Diverticulitis: Incidence and Initial Management

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Introduction

Diverticulitis is one of the most common benign colonic disorders. The severity of the disease is highly variable, with mild cases managed on an outpatient basis with volume repletion and antibiotics, while complicated or severe diverticulitis may require emergent surgical therapy. Given the variability in presentation and the corresponding clinical consequences, an algorithmic approach should be utilized to guide medical and surgical treatment (Fig. 21.1).

Incidence

Diverticulosis is a modern disease. Initially described in the early 1800s as a rare curiosity, this condition has become increasingly common [1]. The risk of developing diverticulosis increases with age, with a prevalence of less than 10% in those younger than 40 and approximately 70% in individuals 80 years or older [2, 3]. Left-sided diverticular disease is more common in Western culture, where right-sided disease is more frequently seen in the Asian population and a younger cohort [4]. Previous literature has described a 10–25% risk of developing complications related to diverticulosis; however; modern population-based studies utilizing colonoscopic screening suggest only 1–4% of patients will progress to symptomatic disease [2, 5–7].

Diverticular disease places a substantial impact on the US healthcare system. Cost estimates from 2015 demonstrated that complications arising from this condition accounted for $2.6 billion in spending, with 333,464 emergency department visits, 216,560 hospital admissions, 4567 deaths, and 2.3 million outpatient visits. These national statistics have increased markedly since 2012, and as the nation's population ages, an increase in disease burden is anticipated [8, 9].

Initial Management

History and Physical Exam

Uncomplicated diverticulitis is defined by inflammation of the colon in association with diverticula. The triad of left lower quadrant abdominal pain, fever, and leukocytosis is present in approximately 40% of patients [10]. Abdominal pain can be right sided or suprapubic in case of cecal diverticulitis or a redundant sigmoid colon [11–13]. Patients often have a change in bowel habits including constipation (34.8%), diarrhea (18.6%),

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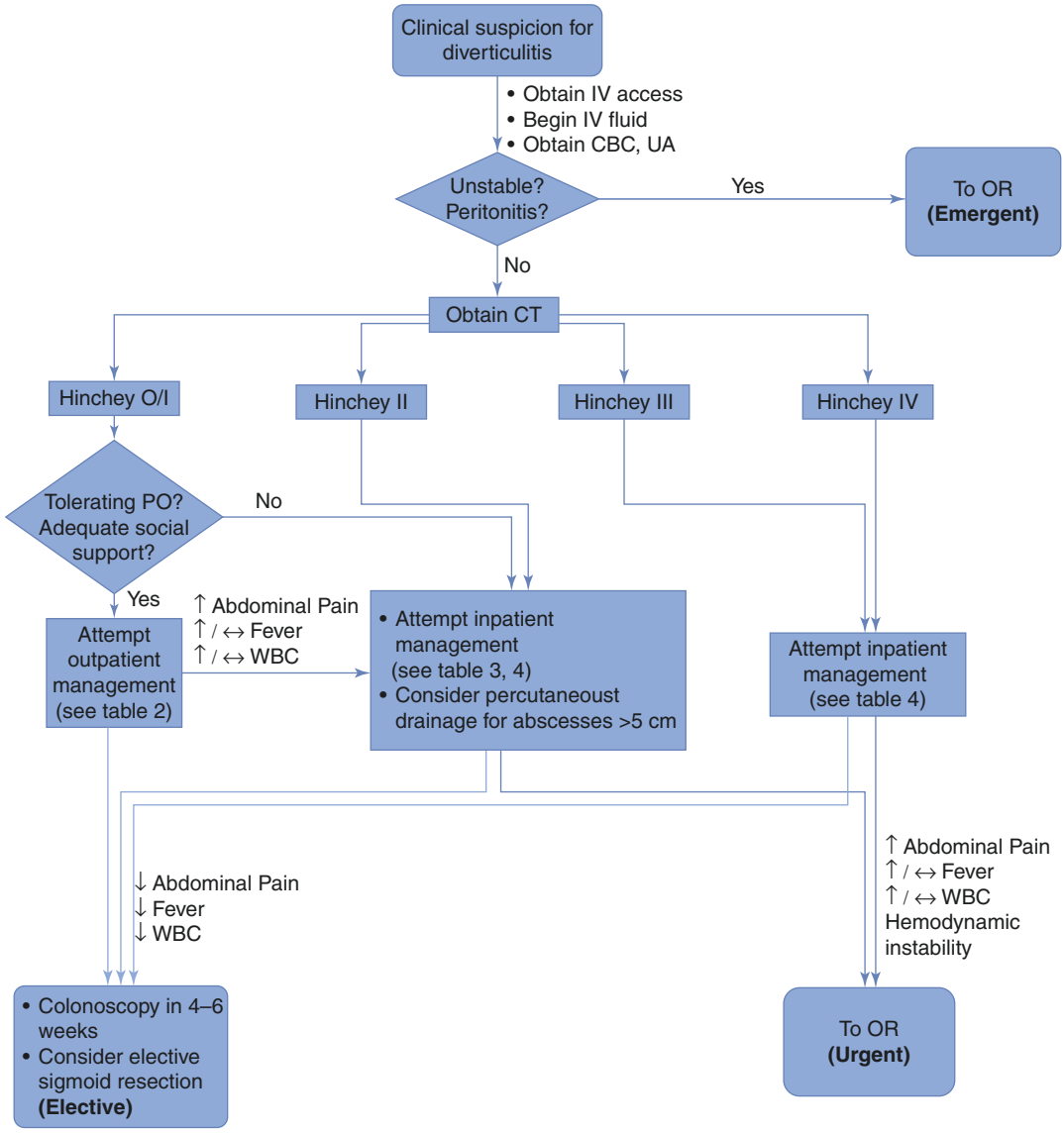

