

REVIEW

Management of acute colonic diverticulitis in the general and surgical emergency departments

Jurij Janež^{1,2,*}, Gašper Horvat¹

¹Department of Abdominal Surgery, University Medical Centre Ljubljana, 1525 Ljubljana, Slovenia

²Faculty of Medicine, University of Ljubljana, 1104 Ljubljana, Slovenia

***Correspondence**jurij.janez@kclj.si

(Jurij Janež)

Abstract

Acute left colonic diverticulitis is a very common disease that primarily affects the older population in the Western world. The pathogenesis of acute inflammation of the diverticula may not be as simple as once thought, and the disease cascade could involve a combination of chronic inflammation and altered gut microbiota. Several lifestyle risk factors such as obesity, low-fibre diet, smoking, use of non-steroid anti-inflammatory drugs, inadequate physical activity and others have been associated with a higher risk for diverticulitis. It has been proven that uncomplicated diverticulitis in immunocompetent patients without systemic signs of infection can be treated symptomatically. Outpatient treatment with peroral antibiotics is effective for managing patients with uncomplicated diverticulitis and signs of systemic inflammation. New, less-invasive surgical options have been recognised as appropriate for a select group of patients with complicated diverticulitis. Laparoscopic lavage and drainage are suitable for abscesses where the bowel wall is intact. Resection with primary anastomosis with or without ileostomy is now considered an option for some patients that would historically have to undergo Hartmann's procedure. The latter still remains the most common operating option even in tertiary referral centres around the world as it is suitable for more complicated cases and critically ill patients. Current evidence does not support routine colonoscopic evaluation for uncomplicated diverticulitis in younger patients without risk factors. Recurrent diverticulitis is now understood to be more benign than was previously thought. Elective resection of the sigmoid colon is therefore no longer a standard treatment for all patients with two or more episodes of acute diverticulitis.

Keywords

Diverticulitis; Classification; Conservative treatment; Surgery; Follow-up

1. Introduction

Diverticulitis is an infection of diverticula, which are abnormal outpouchings of the intestinal wall. Even though diverticula can occur throughout the entire intestine, they most commonly occur in the colon, more specifically on the left side of the colon. The sigmoid colon is most commonly affected [1]. In this article we will focus only on the left-sided colonic diverticula and the associated acute left colonic diverticulitis as it is one of the most common reasons for presentation to the emergency surgical department. For general and abdominal surgeons, and indeed all first-line emergency room physicians, familiarity with the management of this common abdominal emergency is imperative.

2. Pathophysiology, aetiology and epidemiology

Colonic diverticula are herniations of the intestinal mucosa and submucosa through the muscular layer of the intestinal

wall, usually occurring at the mesenteric site of the colon. The mesenteric site, where small arterioles protrude from the layers of the colonic wall, presents an area of weakness. These small areas, where the usually firm muscle layers are perforated, offer a way for the mucosa and submucosa of the colon to protrude outwards, thus forming a colonic diverticulum [1]. The combination of western style diet (low daily fibre intake) and disordered motility of the bowel, which both contribute to increased intraluminal pressure in the colon are among the main proposed aetiological factors in the formation of diverticula [1, 2]. It was once widely considered that diverticulitis occurs because of obstruction of diverticula that eventually leads to microtrauma, ischaemia, infection and even perforation. The theory that the major cause of the obstruction was ingested nuts and seeds has been disproven and new models that combine chronic inflammation of the colonic mucosa and altered gut microbiome have been proposed [3, 4].

Colonic diverticulosis is very common in the western world, occurring in more than 50% of people over the age of 50 years, and in more than 60% of people over the age of 80

years. It is more common in men than women in the first six decades, but becomes more common in women beyond this age. Historically, it was believed that the lifetime risk of developing diverticulitis (when considering people with colonic diverticulosis) is between 10% to 25%. However, modern statistical projections lower this estimate to somewhere between 5% and 7% [2, 3, 5, 6]. Nevertheless, the incidence of diverticulitis has been rising in recent years, with the highest rise seen among younger individuals between 40 and 49 years [7].

