drugs may increase the development of AD. ^(6,8)

For patients with chronic diseases such as diabetes mellitus, arterial hypertension, and cirrhosis an inadequate treatment adherence may result in AD. ⁽⁸⁾

On the other hand, genetic factors include a polymorphism of the TFNSF15 gen that shows up in about 40% as a severe AD marker. ⁽⁹⁾

CLINICAL PRESENTATION AND DIAGNOSIS

Approximately 75-80% of patients with colon diverticulosis remain asymptomatic. The clinical presentation of acute diverticulitis depends on the severity of the underlying inflammatory process and the presence of associated complications. The average age of patients admitted for acute diverticulitis is 63 years. ⁽⁹⁾

Diverticular disease (DD) or diverticulitis is classified as uncomplicated and complicated. The presence of symptoms defines diverticular disease; when DD presents macroscopic, radiological, or serological signs of inflammation, it is called

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“complicated diverticular disease” or “complicated diverticulitis.”⁽¹⁰⁾

The clinical manifestations of acute diverticulitis depend on the severity of the inflammatory process and the presence of complications. Abdominal pain is the most common symptom. Usually, the pain is located at the level of the left lower quadrant because the sigmoid colon is the most frequent site of colonic involvement. Other less common sites of pain location are the right lower quadrant (due to acute diverticulitis in the ascending colon) or suprapubic (due to redundant inflamed sigmoid colon). Other symptoms associated with acute diverticulitis are fever, altered bowel habits (constipation in 50% of patients and diarrhea in 25-35% of patients), general malaise, nausea, and vomiting. Usually, symptoms have a duration of 12 to 48 hours.⁽¹¹⁾

Uncomplicated diverticular disease (UDD) is defined as the presence of abdominal pain and distension associated with changes in bowel habits and the presence of diverticula, without any other obvious cause of the symptoms. Uncomplicated diverticulitis is characterized by inflammation limited to the colonic wall and surrounding tissue.^(10, 12)

The manifestations are indistinguishable from irritable bowel syndrome (IBS), and the overlap between both disorders is a practical problem since 10 to 66% of patients with diverticulosis meet the Rome III diagnostic criteria for IBS. However, there are clinical differences between the two conditions. Both diseases usually manifest at different stages of life, since the peak of IBS presentation is observed between 20 and 40 years of age, while symptoms in uncomplicated diverticular disease usually appear after 60 years of age.⁽¹⁰⁾

IBS predominantly affects women, while UDD is seen more frequently in men. The abdominal pain associated with IBS is visceral and is characterized by being diffuse, while in UDD the pain is somatic and more localized. In IBS, relapses are more frequent, and in UDD, remissions are longer. Despite these differences, overlap between UDD and IBS is present, predominantly in middle-aged patients. In these cases, it is difficult to discern whether the symptoms are caused by the presence of diverticula or due to the superimposition of IBS. Some biomarkers, such as fecal calprotectin, may be useful since this test is negative in IBS and can be detected positive in UDD, but its practical usefulness has not been established.⁽¹⁰⁾

Between 10% and 15% of patients with acute diverticulitis associate urinary symptoms such as frequency, urinary urgency, and dysuria due to bladder irritation caused by colonic inflammation. Constipation is reported in 50% of patients and diarrhea in 25% to 35%. The most common systemic symptoms are fever (less than 39°C) and a change in bowel habits. Other symptoms that may appear are nausea, vomiting, and urinary symptoms.^(11, 13)

Complicated diverticular disease (CDD) is mainly characterized by pain and thickening of the colonic wall, as well as the involvement of the peri-diverticular fat detectable by abdominal tomography. Complicated acute diverticulitis includes the presence of peri-diverticular abscesses [Figure 1], free perforation with fecal peritonitis [Figure 2], stenosis, obstruction or development of fistulas in which the inflammatory phenomenon can penetrate neighboring organs, allowing the passage of intestinal contents to the bladder, vagina, etc.^(10, 12)



Figure 1. Peri-diverticular abscess in sigmoid colon.



Figure 2. Free perforation with fecal peritonitis in sigmoid colon.

