

A three-step approach to patients with suspected acute diverticulitis in the emergency department: An interdisciplinary algorithm proposal

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Abstract

Patients with acute abdominal pain due to acute colonic diverticulitis are a frequent cause of hospital admission. Diverticular disease increases with age. In Western populations, diverticular disease is diagnosed in 50% individuals over 70 years and 80% over 85 years of age. The identification of patients with acute diverticulitis is a considerable challenge, since numerous other acute abdominal conditions mimic its clinical characteristics. Another problem is the atypical presentation in older patients. A high index of suspicion in the setting of a compatible history and physical examination serves as the cornerstone of early diagnosis. The purpose of this review is to underline the importance of an intimately integrate multidisciplinary approach between emergency physicians, radiologists and surgeons.

Introduction

Diverticular disease in the emergency department

Acute abdominal pain is the most common cause for visits to

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the emergency department (ED), accounting for an estimated 5-10% of all admissions.¹ The underlying causes of abdominal pain range from life-threatening conditions that require fairly immediate decision and urgent surgical intervention to self-limiting conditions from common to unusual diseases. Abdominal pain is a common occurrence in elderly patients. With the increasing mean age of the population, the prevalence of age-correlated diseases has concomitantly increased.² A typical example is acute diverticulitis (AD). In Western populations, aging and lifestyle changes place the elderly at high risk for diverticulosis. Diverticula are a sac-like outpouchings of the colon that occur through weakened areas of the muscularis of the colon wall. The pathophysiology is not well understood but diets low in fiber are epidemiologically related to the underlying process of outpouching of colonic mucosa.³ Estimated at 5% of general population, diverticular disease is diagnosed in 50% individuals over 70 years and 80% over 85 years of age.² A population-based cohort study on the Danish population from 2000 to 2012 evidenced that overall admission rates for complicated diverticulitis increased significantly.⁴ The most frequent complications from diverticula include bleeding and diverticulitis. Bleeding occurs in 15% of patients with diverticulosis. It is the most common cause of lower gastrointestinal bleeding in the elderly. The bleeding is usually mild, but occasionally it is massive. Several studies have reported that approximately 30% of patients with diverticular disease develop diverticulitis or its complications.¹ Diverticulitis is caused by obstruction or abrasion by a fecalith, leading to inflammation, and eventually infection from the proliferation of colonic bacteria and build-up of bowel secretions within the diverticula. According to an earlier Swedish study, about 47 patients per 100,000 population/year are admitted in the ED for AD.⁵ It occurs most frequently in the descending and sigmoid regions of the colon but can occur throughout the colon.

The clinical problem

The most common symptom of diverticulitis is abdominal pain. The pain usually evolves over 1 to 2 days from dull, diffuse abdominal discomfort to more intense, localized left lower quadrant pain. Classic signs of left lower quadrant abdominal pain associated with cramping, fever, nausea with occasional vomiting, mild abdominal distention, decreased appetite and leukocytosis are usually present. Many may report a known history of diverticular disease. Diarrhoea and constipation have both been reported as alterations in bowel habits. Diverticulitis might be complicated by the formation of an abscess or fistula, bowel obstruction, free perforation, or the development of sepsis.

The identification of patients with AD is a considerable chal-

lenge, since numerous other acute abdominal conditions can mimic its clinical characteristics. The left lower quadrant is more frequently involved in AD, such as urolithiasis, acute appendicitis, stercoral perforation, ischemic or infectious colitis, aortic abdominal aneurysm, spontaneous retroperitoneal hemorrhage or gynecological disease (Table 1).⁶ In 2010, Lameris *et al.* monitored 126 patients with suspected diverticulitis and showed different final diagnoses in 37% of cases (aspecific abdominal pain and acute appendicitis at first).⁷ In contrast to appendicitis, diagnostic value of specific elements has not been extensively studied for AD. A comprehensive study by the group of Andeweg characterized patients with abdominal pain at high risk of AD based on the following criteria: age greater than 50 years, one or more similar previous episodes, localisation of symptoms in the lower left abdomen, aggravation of pain on movement, absence of vomiting, localisation of tenderness in the lower left abdomen, and CRP of 50 mg/L or higher.⁶ The discriminatory power of the different variables alone was very low but improved upon combining the independent risk factors. The sensitivity of clinical evaluation was not satisfactory, with accuracy in only 43% of patients from the Andeweg cohort. Other comparable studies have demonstrated similar low sensitivity.⁵