Lifestyle-connected risk factors, such as diet low in fibre, high red meat consumption, smoking, central obesity, and a history of significant use of certain medications (non-steroidal anti-inflammatory drugs (NSAID), corticosteroids and opioid analgesics) have all been associated with a higher risk for development of diverticulitis [3, 8]. Remarkably, it has been established that following a low-risk lifestyle and diet could lower the risk of diverticulitis by 75% in men. The low-risk lifestyle was defined as eating less than 4 servings of red meat per week, eating at least 23 g of fibre daily, exercising for at least 2 hours weekly, maintaining a body mass index (BMI) between 18.5 and 25 kg m⁻² and abstaining from smoking [9].

3. Clinical presentation and diagnosis

The most common symptom associated with acute left-sided colonic diverticulitis is pain in the left lower quadrant (LLQ) of the abdomen. It is most commonly accompanied with changes in bowel habit (constipation in approximately 50% of patients and diarrhoea in 25–35%), anorexia, nausea, fever, and sometimes with urinary symptoms. Clinical examination findings include abdominal tenderness or pain in the LLQ, which depends on the severity of the disease. Focal signs of peritonitis in the LLQ can be seen when locally contained perforation of the colon occurs. When the perforation is not contained but diffusely spreads to the whole abdominal cavity, signs of diffuse peritonitis with rebound phenomenon, guarding and diffusely tender abdomen can be observed [1, 10].

Leucocytosis and raised levels of C-reactive protein (CRP) are the most common laboratory findings in acute diverticulitis. CRP has been established as a useful laboratory marker predicting the severity of the disease. Multiple studies on large cohorts of patients have proven that a CRP value higher than approximately 170 mg/L (higher than 150 mg/L in one of the studies) is an independent diagnostic factor for complicated diverticulitis. Interestingly, body temperature was not recognised as a prognostic tool [11–14]. When evaluating the severity of a patient's disease on presentation at the emergency ward, the physician should be aware that the level of CRP starts to rise 6–8 hours after the onset of the disease and peaks 48 hours after [14].

According to the updated guidelines for the management of acute left-sided colonic diverticulitis in the emergency setting issued by the World Society for Emergency Surgery (WSES), the diagnosis of acute colonic diverticulitis should be made by integrating clinical history, examination signs, laboratory inflammation markers and radiological findings. Basing diagnosis on only clinical examination and laboratory findings has

been proven to have positive and negative predictive values of 0.65 and 0.98 respectively. By adding cross-sectional imaging to the diagnostic procedure, the positive and negative predictive values rise to 0.95 and 0.99 respectively [14, 15]. A number of clinical scoring systems have been developed to aid in establishing the diagnosis of acute diverticulitis. For example, a clinical rule devised by Lameris *et al.* [16] in their prospective study on 126 patients suggested that the triad of direct isolated LLQ tenderness, CRP value greater than 50 mg/L and absence of vomiting has a 97% diagnostic accuracy when all three criteria are met. When all three features were negative, 47% of patients did not have acute diverticulitis [16]. Another retrospective study attempting to devise a clinical decision support system was performed by Andeweg *et al.* [17] who demonstrated seven independent prediction factors for acute diverticulitis, and devised a normogram to aid the clinician. Age greater than 50 years, one or more previous episodes of acute diverticulitis, history and clinical presentation of tenderness in the LLQ of the abdomen, aggravation of pain on movement, CRP value greater than 50 mg/L and the absence of vomiting were prediction factors that could, when combined, estimate the probability of a patient having acute colonic diverticulitis [17].

The WSES recommends that all patients suspected to have acute diverticulitis should undertake a computed tomography (CT) scan of the abdomen, as it is an essential tool to assess the severity of the disease and properly plan the treatment. A step-up approach, where firstly an ultrasound of the abdomen is made and CT is done only when the results of an ultrasound are inconclusive or negative, is also appropriate. It has been determined that an abdominal ultrasound in the hands of an experienced radiologist has only slightly worse sensitivity and specificity than CT: 90% versus 95% and 90% versus 96%, respectively [2, 18, 19].

4. Classifications

When managing a patient with acute diverticulitis, it is of utmost importance to determine whether the episode can be classified as uncomplicated or complicated acute diverticulitis. The majority of patients (\approx 90%) present with uncomplicated diverticulitis, meaning that the inflammation process spared the peritoneum; and the clinical picture of such patients will typically include abdominal pain in the LLQ, fever, leucocytosis and CRP values below 150–170 mg/L (as explained previously in the text). Complicated diverticulitis occurs when the peritoneum is involved, meaning that abscess, perforation, local or diffuse peritonitis, stricture or fistula formation can be seen. Most commonly, complicated diverticulitis presents with an abscess formation (70%), peritonitis (27%), obstruction (15%) and fistula formation (14%) [2, 7, 14].