Fig. 21.1 Medical management algorithm

or a combination of both (8.6%) [14]. Nausea, vomiting, and anorexia may be present in up to 20% and can signify the presence of an ileus or bowel obstruction [13, 14]. Urinary symptoms consisting of dysuria, frequency, and urgency are seen in as many 13% of patients and may be associated with sterile pyuria. Hematochezia is rare and mild when present with diverticulitis, and significant bleeding should raise concern for alternative diagnoses such as an underlying neoplastic process [13].

Complicated diverticulitis is defined by the presence of a pericolonic or pelvic abscess, fistula, bowel obstruction, or free perforation. An intra-abdominal abscess may develop in approximately 15–20% of patients requiring hospital admission [15, 16]. Symptoms suggestive of an abscess include high fever, malaise, or a palpable mass on either abdominal, pelvic, or rectal examination [14]. Fistula formation is most likely to be present in those with repeated episodes of diverticulitis. The development of a diverticular fistula

varies based on gender and surgical history, with the most common including colovesical (65%), colovaginal (25%), coloenteric (6.5%), and colouterine (3%). Colovesical fistulae occur more commonly in men and are associated with dysuria, fecaluria, pneumaturia, and a history of recurrent cystitis. A colovaginal fistula is more common in women who have had a hysterectomy and present clinically as foul vaginal discharge or frank passage of feces from the vagina [17]. A large bowel obstruction in the sigmoid colon may occur as a result of chronic recurrent inflammation or secondary to a fibrotic stricture. In addition, a small bowel obstruction can result from the effects of pericolonic inflammation [14]. Free perforation is rare, but rates may be increasing [18]. This manifests as peritonitis, high fever, and hypotension. When present, perforation can rapidly progress to intra-abdominal sepsis and multisystem organ failure [19].