In elderly patients many factors make diagnosis of AD even more difficult. Perception of pain is often suppressed due to decreased immune responses and changes in the neurological system. Additionally, muscular defense and rebound signs in abdominal examination may not be evident despite the presence of serious intra-abdominal diseases because of a thinner abdominal wall, degeneration of the inflammatory process, and abolition of peripheral nerve functions. Thirty percent of elderly with AD don't have abdominal tenderness on exam. Immunosenescence is associated with aging. Older adults experience a reduced febrile response caused by altered thermoregulation and decrease in mean body temperature. Laboratory studies have significant limitations, particularly in older. The group of Laurell (2006) reported that laboratory parameters cannot be effectively used to distinguish patients affected by AD from those with aspecific abdominal pain.⁸ Overall, 24 patients (16%) with a final diagnosis of diverticulitis showed a CRP level below the upper limit of the 95% confidence interval relative to CRP of patients with a final diagnosis of aspecific abdominal pain. Same limitations were evident for leukocyte count. A recent study by the group of Lameris showed that the strongest clinical features used for diagnosis of AD (tenderness in the left lower quadrant, absence of vomiting and CRP level > 50 mg/L) were only present in about a quarter of patients.⁷ Almost

half of older patients suffering AD have a normal white blood cell count.

Diagnosis of AD involves a strategy encompassing age, history, clinical, differential diagnosis and laboratory tests but often it's not enough. It's necessary increase in accuracy after clinical evaluation following an imaging strategy.

An imaging strategy

In the setting of suspected AD, the clinical questions are essentially the following: i) to exclude other potential diseases that can mimic diverticulitis; ii) to confirm the diagnosis of diverticulitis and iii) to stage the entity of the disease.

Abdominal radiography is of limited value, and cannot be utilised to achieve either of the above objectives. Furthermore, plain radiography may be applied in case of suspicion of diverticulitis complicated by occlusion or perforation but it's 100% sensitive only for a large pneumoperitoneum.⁹ Ultrasound (US) is a useful imaging modality for evaluating the abdomen, being noninvasive, portable, widely available, and relatively inexpensive. US, even in the hands of an emergency physician, is highly accurate and sensitive in identifying the most frequent diseases that can overlap with AD (abdominal aortic aneurysms, obstructive hydro-nephrosis, intestinal occlusion). US findings in patients with AD include a thickened loop of bowel with a target-like appearance. Small air bubbles can be visualised as a sign for microperforation. Sonography is also useful for assessing large abscesses. In emergency setting the most common US technique used to examine patients with suspected AD is a transabdominal compression, first introduced in 1990. The clinician performs an abdominal US to assess for diverticulitis using a low-frequency curvilinear transducer by gently squeezing through loops of the bowel in the area of localised abdominal pain. The presence of echogenic non-compressible fat surrounding one or more diverticula is suggestive for the presence of inflammation.¹⁰⁻¹²

The sensitivity of US in diagnosing AD has been reported to be as high as 84-100%.¹³ But two complete and comprehensive literature researches conducted by the groups of Liljegen in 2006¹⁴ and Lameris in 2008¹⁵ to compare the diagnostic accuracy of graded compression of US vs CT in diagnosis AD revealed a very limited number of high-quality studies. A complete search of the Medline, Embase and Cinahl databases resulted in a collection of 1689 studies, among which only 12 were relevant. Numerous bias

Table 1. Differential diagnosis of left lower quadrant pain.

Vascular	Gastrointestinal	Genitourinary
Abdominal aneurysm	Acute left colon diverticulitis	Ureterolithiasis
Iliac aneurysm	Colorectal malignancy	Urinary infection
	Intestinal ischemia	Urinary malignancy
Gynecologic	Incarcerated hernia	Other
Ectopic pregnancy	Constipation	Abdominal wall hematoma
Malignancy	Diverticulosis	Retroperitoneal hemorrhage
Ovarian torsion	Acute appendicitis	Psoas abscess
Ruptured corpus luteum	Intestinal obstruction	Aspecific abdominal pain
Ruptured ovarian cyst	Sigmoid volvulus	
	Mesenteric lymphadenitis	
	Intestinal perforation	

