

Colorectal Emergencies: Perforated Diverticulitis (Operative and Nonoperative Management)

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Introduction

Diverticulitis is the most common manifestation of diverticulosis. It accounts for roughly 150,000 hospital admissions in the USA per year, resulting in ~50,000 bowel resections. It is defined simply as inflammation due to perforation of a diverticulum.

Diverticulosis, defined as the presence of diverticula in the colon, was rare prior to the 1900s. Since that time, there has been a significant increase in the incidence of diverticulosis and diverticulitis, across all age groups.^{1,2} This rising incidence coincided with the advent of industrial roller milling in the late 1800 s, a process that turned whole grains into refined white flour and led to a significant reduction in fiber consumption in western societies. We currently estimate that roughly 5–10 % of the US population has diverticula present in their colon by the age of 40. This incidence increases to 60–70 % by the age of 80. Of all patients who have diverticulosis, 10–25 % will become symptomatic.

Low dietary fiber results in diminished stool bulk, resulting in slower gastrointestinal transit and changes in colonic motility, leading to elevated regional colonic (intraluminal) pressures

as the colon must contract more vigorously to propel stool. Diverticula develop due to these increased intraluminal pressures, forming herniations at areas of weakness where the vasa recta, terminal branches of the marginal artery, penetrate the bowel wall to provide arterial blood to the mucosal layer. Colonic diverticula are pulsion, or false diverticula, composed of mucosa, muscularis mucosa, and peritoneum. The sigmoid colon is the most commonly affected segment of bowel. Other risk factors for the development of diverticulosis include age, obesity, and lack of physical activity.

Diverticulitis develops following perforation of a diverticulum. Older theories surmised that diverticulitis was caused by an initial obstruction at the neck of the diverticulum, leading to distention and eventual perforation. This led to the recommendation of avoiding certain foods such as popcorn, seeds, and nuts to minimize the risk that they might get stuck and lead to perforation. This theory has largely fallen out of favor, and the current thinking is that diverticulitis simply develops when the colonic pressure exceeds the wall tension of a diverticulum.

Symptoms

Patients typically present with left lower quadrant abdominal pain that may radiate to the suprapubic area, left groin, or back. This may be in association with alterations in bowel habits (constipation and less commonly diarrhea), fevers, chills, and urinary symptoms, either due to inflammation in close proximity to the bladder or from a colovesical fistula. Rectal bleeding, the other common manifestation of diverticular disease, is uncommon in the setting of diverticulitis. On physical exam, patients may have isolated tenderness in the

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left lower quadrant of the abdomen or diffuse peritoneal signs, depending on the severity of the perforation. A tender mass in the left lower quadrant is suggestive of a phlegmon or abscess, or the patient may be distended as a result of a small bowel ileus, or from a large bowel obstruction due to a colonic stricture. Laboratory tests are notable for a leukocytosis.

Diagnosis

The differential diagnosis includes irritable bowel syndrome, appendicitis, inflammatory bowel disease, cystitis, endometriosis, ectopic pregnancy, ovarian torsion, pelvic inflammatory disease, colitis from any cause, and colon cancer. The CT scan is the diagnostic test of choice and is valuable because it establishes the diagnosis, determines the location of disease, and assesses the severity of the inflammation. Common CT scan findings include pericolic fat infiltration, wall thickening, and muscular hypertrophy. The severity of inflammation seen on CT scan correlates with clinical response and can therefore guide clinical decision making.^{3,4} The CT scan may also identify other complications of diverticulitis, including a fistula, abscess, or obstruction.

The most well-known classification system for diverticulitis is the Hinchey classification, described in 1978 based on operative findings at the time of surgery.⁵ Hinchey stage 1 is considered “uncomplicated” diverticulitis and is defined by diverticulitis with a pericolic phlegmon or a small pericolic (<2 cm) abscess. Hinchey stage 2 falls under the category of “complicated” disease and is defined as diverticulitis with a pelvic, abdominal, or retroperitoneal abscess. Hinchey stages 1 and 2 are contained perforations, usually caused by a microperforation. Hinchey stage 3 is defined as diverticulitis with generalized purulent peritonitis, while Hinchey stage 4 is diverticulitis with generalized feculent peritonitis. Hinchey stages 3 and 4 are free perforations. These occur in less than 10 % of patients who present with diverticulitis. Hinchey stages correlate with mortality (<5 % for stages 1–2, 13 % for stage 3, and 43 % for stage 4).⁶