Historically, the Hinchey classification was used to categorize the severity of acute diverticulitis into four stages: stage 1—pericolic abscess; stage 2—pelvic, intra-abdominal or retroperitoneal abscess; stage 3—generalized purulent peritonitis and stage 4—generalized faecal peritonitis. The last two stages can only be correctly determined intraoperatively and therefore offer little help to the clinician trying to decide how to treat a patient in the emergency room setting. Several

other newer classifications have been developed that rely more on CT imaging findings. For example, a modification of Hinchey's classification was developed by Kaiser *et al.* [20], where the stages are determined according to the CT finding: stage 0—mild clinical diverticulitis; stage 1a—confined pericolic inflammation; stage 1b—confined pericolic abscess; stage 2—pelvic or distant intra-abdominal abscess; stage 3—generalized purulent peritonitis; stage 4—faecal peritonitis at presentation. This modified Hinchey's classification appears to be the most widely used currently, as evident in the majority of studies available online regarding acute colonic diverticulitis. Another useful CT-based classification proposed by Ambrosetti classifies diverticulitis into moderate (inflammation of colonic wall with wall thickening ≥ 5 mm and signs of pericolic fat inflammation), and severe (features of colonic wall thickening with signs of abscess, extraluminal gas or extraluminal extravasation of contrast) [21].

The WSES proposed a solely CT guided classification of acute colonic diverticulitis in 2015 which divides acute complicated diverticulitis into 4 stages. Uncomplicated diverticulitis is stage 0, which is a CT finding of diverticula, thickening of the colonic wall or increased density of the pericolic fat. Stage 1a of complicated diverticulitis is pericolic air bubbles or little pericolic fluid without abscess (within 5 cm of inflamed bowel segment). Stage 1b is abscess less than or equal to 4 cm. Stage 2a is abscess larger than 4 cm. Stage 2b is distant air in the abdominal cavity (more than 5 cm away from the inflamed bowel). Stage 3 is diffuse fluid without distant free air (without signs of colonic perforation). Stage 4 is diffuse fluid with distant free air (signs of colonic perforation) [14].

5. Treatment

In managing immunocompetent patients with no signs of systemic inflammation (body temperature <38 °C, leukocyte level $<11 \times 10^9/L$, no gastrointestinal dysfunction) current evidence-based recommendations do not support antibiotic treatment for acute left colonic diverticulitis. Several randomized trials performed in the past few years demonstrated that antibiotic therapy in the aforementioned patient group has no significant effect on recovery pace, complication prevention or recurrences. Accordingly, it is now regarded safe and justified to omit antibiotic therapy in immunocompetent patients with uncomplicated (or moderate, on the Ambrosetti's classification) diverticulitis [22–26].

However, patients diagnosed with uncomplicated diverticulitis with signs of systemic inflammation should undergo antibiotic treatment. The selected antibiotics should cover Gram-positive and Gram-negative bacteria and anaerobes. The most commonly prescribed regimen globally is the combination of ciprofloxacin and metronidazole or the combination of amoxicillin with clavulanic acid for a duration ranging from 7 to 14 days. Local epidemiological data and bacterial resistance should be taken into account [2, 14]. It has been shown that both orally and intravenously administered antibiotics can be equally effective [27]. It is also deemed safe to treat these patients as outpatients if certain criteria are met, as demonstrated in many trials [28–30]. Such patients should have no comorbidities and/or immunosuppression; and

should be able to tolerate oral intake and have adequate social network. Systematic reviews and meta-analyses performed by van Dijk *et al.* [26, 29] and Cirocchi *et al.* [30] reported 7% readmission rate for outpatient-treated patients, and 4.3% rate of outpatient treatment failure, respectively. No generally accepted outpatient treatment protocol has been validated, but the WSES suggests that a clinical evaluation after 7 days of treatment with antibiotics should be undertaken. If the clinical condition of the patient deteriorates before time, an earlier re-evaluation is indicated [14].