Hemodynamic instability and shock are rare but may be associated with perforation and peritonitis. During the abdominal physical examination, in addition to pain, the

following findings may be found a) Signs of peritoneal irritation, b) Palpable mass due to pericolic inflammation or peridiverticular abscess (20% of patients). Rebound

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tenderness, rigidity, and absence of peristalsis may suggest peritonitis. In laboratory tests, elevated inflammatory markers and leukocytosis are common. ^(11, 13)

Fistulas can present with a range of symptoms, including pneumaturia and fecaluria in those with colo-vesicular fistulas and vaginal air or stool per vagina in those with colovaginal fistulas. Obstructions present most commonly with abdominal distension, nausea, or vomiting. Nausea and vomiting may also be associated (20 to 60% of patients), due to intestinal obstruction or paralytic ileus due to peritoneal irritation. Patients may have localized peritoneal signs with localized guarding, rigidity, and rebound tenderness. ^(9, 14)

Imaging studies

Imaging studies are recommended in patients who have severe symptoms, hemodynamic or respiratory involvement, and an increase in inflammatory markers. They are often used to evaluate rejection of treatment and assess complications. ⁽¹⁵⁾

The study of choice is an abdominal computed tomography (CT) scan with intravenous contrast due to its 95% and 96% sensitivity, which compares to 90% and 90% sensitivity for abdominal ultrasound. ^(15, 16)

Computed tomography (CT) imaging plays a key role in the diagnosis and staging of acute diverticulitis. More importantly, CT may help stratify patients into those at low risk of complications with good response rates to conservative treatment versus those at high risk of complications and the need for early surgical intervention. Therefore, multiple different scoring systems have been proposed to allow for both assessment of acute diverticulitis and to provide guidance in treatment decisions. These include the modified Hinchey, modified Neff, World Society of Emergency Surgery (WSES) and modified Siewert scoring systems. ⁽¹⁹⁾

Complicated diverticulitis is characterized by perforation, stenosis, fistulas, and obstruction. The extension of abdominal contamination owing to perforation is classified according to Hinchey. Initially, the classification was based on surgical findings, but the improvement in radiological diagnostics, especially CT, has resulted in localized abscesses (Hinchey grade I and II) and perforation causing abdominal contamination and purulent or faecal peritonitis (Hinchey grade III or IV respectively), particularly if the patient develops sepsis. ⁽¹⁸⁾

The Hinchey classification, originally a surgical classification system, was first described in 1978 and was subsequently adapted for use in CT interpretation by Kaiser et al. in 2005. It has been the most widely accepted system with disease classified into stages based on severity. ⁽¹⁹⁾

In Hinchey grade 0, there is colonic wall thickening but not pericolic fat stranding. Grade 1a consists of wall thickening and pericolic fat stranding, while grade 1b includes pericolic or mesocolic abscess. Patients with grade 2 disease have distant intra-abdominal or pelvic abscesses. Patients with grade 3 and grade 4 disease have purulent and fecal peritonitis, respectively. CT is somewhat limited in distinguishing between patients with grade 3 and grade 4 disease, as purulent and fecal peritonitis often cannot be distinguished on imaging. ⁽²⁰⁾

Kaiser found that disease severity using the modified CT Hinchey classification system correlated with postoperative morbidity and mortality. This group also found that the CT stage correlated with recurrence in patients managed nonoperatively. The presence of diverticulitis with an associated abscess was one factor highly associated with an increased risk of failed nonoperative management. ⁽²⁰⁾

Table 2. Modified Hinchey Classification.

MODIFIED HINCHEY CLASSIFICATION	
STAGE	CT imaging findings
1A	Confined pericolic inflammation or phlegmon
1B	Confined pericolic abscess
II	Pelvic, distant intra-abdominal or retroperitoneal abscess
III	Generalized purulent peritonitis
IV	Generalized faecal peritonitis

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Other studies that may help diagnose AD include abdominal radiography which can be useful for patients with diverticular perforation with the appearance of a pneumoperitoneum, whereas abdominal ultrasound is preferred for pregnant patients. On the other hand, magnetic resonance is a great alternative to a CT scan to avoid unnecessary radiation however it's expensive and time-consuming. ⁽¹⁷⁾

TREATMENT

Management of acute diverticulitis depends on disease severity. For mild cases, the use of antibiotics has shown a reduction in time recovery and complications. ⁽²¹⁾ Antibiotic treatment in this group of patients is recommended in those with a high number of risk factors and comorbidities. When giving antibiotics, an initial follow-up of 2 to 3 days after the start is important, followed by this every week. ^(21,22)

If no clinical improvement is observed, the patient should be hospitalized, and given intravenous antibiotic therapy, fluid therapy with 0.9 saline or lactate ringer solutions, a liquid diet, and analgesia. Antibiotic therapy should target gram-negative and anaerobic bacteria. For one-agent low-risk infections, piperacillin-tazobactam is recommended, whereas for multiple agents low-risk infections metronidazole with cefazolin, cefuroxime, or ceftriaxone should be considered. On the other hand, high-risk infections may require the use of carbapenem antibiotics. They should be administered for 3 to 5 days or until clinical improvement, then continued orally until a 10 to 14-day schedule is completed. ^(21, 22)