Treatment

Management of Hinchey Stages 3 and 4 (Diverticulitis with a Free Perforation) Hinchey stages 3 (purulent peritonitis) and 4 (feculent peritonitis) patients present with generalized peritonitis due to a free perforation, have systemic symptoms, and require emergency surgery. Historically, this was performed in a “three-stage” fashion. Stage 1 consisted of a proximal diverting colostomy, irrigation, and drainage of the diseased segment. Stage 2 involved a resection of the diseased segment and primary anastomosis, and stage 3 involved a colostomy takedown. Today, patients undergoing emergency surgery are

managed by a two-stage approach, which is associated with improved morbidity and mortality, and a greater likelihood of stoma reversal compared to the three-stage approach. The classic two-stage operation, also referred to as the Hartmann procedure, involves resection of the diseased segment of the colon, closure of the rectal stump, and creation of a proximal end colostomy. The second stage involved takedown of the colostomy and primary anastomosis. An alternative two-stage approach has been gaining favor recently and involves resection of the diseased segment of colon, a primary anastomosis, and a diverting ileostomy, followed by ileostomy reversal at the second operation. Comparing these two “two-stage” approaches, morbidity and mortality rates were similar for the first operation, but for the second operation, hospital costs, length of stay, operative time, and the likelihood of stoma reversal all favored the ileostomy group.⁷

Operative management of diverticulitis involves basic surgical principles that apply regardless of whether surgery is elective or emergent, laparoscopic or open, or performed in one, two, or three stages. The first and most obvious is that the diseased segment of colon is removed. Surgery does not involve removal of all the diverticula, which may be present anywhere in the colon. Therefore, recurrent diverticulitis is possible following surgery, estimated to occur in 3–7 % of patients.^{8–10} Second, the remaining sigmoid colon distal to the area of disease should be resected, even if it appears normal. The level of bowel transection is a major determinant of recurrence (3–7 % for a colorectal anastomosis vs. 12.5 % for a colo-sigmoid anastomosis).^{9,10} The rectosigmoid junction is characterized by a loss of epiploic appendages (present on the sigmoid colon but not the rectum) and splaying of the taenia, three bands of longitudinal muscle present on the colon wall that become a uniformly distributed layer of longitudinal muscle at the level of the upper rectum. Third, one should try to preserve the inferior mesentery artery (IMA) whenever possible. It may be unavoidable in situations when cancer has not yet been excluded. Otherwise, some studies suggest that preservation of the IMA may improve anastomotic leak rates and functional outcomes following surgery.^{11,12} This may be related to the preservation of arterial blood flow to the upper rectum or to preservation of the underlying hypogastric nerves. Also, in emergent situations in which a preoperative colonoscopy was not performed, it is prudent to open the resected specimen in the operating room to evaluate for the presence of cancer.

Management of Complicated Diverticulitis (Abscess, Fistula, Stricture) Hinchey stage 2 patients present with diverticulitis and a contained perforation (abscess). These patients are typically managed by percutaneous drainage and conservative measures. Elective resection is indicated in these patients because their risk of developing another episode of complicated diverticulitis is higher.¹³ When a perforation leading to diverticulitis is contained by adjacent organs or structures, this

can lead to the development of a fistula (large or small bowel, bladder, vagina, uterus, ureter, skin). For these patients, initial treatment involves controlling the infection with antibiotics and bowel rest, followed by excision of the diseased colon to remove the fistula source, often on an elective basis. Chronic inflammation from recurrent episodes can lead to the development of a colonic stricture. Malignancy must be excluded in this situation, and surgery is required to remove the area of narrowing.

Management of Uncomplicated Diverticulitis Patients who present with uncomplicated (Hinchey stage 1) diverticulitis are managed conservatively. Outpatient management is reserved for patients who can tolerate oral intake, have no systemic symptoms and no comorbidities, and can reliably follow up if their symptoms worsen. These patients are treated with oral antibiotics for 7–10 days and a low residue diet. Inpatient management is reserved for patients who are older, have comorbidities, present with localized peritonitis and/or systemic symptoms, cannot tolerate oral intake, or require additional pain medication. These patients are treated with IV antibiotics and are initially kept NPO. Most experience symptom resolution within 2–3 days. A CT scan should be considered for persistent or worsening symptoms to assess for the presence of worsening inflammation or an abscess. Surgery should be considered for patients with worsening symptoms, or with no symptomatic improvement in 3–4 days.