Patients suffering from complicated diverticulitis (modified Hinchey 1b and beyond) are treated in accordance with the presenting complications. Intraabdominal abscesses can be drained percutaneously if their size and location permit so. Patients with intrabdominal abscess should be treated with intravenous antibiotics and therefore hospitalized. The decision on further steps in management (percutaneous drainage or surgical intervention), is based on the clinical status of the patient, laboratory findings, response to the antibiotic treatment and the size and location of the abscess. With abscess size of more than 4–5 cm, conservative antibiotic therapy is associated with higher rates of treatment failure. In such cases percutaneous drainage (if feasible) should be considered as a treatment option. If that fails, surgical drainage and lavage remains as a definitive treatment option [14].

In patients with acute complicated diverticulitis presenting with generalised peritonitis (Hinchey 3–4), perforation or signs of critical systemic illness (clinical parameters such as tachycardia, hypotension, elevated respiratory rates; laboratory findings such as leucocytosis, raised levels of CRP and procalcitonin) a primary surgical intervention is the treatment of choice. The standard procedure in this group of patients remains the Hartmann's procedure [14]. In this procedure, the affected part of the sigmoid colon is resected. Distally a rectal stump is formed, which nowadays is usually closed using a stapling device. The proximal part of the colon is then diverted through the abdominal wall, thus forming an end colostomy. This procedure is safe, as anastomosis—associated complications such as dehiscence with resulting peritonitis and septic shock, are avoided [1]. The Hartmann's procedure remains the most commonly performed operation in the emergency treatment of acute complicated diverticulitis even in tertiary referral centres [31]. Usually, patients with Hartmann's procedure undergo a bowel continuity restoration operation, which is usually done at least 3 to 6 months after the first operation. In some cases, where the restoration operation is considered too risky for the patient a permanent colostomy is performed.

In selected patients with Hinchey 3 acute diverticulitis, laparoscopic lavage and drainage of the abdominal cavity, without bowel resection can be performed. This type of surgery is possible in patients with generalized purulent peritonitis without evident bowel perforation [14]. With the advancements in laparoscopic surgery and the increasing tendency for minimally invasive procedures, an operation with primary anastomosis as a possible treatment option has been advocated. Resection of the sigmoid colon with primary anastomosis between the proximal part of the colon and rectum was deemed feasible in a select group of patients with generalised peritonitis

[14]. When this type of operation is performed, a temporary diverting loop ileostomy can be made to function as a safeguard for the primary colorectal anastomosis, as no faeces passes through it and the anastomosis is kept in a permanent state of “bowel rest”. Several multicentre randomised controlled trials such as DIVERTI or LADIES showed no statistically important difference in morbidity and mortality between patient groups undergoing Hartmann’s procedure or primary anastomosis. Both studies have also shown a significantly higher rate of stoma reversal in the anastomosis cohort, with associated better quality of life for the patients [32, 33]. It should be noted that in the LADIES study, only immunocompetent and hemodynamically stable patients under the age of 85 years were deemed fit to undergo the primary anastomosis operation. This is consistent with the current consensus that this procedure is only suggested in a select group of patients, and that the final decision still lies in the surgeon’s assessment of the degree of inflammation and the state of the bowel and patient’s general clinical condition [14].

6. Long term treatment and follow up

A population-based study of the natural history of diverticulitis by Bharucha *et al.* [7] revealed that the incidence of recurrent diverticulitis after the first episode is 8% at 1 year, 17% at 5 years and 22% at 10 years. The incidence levels at years 1, 5 and 10 were even higher for patients that have already suffered two or three episodes of diverticulitis. The independent risk factors for recurrent episode were younger age and female sex [7]. Historically, patients with more than 2 episodes of diverticulitis were offered an elective resection of the sigmoid colon, a paradigm that has been challenged in recent years. Several trials have attempted to determine the group of patients that would benefit from an elective resection of the sigmoid colon and the proper timing of the procedure. It was determined that the probability for an episode of complicated diverticulitis after an episode of uncomplicated diverticulitis is between 3.9 and 5%. The risk of recurrence of uncomplicated diverticulitis is estimated at 13–23% [2, 3, 34, 35]. Hall *et al.* [34] noted that family history of diverticulitis, length of involved colon greater than 5 cm and retroperitoneal abscess, were factors associated with recurrence of the disease. Furthermore, Chapman *et al.* [36] found that patients with more than two episodes of diverticulitis were not at higher risk for complications than patients that suffered one or two episodes. In addition, it has been established that the risk of septic peritonitis is lower with each next recurrence [35]. The current consensus seems to be that elective resection of the sigmoid colons should be a case-to-case decision between a surgeon and a patient, where all the patient’s risk factors are taken into account [3, 14]. As recommended in different guidelines and treatment protocols, a colonoscopy should be performed in every patient that suffered an episode of diverticulitis. The best time for the procedure is somewhere between 4 and 8 weeks after the resolution of the symptoms. Colonoscopy is advised, as it has been shown that approximately 1 in 67 patients primarily diagnosed and treated for acute colonic diverticulitis is suffering from colon cancer [3]. Other types of colitis, such as ischemic or Crohn’s can also mimic acute diverticulitis [35]. Some trials have ques-