Laboratory Evaluation

A complete blood count, basic metabolic panel, and urinalysis are the most useful labs when assessing patients with known or suspected diverticulitis [20]. In addition, there has been increased interest in evaluating the role of C-reactive protein (CRP) in the management of acute diverticulitis. A CRP value ≥150 mg/L has been demonstrated to have a sensitivity (Sn) of 85% and specificity (Sp) of 65% in distinguishing complicated from uncomplicated diverticulitis [21]. This is of uncertain clinical relevance given the widespread use of cross-sectional imaging and a poor negative predictive value of CRP. Makela and colleagues reported over 35% of patients with a CRP ≤150 mg/L were found to have complicated disease on imaging [22]. The trend of CRP in the first 24 hours has not been found to be predictive of response to treatment; however, this may play a role in identifying failure of treatment without antibiotics [23]. Stool testing for bacteria or parasites should only be implemented when there is concern for infectious diarrhea as an alternative explanation for abdominal pain.

Imaging

Computed tomography (CT) is the preferred diagnostic imaging modality for the diagnosis of acute diverticulitis [20]. The sensitivity of CT imaging in the identification of diverticulitis is 94% with a specificity of 99% [24, 25]. Findings suggestive of diverticulitis on CT include bowel wall thickening (>4 mm), pericolonic fat stranding, presence of a fluid collection or air fluid levels, extraluminal gas, abscess, stricture, fistula, or a pericolonic soft tissue density (phlegmon) [20, 26]. The modified Hinchey classification is the most common CT-based grading scale for complicated diverticulitis (Table 21.1 and Fig. 21.2) [27–29]. Representative CT slices are shown in Figs. 21.3, 21.4, 21.5, and 21.6. The Hinchey grade can aid in determining the appropriate management for these patients (Fig. 21.1).

Table 21.1 Comparison of Hinchey and modified Hinchey classifications

Hinchey classification, 1978 [27]		Modified Hinchey classification, 1997 [28]		Modified Hinchey classification, 1999 [29]	
I	Pericolic abscess or phlegmon	I	Pericolic abscess	Ia	Phlegmon
				Ib	Pericolic abscess
II	Pelvic, intra-abdominal, or retroperitoneal abscess	IIa	Pelvic abscess or phlegmon amenable to drainage	II	Pelvic abscess
		IIb	Complex abscess associated not amenable to drainage, presence of fistula		
III	Generalized purulent peritonitis	III	Generalized purulent peritonitis	III	Purulent peritonitis
IV	Generalized fecal peritonitis	IV	Fecal peritonitis	IV	Fecal peritonitis