factors (for instance, representative heterogeneity of the population, non-specific selection criteria, inaccurate description of the reference standard) affected the results in most of the studies. Only two investigations performed a head-to-head comparative accuracy assessment of US and CT. In both cases, the two imaging modality displayed similar accuracy in evaluation of patients suspected with diverticulitis. However, both studies were single-centre trials, including only 63 patients recruited by Soliman¹⁵ and only 64 by Pradel.¹⁶ In both cases, the images were had been interpreted by radiologists. In 1997, Zielke *et al.*¹⁷ reported another similar results. The group calculated the sensitivity and specificity of US performed by surgeons on a small group of 74 patients with suspected AD. Their results were encouraging, disclosing a sensitivity of 84% and specificity of 93%, but the same numerous bias factors remained to be taken into account. It must be noted that these studies were not designed for the emergency room arena and are potentially misleading, providing a false impression of highest accuracy. If utilized by providers with appropriate training, US could possibly represent an ideal first-line imaging test for uncomplicated diverticulitis. Accordingly, a step-up approach has been proposed that involves validation with CT after an inconclusive or negative US results.¹⁸ The majority of Experts agree that the accuracy of US is limited in obese patients when inflammation is minimal or air is present in the colon, and correlated with the examiner's expertise.¹⁹⁻³⁷ Multicentric study will certainly be needed of focus on the role of US. The American College of Radiology recommends abdominal and pelvic CT with IV contrast (rating 9) in patients with suspected AD.¹⁹ The TC responds accurately to all 3 questions we have seen above: it is useful to evaluate the severity and extent of disease and to identify complications, it also may diagnose other causes of left lower-quadrant pain that can mimic diverticulitis.²⁰ CT has reported sensitivity and specificity as high as 100 percent in diagnosing acute sigmoid diverticulitis.²¹ According with old studies published by BC Morson from St Mark's Hospital in London in 1963²² the mesenteric fat tissue around the sigmoid colon plays a central role in diagnosing and managing an AD. If the mesenteric fat becomes inflamed can produce a phlegmon or an abscess. Studying the fat around the sigmoid colon helps to determine the severity of disease, from here the treatment planning.²³ In the real world the choice of imaging strategies are driven by the clinical and by patient's characteristics. In obese patient, in whom US is more likely to be non diagnostic, in older patients with a new acute left lower abdominal pain and in severely ill patients the CT is more able to detecting alternative diagnoses and to assist in planning of a radiological or surgical intervention.

The management

In the last years the management of AD is profoundly changed. Until a few years ago hospitalization, bowel rest, intravenous fluids and antibiotic therapy were universally accepted as the first

choice treatment for mild uncomplicated diverticulitis. This practice was based on the belief that diverticulitis was due to obstruction of a diverticulum leading to mucosal abrasions, microperforation and bacterial translocation. However, this concept has been changed with newer hypotheses highlighting that AD may be an inflammatory rather than an infectious condition. Indeed, prospective randomized, case-control and retrospective cohort study shown no benefit for the use of antibiotics in the treatment of uncomplicated AD, suggesting that its use should be reserved for the treatment of complicated disease.²³⁻²⁵ An increasingly conservative approach changed also the surgery. The old simple rule of *2 attacks, then operate* is gone, the patients with pericolic air or small fluid collection should be managed by antibiotic therapy, abscesses having a diameter of more than 4 cm are best treated by percutaneous drainage.²⁶ Surgical resection is confined to patients with severe sepsis or septic shock, or if non-invasive treatments fail. The cornerstone is to create a puzzle that takes in account the clinical conditions and the extension of the disease.²⁶ More extensive is the infection, more aggressive is the treatment. Fortunately, the majority of AD episodes are uncomplicated, with about only 15% presenting complications (abscess, perforation, obstruction, fistula); even if a recurrence of AD has been reported in 15-30% of patients, generally the first episode is the most severe.²⁷⁻²⁹ The development of CT has radically changed the treatment approach for patients with acute diverticulitis. CT can be effectively employed not only to diagnose colonic acute diverticulitis but also verify the severity and extent of disease. Staging of acute diverticulitis is an essential tool that could aid in clinical decision making, such as determining the need for percutaneous drainage or surgical intervention, assessing the length of hospitalization and antibiotic administration or the opportunity for early return home directly from the ED. The original classification proposed by Hinchey³⁸ in 1978 was used as an intraoperative system, and did not meet these needs. The modified Hinchey classification proposed in 1999³⁹ was essentially a surgical assessment that described the stages of perforated diverticular disease. Both classifications have some bias, they don't take clinical symptoms into account, and are built for advanced-stage disease. In 2015, Sartelli *et al.*²⁶ proposed a more complete classification taking in account the severity of the disease and the clinical condition (Table 2). Fortunately, patients with uncomplicated diverticulitis are more frequently admitted to the ED. Usually the patient complains of moderate pain and is able to tolerate oral intake, with good response to first treatment measures in the ED. A corroborative CT is performed in these cases, which highlights that the infection only involves the colon and does not extend to the peritoneum, leading to safe discharge of patients directly from the ED. Furthermore, evidence of involvement of <5 cm of the colon is associated with a low probability of recurrence.⁴⁰ The severity of diverticulitis on CT is statistically predictive of the risk of medical treatment failure during the acute phase and chance of poor secondary outcome after successful medical treatment of the first episode. Staging is also a guide for antibiotic therapy. The AVOD study was the first prospective random-