Risks, Quality, and Outcomes

The vast majority of patients who present with uncomplicated diverticulitis respond to conservative measures. The decision to recommend prophylactic resection hinges on several factors. Historically, surgeons recommended elective surgery due to concerns that a subsequent episode of diverticulitis may require emergency surgery or may lead to the need for a colostomy. A growing body of evidence suggests that the vast majority of patients who present with complicated diverticulitis (Hinchey stage 2) or a free perforation (Hinchey stages 3 and 4) do so at the time of their initial episode, and therefore this cannot be surgically prevented.^{14,15} A study by Hall et al. found a 5-year recurrence rate of 36 % in patients following an initial episode of diverticulitis. They also identified several risk factors (family history of diverticulitis, length of involved colon >5 cm, presence of a retroperitoneal abscess) that increased the likelihood of recurrent episodes.⁴ There is some recent evidence to suggest that younger patients, particularly males, present with more severe disease. However, currently, there is no consensus on whether young age or male sex alone is associated with an increased risk of recurrence or complications. Patients with multiple episodes of diverticulitis are not at any higher risk for developing complicated disease, and a history of multiple episodes is not currently considered an absolute indication for

surgery. Immunocompromised patients are a high-risk group with a significantly higher rate of free perforation and emergency surgery, and a higher postoperative mortality. This is particularly true in lung transplant patients, whose risk of diverticulitis is highest in the first 1–2 years following transplantation. For these patients, surgery should be strongly considered early, or on the same admission. Taken together, for patients with uncomplicated diverticulitis, a recommendation for surgery should be based on the above risk factors, as well as the frequency and severity of clinical symptoms and CT scan findings, taking into account patient comorbidities and age.

Patients with diverticulitis who were managed conservatively should undergo an outpatient colonoscopy to rule out other diseases such as inflammatory bowel disease and cancer. This is typically performed 6 weeks after the episode. The incidence of detecting cancer in this setting is actually quite low, ~2%.^{16,17} If surgery is being considered, there should be radiographic evidence of disease to confirm the diagnosis, and elective surgery is delayed for 4–6 weeks.

Laparoscopic Peritoneal Lavage Laparoscopic peritoneal lavage is a minimally invasive approach that has garnered considerable attention as a less morbid option for select patients. In fact, this approach shares similarities with the first stage of the historical three-stage operation. Studies have suggested that this approach could be considered for Hinchey stages 2–3 patients.^{18,19} Several prospective, multi-institutional trials are currently underway to evaluate this approach in a more rigorous fashion.

References

1. Etzioni DA, Mack TM, Beart RW, Jr., Kaiser AM: Diverticulitis in the United States: 1998–2005: changing patterns of disease and treatment. *Annals of surgery* 2009, 249(2):210–217.
2. Masoomi H, Buchberg BS, Magno C, Mills SD, Stamos MJ: Trends in diverticulitis management in the United States from 2002 to 2007. *Archives of surgery* 2011, 146(4):400–406.
3. Shaikh S, Krukowski ZH: Outcome of a conservative policy for managing acute sigmoid diverticulitis. *The British journal of surgery* 2007, 94(7):876–879.
4. Hall JF, Roberts PL, Ricciardi R, Read T, Scheirey C, Wald C, Marcello PW, Schoetz DJ: Long-term follow-up after an initial episode of diverticulitis: what are the predictors of recurrence? *Diseases of the colon and rectum* 2011, 54(3):283–288.
5. Hinchey EJ, Schaal PG, Richards GK: Treatment of perforated diverticular disease of the colon. *Advances in surgery* 1978, 12:85–109.
6. Schwesinger WH, Page CP, Gaskill HV, 3rd, Steward RM, Chopra S, Strodel WE, Sirinek KR: Operative management of diverticular emergencies: strategies and outcomes. *Archives of surgery* 2000, 135(5):558–562; discussion 562–553.
7. Oberkofler CE, Rickenbacher A, Raptis DA, Lehmann K, Villiger P, Buchli C, Grieder F, Gelpke H, Decurtins M, Tempia-Caliera AA