tioned this logic. The WSES recommends early colonoscopy for patients with abscess formation treated conservatively, but recommends only age-appropriate colon cancer screening in patients recovering from uncomplicated diverticulitis [18]. Based on several meta-analyses it appears that the incidence of colon cancer is higher in patients with complicated than uncomplicated diverticulitis and that the incidence of colon cancer in patients with uncomplicated diverticulitis is low [2]. The guideline from the 2018 consensus conference of the American Gastrointestinal and Endoscopic Surgeons and the European Association of Endoscopic Surgery reflects these findings as it does not recommend a routine colonoscopy in patients after uncomplicated diverticulitis without colonic cancer risk factors [37].

7. Recommendations for emergency doctors on the management of patients with acute colonic diverticulitis in the emergency department

When managing a patient presenting with acute pain in the LLQ as a primary complaint, a thorough history and physical examination should always be performed. Firstly, the severity of the patient’s complaints should be determined by evaluating the pain level using the VAS (visual analogue scale) pain score; the duration since the onset of the presenting complaints and most importantly, symptoms and signs of systemic inflammatory response syndrome (SIRS), such as body temperature of less than 36 °C or over 38 °C, tachycardia over 90 beats per minute, tachypnoea over 20 breaths per minute and leukopenia of under $4 \times 10^9/L$ or leucocytosis of over $12 \times 10^9/L$ [38]. From the patient’s medical history and list of medications, it is possible to determine whether the patient is immunocompetent or immunosuppressed. Logically, the latter patient bears a greater risk for complications and should be treated with extra caution, including a lower threshold for hospitalisation and need for intravenous antibiotics, and prompt expert opinion from the consulting surgeon. Importantly, history of previous surgery in the abdomen must be explored, because pain in the LLQ with associated constipation can be also caused by acute colonic obstruction, particularly in patients with previous abdominal operation. The emergency doctors should avoid redundant tests and speed up the diagnostics. X-ray has no proper role in patients with acute abdomen and CT scan should be employed as soon as possible. If the colon or small bowel is distended on a CT scan, the patient should be treated accordingly to the findings. Acute bowel obstruction can occur as a secondary complication of acute diverticulitis, or it could be of completely different origin [1]. Patients with suspected acute left-sided colonic diverticulitis should never be given a colonic enema as it could be a risk factor for bowel perforation.

The next questions that need to be asked include if the index episode is the patient’s first experience of LLQ pain. Was there ever a colonoscopy performed and if so, what were the findings? When treating a patient with recurrent episodes of acute diverticulitis or a patient where sigmoid diverticula were proven during the colonoscopy exam, the clinical suspicion that the patient is indeed suffering from an episode of acute

diverticulitis is much higher. An emergency room doctor should also be wary of any changes in the patient's stool. A combination of pain in the LLQ and signs of rectal bleeding is primarily suspicious of ischemic colitis, and can also be associated with infectious colitis or inflammatory bowel disease. More rarely, even acute colonic diverticulitis can present with bleeding [39].

A lot of information can be obtained from careful palpation of the abdomen. As already mentioned earlier, signs of local or diffuse peritonitis are associated with complicated diverticulitis. When a patient presents with aforementioned signs, a surgeon should always be consulted. Unfortunately, palpation of the abdomen can be very challenging and usually takes quite a great deal of experience to perform adequately. Diffuse peritonitis, which presents with guarding, rebound-tenderness phenomenon and general rigidity of the abdominal wall muscles can be properly diagnosed even by an inexperienced physician. Such patients are usually in general distress, complaining of high levels of pain and are not able to tolerate even gentle percussion of the abdomen, movement of the body and coughing or sneezing [1, 39]. They should be offered intravenous analgesics and their vital signs closely and regularly monitored. Laboratory investigations should be obtained as quickly as possible. A CT scan is mandatory. It is advisable to inform the consulting surgeon about such a patient even before getting the full laboratory or CT exam, because these patients almost always need an emergent operation within hours of presentation in the emergency department. Local peritonitis is confined to one of the abdominal quadrants and when discovered doesn't merit such swift and drastic measures as its diffuse counterpart. But it can take a progressive course, where the inflammation spreads beyond the colonic wall. A full laboratory exam, an ultrasound or CT scan (depending on local protocols) should be done. The surgeon has to be informed about the finding of features of local peritonitis as it is a very important sign suggesting that the patient will have to undergo an operation in the next hours or days. Palpation can be tricky in obese patients as the fat layers may mask the tenderness and muscle rigidity occurring underneath.