Table 2. A proposal for a computed-tomography guided classification of acute diverticulitis. Adapted from Sartelli *et al.*²⁶

Stage 0	Diverticula, thickening of the colonic wall or increased density of the pericolic fat
Stage Ia	Pericolic air bubbles or little pericolic fluid without abscess (within 5 cm from inflamed bowel segment)
Grade Ib	Abscess \leq 4 cm
Grade IIa	Abscess > 4 cm
Grade IIb	Distant air (>5 cm from inflamed bowel segment)

ized controlled trial to show no benefit of antibiotic treatment in patients with uncomplicated diverticulitis.⁴¹ Small abscesses may be solely treated with antibiotics while large abscesses need to be interventionally drained in addition to antibiotic treatment.

The three-step approach

Several guidelines and reviews on diverticular disease have been published in last years with discrepancies regarding important issues, such as the role of clinical examinations, the imaging approach, the antibiotic prescriptions for uncomplicated diverticulitis, treatment of abscesses, and indications for colon resection in case of peritonitis.^{20,30-34} The diversified approach is attributed to the lack of high-quality evidence.³⁰ Another limitation of these guidelines is that they were originally developed by experts in various fields, including gastroenterologists,^{31,32} colorectal surgeons^{33,34} and emergency surgeons.²³ In the clinic, the course of suspected AD can involve emergency physicians at first, followed if necessary by radiologists and surgeons. Aim of this review authored by a small group of emergency physicians, radiologists and surgeons with expertise in acute abdominal pain is focused on a multimodal and collaborative approach for treatment of patients suspected of AD. This approach involves three steps, each of them is essential for the success of the course.

Step one: the suspicion

i) Age greater than 50 years, one or more similar previous episodes, localization of symptoms in the lower left abdomen, aggravation of pain on movement, absence of vomiting, tenderness in the lower left abdomen, and CRP of 50 mg/L or higher characterize patients with high suspect of AD; ii) It's reasonable a prudent approach and an high suspect of disease in older patients with lower abdominal pain. Difficulty in obtaining history, lack of consistent physiologic responses (fever, hypotension, pain, tachycardia and leukocytosis) make diagnosis of AD a very challenge; iii) Since clinical assessment remains ambiguous in the majority of cases, an imaging strategy is recommended.

Step two: the confirmation

i) US may aid in excluding the most frequent diseases that mimic of AD, (abdominal aortic aneurysm or hydronephrosis, for example); ii) US appears also to present a logical and safe technique of choice in younger skinny patients or if there's the suspect of a non-complicated recurrent colonic diverticulitis; iii) CT is the imaging technique of choice for evaluation of patients with suspected AD. CT is also helpful in identifying alternative diagnoses with similar presentations.

Step three: the staging

i) Assessing the site and the severity of the disease is the key; ii) Staging of diverticulitis on CT is the guide for the treatment planning according to its severity; iii) Effective communication and condivision of strategies among emergency physicians, radiologists and surgeons must be necessary for a positive impact on the quality of care provided to patients with suspect of AD.

Conclusions

Over the last 10 years, the number of patients suffering of AD is increasing in all over the world.⁴² It is now classified as the third most common gastrointestinal discharge diagnosis.⁴³ Most of the

time signs and symptoms associated with AD are aspecific and commons to other intra-abdominal pathologic conditions. In recent years, integrated imaging has revolutionized the classical approach to acute abdominal pain and close cooperation is essential among emergency physicians, radiologists and surgeons for improving treatment outcomes. A high index of suspicion in the setting of a compatible history and physical examination is the cornerstone of early diagnosis. Inclusion of an appropriate diagnostic modality is crucial to validate initial suspicion of the disease, to exclude other potential diseases that mimic diverticulitis, and to evaluate the severity and extent of disease. Only a collaborative strategy that takes into account the extension of the disease, the clinical condition and the compliance of the patients permits to plan a tailored treatment.

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