Medical treatment aims to improve vital signs, resolve severe abdominal pain, treat leukocytosis, and enable patients to accept oral treatment. ⁽²¹⁾

On the other hand, complicated AD treatment depends on the presence of abscesses, perforation, obstruction, or fistulas. ^(21, 22) In the case of abscesses, management is defined according to size. In abscesses smaller than 3 cm, management with antibiotics is given. If the abscess is greater than 3 cm, percutaneous drainage is performed. It is also performed in patients with abscesses smaller than 3 cm that do not respond to antibiotic treatment. Risk factors for treatment failure are leukocytosis >15000, abscess greater than or equal to 5 cm, and corticosteroid use. If the patient is unstable, surgical treatment is recommended. ^(21, 22)

Patients with diverticulitis perforation without abscesses and peritonitis can be given medical treatment with surveillance. However, if a frank colonic perforation is given [Figure 3], emergency surgery is required; the main objective of this treatment is to extract the perforated intestinal segment. ^(21, 22)

The surgery that is performed is the Hartmann operation, which consists of resection of the affected colon segment [Figure 4], completion of terminal colostomy, and a rectal stump. In a second surgical time, the colostomy must be reversed, this can be done up to within a year after the first time. ^(21, 22) Other surgical interventions that can be performed include primary anastomosis with proximal bypass and the three-stage procedure which consists of washing, resection with primary closure, and proximal ostomy and ostomy closure. ^(21, 22)



Figure 3. Frank perforation in sigmoid colon.

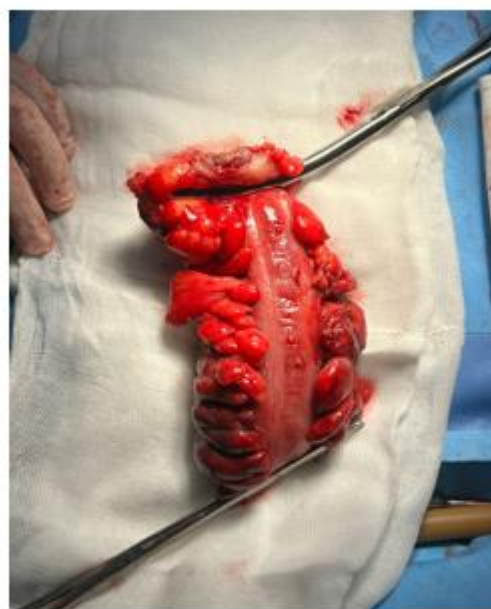


Figure 4. Resected piece of sigmoid colon.

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OUTCOMES

AD complications include abscesses, and fistulas between the colon and another part of the body; the bladder being the most common in 84% with prevalence in men. On the other hand, intestinal obstruction may occur due to a partial or total blockage of movement of food, fluid, air, or stool through the intestines. If intestinal perforation happens, an infection of the lining of the abdominal cavity with peritonitis will occur⁽²³⁾

About 30% of patients will have some of these complications, also adding to diverticular hemorrhage as one of the most common complications. Abscesses should be suspected in all patients with a torpid course, who present persistent fever above 39°C, pain, or palpable mass. Fistulas occur when an abscess spreads and opens into neighboring structures or affects the skin. Obstructions are rarely seen in acute cases, where edema or compression by an abscess plays a pathophysiogenic role. A narrowing of the endoluminal caliber is observed due to the healing processes of these abscesses. Finally, in diverticular hemorrhage, which along with angiogenesis is the most frequent cause of low digestive hemorrhage, only 5% of cases will cause bleeding of great severity.⁽²³⁾

When there is clinical improvement, the patient can be discharged with lifestyle modifications (weight loss, no smoking, high fiber diet, etc.)^(23, 24)

Some patients may decide to have surgery before having complicated diverticulitis. The objectives of elective surgery are to avoid recurrences, and emergencies and improve the quality of life of patients.^(23, 24)

CONCLUSION

Acute diverticulitis is an increasingly prevalent disease in the world, due to multiple risk factors such as: obesity, a sedentary lifestyle and a diet poor in fiber and consumption of fruits and vegetables. When faced with abdominal pain syndrome, it is important to take this disease into account as a differential diagnosis, especially if the pain is located in the lower left quadrant of the abdomen. In the face of high diagnostic suspicion, the implementation of complementary studies such as abdominal tomography continues to be very useful to define different treatment alternatives, both medical and surgical. It is important to provide adequate follow-up to patients who experience their first case of uncomplicated diverticulitis, in order to guide them on the lifestyle changes they should make and the probability of presenting more complicated abdominal symptoms.

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