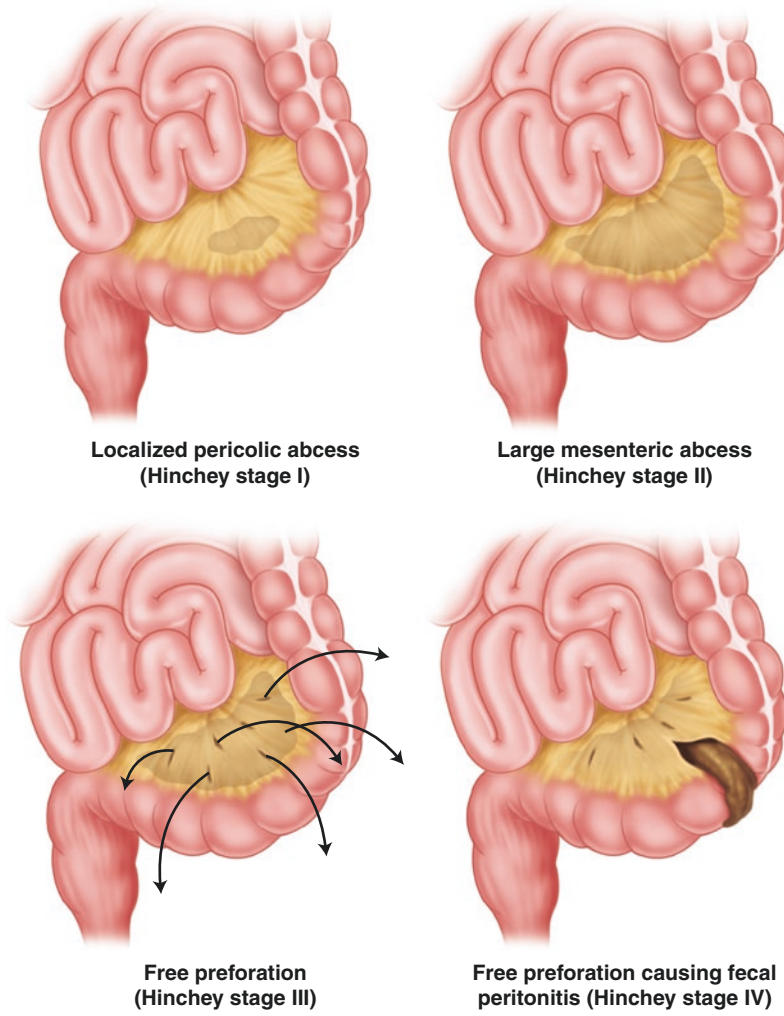

Fig. 21.2 Hinchey classification

While CT is favored, magnetic resonance imaging (MRI) and graded compression ultrasound are potential alternatives. MRI has a similar sensitivity (>94%), but lower specificity (88%) than CT in the diagnosis of diverticulitis [30]. Although MRI offers the benefit of avoiding radiation exposure, the increased cost, decreased availability, and decreased expedience limit its utilization. Graded compression ultrasound offers a sensitivity of 92% and specificity of 90% [24]. The drawbacks of ultrasound in the diagnosis of diverticulitis include high inter-user variability, decreased utility in obese patients, and a decreased ability to identify alternative diagnoses. The American Society of Colon and Rectal Surgeons (ASCRS) clinical practice guidelines only acknowledge ultrasound's capability to aid in diagnosis, whereas European professional organizations either have no preference between US and CT or recommend the use of CT only if ultrasound is unavailable or findings are equivocal [31].

Endoscopy

Colonoscopy does not have a diagnostic role in the acute setting. Tissue friability, severe

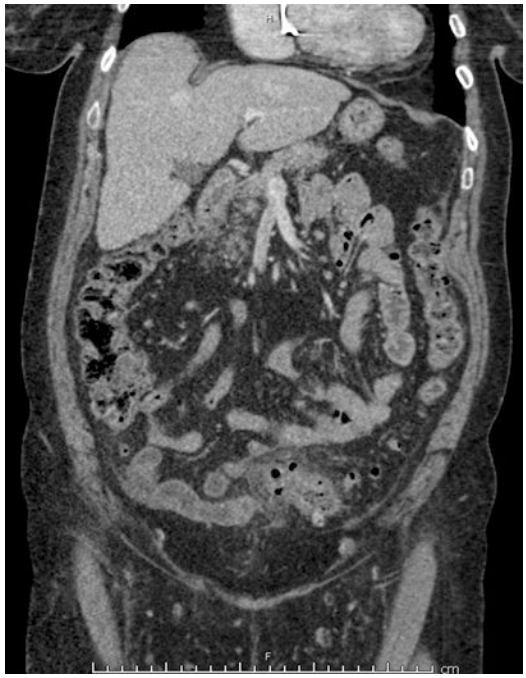

Fig. 21.3 Uncomplicated diverticulitis: pericolonic inflammation without perforation or free air

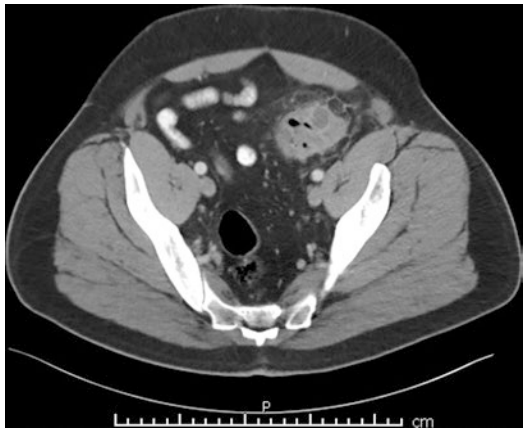

Fig. 21.4 Hinchey Ib: localized pericolonic abscess

inflammation, and potential pre-existing perforation make attempting colonoscopy dangerous. Given low utility and high risk, it is not recommended as part of the initial management. Colonoscopy is recommended 4–6 weeks following successful management of acute diverticulitis to evaluate for an underlying malignancy [20].