A full laboratory investigation should be performed. The leucocyte and CRP levels will provide a reliable assessment of the severity of the episode of acute diverticulitis. As noted above, a CRP level greater than 150 to 170 mg/L can be used to distinguish between uncomplicated and complicated diverticulitis. Markers of inflammation are crucial in the treatment of acute diverticulitis as they aid in calibration of the severity of the disease and treatment plan [14]. Electrolytes, blood urea nitrogen and creatinine will help in assessing for dehydration or electrolyte disbalance, both of which could occur in patients presenting with diarrhoea or in patients not tolerating oral intake. If findings are remarkable, treatments should be offered accordingly. Indeed, all patients should be offered some kind of intravenous solution (whether it be saline or electrolyte balanced solution) during their period at the emergency department. Patients suspected to be suffering from acute diverticulitis should not be allowed to eat or to drink before the final decision for treatment is made. Coagulation markers such as prothrombin time (PT) and international normalised ratio (INR) are mandatory laboratory parameters to

be obtained prior to surgery or percutaneous drainage. If the results are abnormal, anaesthesiologists (or other specialities depending on local protocols) should be informed and where indicated correction of the abnormal coagulation should be started as soon as possible. Special care must be taken in patients on warfarin or the new oral anticoagulants (NOAC) as the reversal of their effect is more challenging. Correction using prothrombin complex concentrate, fresh frozen plasma (which both have an immediate effect on coagulation) or K-vitamin (with more gradual normalisation of coagulation) is prompt in patients on warfarin therapy. There are some other specific antidotes for NOAC, which may be employed to cancel out their effect. However, all of the above-mentioned antidotes should be used only following consultation with the anaesthesiologists.

Analgesics should be offered to all patients in need. The old mantra that they conceal the true nature of disease and will hinder objective exploration of the right diagnosis is currently considered untrue and rather ethically inhumane.

Patients with LLQ pain and negative markers of inflammation and without any risk factors such as immunodeficiency, use of steroid drugs, etc., can be treated symptomatically (without antibiotics); in principle they do not require radiological diagnostics at the emergency department. However, they should be advised to visit their general practitioner in the next 2 or 3 days for a control laboratory examination. They should be informed of the signs and symptoms they have to pay attention to, and to seek immediate medical attention if their condition deteriorates. In such patients, colonoscopy at greater than eight weeks after the cessation of LLQ pain, is advisable, especially if the diagnosis of colonic diverticula has not been established before. In such cases there is no need to consult the surgeon.

Patients with elevated markers of inflammation (SAGES and EAES consensus recommends a cut-off value of CRP over 50 mg/L) [37] and/or signs of systemic inflammatory response should undergo an abdominal ultrasound or CT scan (depending on the institution protocols). When the radiologic diagnostics confirm an uncomplicated diverticulitis, patients should be offered some kind of antibiotic treatment. Immunocompetent patients that are able to tolerate oral intake and have a good social network can be discharged home with oral antibiotics. In some protocols, the first dose of the antibiotic is given intravenously at the emergency department. As per WSES guidelines, a control examination at the general practitioners' office should be performed 7 days after the start of antibiotic treatment or before if the antibiotic treatment fails and the patient's clinical condition worsens. In such cases, the surgeon does not need to be involved in the treatment at the emergency department. If the patient has suffered from many episodes of diverticulitis before, it may be advisable to refer him for control check-up with the surgeon to discuss the possibility of elective sigmoid colon resection [2]. In patients with uncomplicated diverticulitis who are immunosuppressed, or who are not able to tolerate oral intake, or who do not have an adequate social network, hospitalization and intravenous antibiotic administration is advisable. Such patients are usually admitted to the local surgery department, so communicating it with the surgeon is necessary.