- et al.: A multicenter randomized clinical trial of primary anastomosis or Hartmann's procedure for perforated left colonic diverticulitis with purulent or fecal peritonitis. *Annals of surgery* 2012, 256(5):819–826; discussion 826–817.
8. Binda GA, Arezzo A, Serventi A, Bonelli L, Italian Study Group on Complicated D, Facchini M, Prandi M, Carraro PS, Reitano MC, Clerico G et al.: Multicentre observational study of the natural history of left-sided acute diverticulitis. *The British journal of surgery* 2012, 99(2):276–285.
 9. Thaler K, Baig MK, Berho M, Weiss EG, Noguera JJ, Arnaud JP, Wexner SD, Bergamaschi R: Determinants of recurrence after sigmoid resection for uncomplicated diverticulitis. *Diseases of the colon and rectum* 2003, 46(3):385–388.
 10. Benn PL, Wolff BG, Ilstrup DM: Level of anastomosis and recurrent colonic diverticulitis. *American journal of surgery* 1986, 151(2):269–271.
 11. Tocchi A, Mazzoni G, Fornasari V, Miccini M, Daddi G, Tagliacozzo S: Preservation of the inferior mesenteric artery in colorectal resection for complicated diverticular disease. *American journal of surgery* 2001, 182(2):162–167.
 12. Dobrowolski S, Hac S, Kobiela J, Sledzinski Z: Should we preserve the inferior mesenteric artery during sigmoid colectomy? *Neurogastroenterology and motility : the official journal of the European Gastrointestinal Motility Society* 2009, 21(12):1288–e1123.
 13. Kaiser AM, Jiang JK, Lake JP, Ault G, Artinyan A, Gonzalez-Ruiz C, Essani R, Beart RW, Jr.: The management of complicated diverticulitis and the role of computed tomography. *The American journal of gastroenterology* 2005, 100(4):910–917.
 14. Chapman J, Davies M, Wolff B, Dozois E, Tessier D, Harrington J, Larson D: Complicated diverticulitis: is it time to rethink the rules? *Annals of surgery* 2005, 242(4):576–581; discussion 581–573.
 15. Janes S, Meagher A, Frizelle FA: Elective surgery after acute diverticulitis. *The British journal of surgery* 2005, 92(2):133–142.
 16. Schout PJ, Spillenaar Bilgen EJ, Groenen MJ: Routine screening for colon cancer after conservative treatment of diverticulitis. *Digestive surgery* 2012, 29(5):408–411.
 17. Sai VF, Velayos F, Neuhaus J, Westphalen AC: Colonoscopy after CT diagnosis of diverticulitis to exclude colon cancer: a systematic literature review. *Radiology* 2012, 263(2):383–390.
 18. O'Sullivan GC, Murphy D, O'Brien MG, Ireland A: Laparoscopic management of generalized peritonitis due to perforated colonic diverticula. *American journal of surgery* 1996, 171(4):432–434.
 19. Myers E, Hurley M, O'Sullivan GC, Kavanagh D, Wilson I, Winter DC: Laparoscopic peritoneal lavage for generalized peritonitis due to perforated diverticulitis. *The British journal of surgery* 2008, 95(1):97–101.
- c. **Male sex**
 - d. age
2. Common presenting symptoms in a patient with diverticulitis include all except:
 - a. Left lower quadrant abdominal pain
 - b. Fevers
 - c. **Rectal bleeding**
 - d. Urinary urgency
 3. **Hickey** stage 3 is characterized by:
 - a. Diverticulitis with a pericolic phlegmon
 - b. Diverticulitis with feculent peritonitis
 - c. Diverticulitis with a retroperitoneal abscess
 - d. **Diverticulitis with purulent peritonitis**
 4. A major determinant of recurrence following surgery for diverticulitis is:
 - a. Preservation of the IMA
 - b. Removing all diverticula
 - c. **The distal level of bowel transection**
 - d. Laparoscopic vs. open surgery
 5. The incidence of detecting cancer during outpatient colonoscopy in a patient with diverticulitis is:
 - a. 2 %
 - b. 10 %
 - c. 15 %
 - d. 25 %
 6. Elective surgical resection should be considered for all patients except:
 - a. **An asymptomatic immunocompromised patient**
 - b. Multiple recurrent episodes
 - c. One episode of complicated diverticulitis
 - d. One episode of uncomplicated diverticulitis
 7. The pathophysiology of diverticulitis includes all except:
 - a. Elevated intraluminal pressures
 - b. **Lodging of a seed or nut in the neck of a diverticulum**
 - c. Herniations in the colon wall
 - d. A micro- or macro-perforation
 8. By the age of 80, what percentage of the US population has diverticula present in their colon:
 - a. 5 %
 - b. 15 %
 - c. 25 %
 - d. **60 %**

CME Questions

1. Risk factors for the development of diverticulosis include all except:
 - a. Low fiber diet
 - b. Lack of physical activity