Medical Management

Medical management alone should be considered in all patients without generalized peritonitis or obstruction. This may be carried out either on an inpatient or outpatient basis. Regardless, all patients receiving nonsurgical therapy should be frequently reassessed for treatment failure.

Outpatient Management

Outpatient management should be considered for mild uncomplicated diverticulitis. This is appropriate in patients who are able to tolerate an oral diet, have adequate social support, and demonstrate an appropriate response with initial resuscitation [32, 33]. Predictors of failure include female gender and free fluid on CT scan. Age, white blood cell count, CRP trend, comorbidities, and duration of antibiotic therapy have not been found to be significantly associated with outpatient treatment failures [23, 34].

Administration of antibiotics is the standard of care for uncomplicated diverticulitis in the United States. However, two multicenter randomized controlled trials have demonstrated equivalent outcomes with and without antibiotics [35, 36]. While acknowledging the poor evidence for antibiotic use in uncomplicated diverticulitis, the most current ASCRS practice parameters strongly recommend the use of oral or intravenous antibiotics [20]. Current American Gastroenterological Association Institute Guidelines advocate for the selective use of antibiotics; however, they provide no guidance regarding patient selection [37]. A Dutch retrospective cohort study assessed patients with uncomplicated diverticulitis treated without antibiotics for predictors of treatment failure, which was defined as (re)admittance, disease progression, requirement of a procedural intervention, or mortality. Significant predictors of failure included an elevated CRP on presentation, ASA > 2, and greater mean age (63 vs. 58 year old; $p = 0.02$). A CRP level > 170 mg/L was associated with a sensitivity of 20% and specificity of 91% in predicting treatment failure [38].

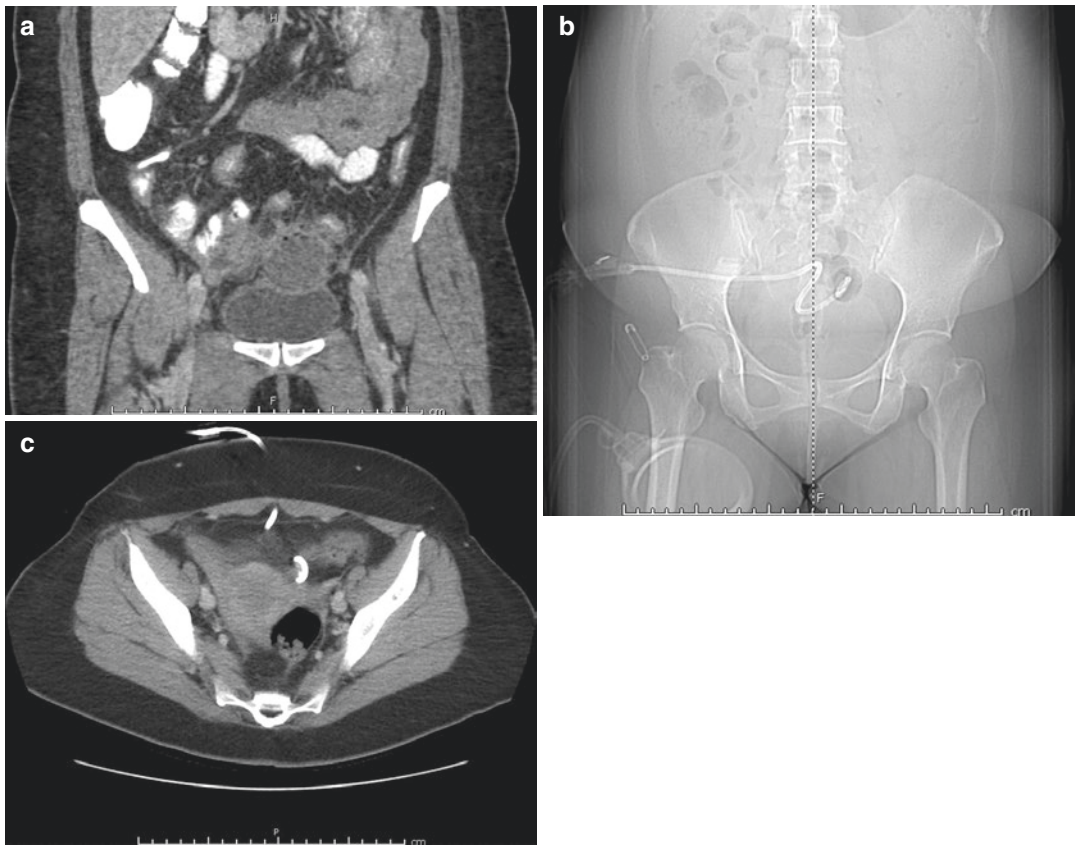

Fig. 21.5 (**a**) Hinchey IIa: pelvic abscess. (**b**) Pelvic abscess following placement of pigtail drain (scout). (**c**) Pelvic abscess with pigtail drain

Antibiotic regimens should target gram-negative and anaerobic bacteria [20, 39]. Possible oral regimens per Infectious Disease Society of America (IDSA) guidelines are outlined in Table 21.2 [40]. Multiple studies have demonstrated non-inferiority of oral antibiotics when compared to intravenous antibiotics [32, 41, 42]. The duration of treatment is typically 7–10 days, although limited evidence suggests shorter courses may be equally effective [43, 44]. A local antibiogram should be utilized prior to prescribing fluoroquinolones given the increased rates of *Escherichia coli* resistance to this class of medications [45].

There is no evidence that dietary modifications affect the course of mild uncomplicated diverticulitis. If desired, a patient can be placed on a clear liquid diet initially with a transition to a low residue diet while recovering [43]. Following recovery, the patient should be transitioned to high-fiber diet [20].

Patients managed on an outpatient basis should be frequently reassessed in the acute period to determine if they require admission. The optimal interval for initial assessment is dependent on whether a patient is at increased risk for failure. In general, patients should be evaluated 1–3 days following the commencement of therapy. Treatment failure should be recognized by the development of fever, worsening pain, and inability to tolerate a diet.

Inpatient Management

Inpatient management is appropriate for patients with clinical evidence or radiographic findings to suggest complicated disease. This includes a high

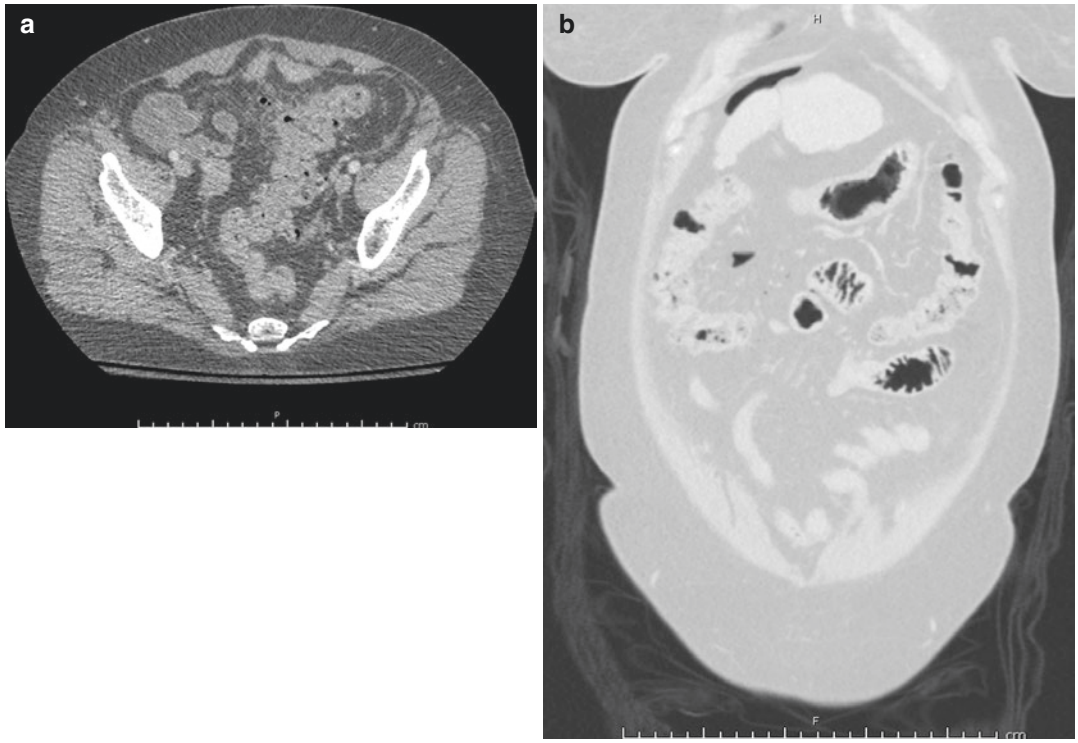

Fig. 21.6 (**a**) Hinchey III: localized free air surrounding the inflamed colon. (**b**) Diverticulitis with distant free air present above the liver

Table 21.2 Oral Antibiotic Regimens for Diverticulitis [40]

Medication	Dose
Single agent	
Amoxicillin-clavulanic acid	875 mg/125 mg PO every 12 hours
Moxifloxacin	400 mg every 24 hours
Combination regimens	
Metronidazole	500 mg every 8 hours
and	
Ciprofloxacin	500 mg PO every 12 hours
or	
Levofloxacin	750 mg every 24 hours
or	
Cefazolin	1–2 g every 8 hours
or	
Cefuroxime	1.5 g every 8 hours

fever, marked leukocytosis, hemodynamic instability, and peritonitis. In addition, inpatient management should be considered for the treatment of uncomplicated diverticulitis when patients lack social support and have an inability to tolerate an oral diet, in the setting of pregnancy, or those who are immunocompromised. Patients should be counseled and educated on their expected hospital course. Non-operative management is often successful, even in the setting of an intra-abdominal abscess and pneumoperitoneum, with greater than >90% of patients avoiding surgical therapy during their initial hospitalization [46].

Once inpatient management is initiated, any oral intake should be avoided until the requirement of surgical intervention or percutaneous drainage is determined. The patient should receive intravenous volume resuscitation and antibiotics [20]. Tables 21.3 and 21.4 outline IDSA recommended intravenous antibiotic regimens for mild to moderate and severe disease, respectively [40].

Diverticular Abscess

Diverticular abscesses >5 cm should be considered for percutaneous drainage in addition to

Table 21.3 Intravenous antibiotic regimens for mild to moderate diverticulitis [40]

Medication	Dose
Single agent	
Cefoxitin	2 g every 6 hours
Ertapenem	1 g every 24 hours
Moxifloxacin	400 mg every 24 hours
Tigecycline	100 mg initial dose, then 50 mg every 12 hours
Ticarcillin-clavulanic acid	3.1 g every 6 hours (200–300 mg/kg/day divided to be dosed every 6 hours)
Combination regimens	
Metronidazole	500 mg every 8 hours
and	
Cefazolin	1–2 g every 8 hours
or	
Cefuroxime	1.5 g every 8 hours
or	
Ceftriaxone	2 g every 24 hours
or	
Cefotaxime	2 g every 24 hours
or	
Ciprofloxacin	400 mg every 12 hours
or	
Levofloxacin	750 mg every 24 hours

Table 21.4 Intravenous antibiotic regimens for severe diverticulitis [40]

Medication	Dose
Single agent	
Imipenem-cilastatin	500 mg every 6 hours
Meropenem	1 g every 8 hours
Doripenem	500 mg every 8 hours
Piperacillin-tazobactam	4.5 g every 6 hours
Combination regimens	
Metronidazole	500 mg every 8 hours
and	
Cefepime	2 g every 8 hours
or	
Ceftazidime	2 g every 8 hours
or	
Ciprofloxacin	400 mg every 12 hours
or	
Levofloxacin	750 mg every 24 hours

intravenous antibiotics (Fig. 21.5a–c). The objective of drainage is to temporize the acute infectious process in order to defer surgical intervention to the elective setting. This avoids the high morbidity and mortality associated with emergent operations. Although there is variability in size criteria, current consensus guidelines recommend the drainage of any "large" abscess (ranging from at least 2 to 5 cm on CT scan). These recommendations stem from the findings that an abscess >5 cm is unlikely to be successfully managed with antibiotics alone [20, 31, 47].

CT-guided drainage is successful at controlling sepsis and preventing need for emergent surgery in 66–93.8% of cases [48–50]. A pelvic abscess has a greater risk of requiring surgical intervention as compared to mesocolic abscesses during the initial hospitalization despite percutaneous drainage (39% vs. 15%, $p = 0.04$). However, there is no difference in the rate of an elective sigmoid resection between a pelvic and mesocolic abscess when successfully drained during the initial hospitalization (32% vs. 36% at a median of 43 months) [51]. The risk of recurrent complicated disease following successful drainage is relatively frequent at 71%, suggesting that CT-guided drainage should only be viewed as an effective tool for deferring surgery, not as a substitute [48].

Failure of Medical Management

Medical management with or without CT-guided drainage is considered to have failed when the patient develops worsening abdominal pain, fevers, peritonitis, leukocytosis, or hemodynamic instability despite maximal therapy or interventions. These patients will require surgery during their initial hospitalization. The surgical decision-making process and operative interventions will be addressed in a subsequent chapter.

Special Considerations

Immunosuppression

A high level of suspicion must be maintained to accurately diagnose diverticulitis in the immunosuppressed (IMS) patient. Limited ability to mount an inflammatory response can minimize the typical radiographic findings of diverticulitis

[20]. These patients require inpatient management to facilitate close observation and expedite intervention if needed. The IMS patient is at an increased risk of clinically decompensating even during an episode of uncomplicated acute diverticulitis (OR 4.34, $p = 0.04$) [52]. These patients are more likely to require emergent or urgent surgery than immunocompetent patients (31.3% vs. 21%, $p = 0.004$), and perioperative mortality is significantly higher (33.3% vs. 15.9%, $p = 0.004$) [53]. Furthermore, immunocompromised patients receiving chemotherapy were more likely to present with a complicated recurrence (87.5% vs. 29.4%, $p = 0.01$) and require surgery for their recurrence (75% vs. 23.5%, $p = 0.03$), with an increased risk of diversion at the time of that surgery (100% vs. 25%, $p = 0.03$) [54].

Right-Sided Diverticulitis

Right-sided or cecal diverticulitis is frequently mistaken for appendicitis [55]. Historically, the diagnosis was made at the time of surgery, but modern cross-sectional imaging often this entity. Right-sided disease is more prevalent in the Asian population; however, a recent study utilizing the National Inpatient Sample found 67% of cases in the United States occurred in Caucasian patients [56]. When properly identified, the management of right-sided diverticulitis is primarily conservative with bowel rest and intravenous antibiotics. The requirement for operative intervention is similar to left-sided disease [57]. Although data is limited, recurrence appears to be low with only 9 of 153 patients managed nonoperatively experiencing recurrence when followed for 60 months [55].

Conclusion

As the nation's population ages, acute diverticulitis has become more prevalent in our healthcare system. Although the progression from diverticulosis to an infectious process is only 1 in 50, the management of this disease may be complex. A CT scan remains the diagnostic mainstay given its ability to determine the presence or absence of complicated disease or demonstrate an alternative diagnosis. Uncomplicated diverticulitis in an otherwise healthy, reliable patient can be safely managed with a 7-day course of oral antibiotics. Complicated diverticulitis is best managed in the hospital with percutaneous drainage being utilized in the appropriate setting. Regardless of the therapies implemented, the primary goal of medical management is to avoid surgical therapy in the acute setting.

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