If the radiological evaluation reveals signs of complicated

diverticulitis and/or the inflammation markers are high (for example CRP levels over 150–170 mg/L), and/or signs of local or diffuse peritonitis are present, or the general medical condition of the patient is critical, the surgeon should be consulted. Such patients usually need hospitalisation, intravenous antibiotics and some kind of surgical (or radiological) intervention. Patients like these should receive some type of electrolyte infusion and adequate analgesics at the emergency department. Following discussion with the surgeon, they may be offered intravenous antibiotics early on at the emergency department. Preparation for the operation (treatment of abnormal coagulation, electrolyte imbalance) should commence at the emergency department if the need for an immediate operation is confirmed. In such cases, cooperation between emergency doctor, anaesthesiologist and surgeon is of utmost importance.

8. Conclusions

Acute left-sided diverticulitis is a very common diagnosis in the emergency department world-wide. Accordingly, its characteristics should be known not just to general and visceral surgeons, but to all emergency doctors. Following a diagnosis, several options of treatment are recommended according to specific evidence-based criteria. According to the modern consensus, immunocompetent patients without systemic signs of inflammation recover well only on symptomatic therapy. Cases of uncomplicated diverticulitis with signs of systemic inflammation would require antibiotic therapy, but do not necessarily need hospitalization as it has been proven that both oral and intravenous antibiotics can be equally effective. Percutaneous drainage for abscesses bigger than approximately 4–5 cm has become a standard treatment. Surgery is reserved for complicated cases of acute diverticulitis. Laparoscopic surgery offers a new, minimally invasive approach for treating some of the abscesses even without the need for resection. When the need to remove the damaged bowel occurs, primary anastomosis with or without ileostomy can be performed, offering better long-term quality of life for patients. When the patient is critically ill, or the complications in the abdominal cavity presents limited prospect of successful conservative treatment, the standard intervention remains the Hartmann's procedure. It is a procedure which allows the surgeon to remove the ischemic, highly inflamed or perforated part of the colon with the maximum amount of safety for the patient.

AUTHOR CONTRIBUTIONS

JJ wrote the concept of the manuscript and GH wrote the draft of the manuscript. JJ and GH both finalized and approved the final version of the manuscript. JJ and GH both participated in the revised version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

ACKNOWLEDGMENT

Thanks to all the peer reviewers for their opinions and suggestions.

FUNDING

This research received no external funding.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

REFERENCES

- [1] Sabiston DC, Townsend CM, Beauchamp RD, Evers BM, Mattox KL. Sabiston textbook of surgery: the biological basis of modern surgical practice. Wb Saunders: Philadelphia. 2017.
- [2] Hawkins AT, Wise PE, Chan T, Lee JT, Glyn T, Wood V, *et al.* Diverticulitis: an Update from the Age Old Paradigm. *Current Problems in Surgery.* 2020; 57: 100862.
- [3] Strate LL, Morris AM. Epidemiology, Pathophysiology, and Treatment of Diverticulitis. *Gastroenterology.* 2019; 156: 1282–1298.e1.
- [4] Strate LL, Liu YL, Syngal S, Alloori WH, Giovannucci EL. Nut, corn, and popcorn consumption and the incidence of diverticular disease. *The Journal of the American Medical Association.* 2008; 300: 907–914.
- [5] Shahedi K, Fuller G, Bolus R, Cohen E, Vu M, Shah R, *et al.* Long-term Risk of Acute Diverticulitis among Patients with Incidental Diverticulosis Found during Colonoscopy. *Clinical Gastroenterology and Hepatology.* 2013; 11: 1609–1613.
- [6] Loffeld RJ. Long-term follow-up and development of diverticulitis in patients diagnosed with diverticulosis of the colon. *International Journal of Colorectal Disease.* 2016; 31: 15–17.
- [7] Bharucha AE, Parthasarathy G, Ditah I, Fletcher JG, Ewelukwa O, Pendlimari R, *et al.* Temporal Trends in the Incidence and Natural History of Diverticulitis: a Population-Based Study. *The American Journal of Gastroenterology.* 2015; 110: 1589–1596.
- [8] Böhm SK, Kruis W. Lifestyle and other risk factors for diverticulitis. *Minerva Gastroenterologica e Dietologica.* 2017; 63: 110–118.
- [9] Liu PH, Cao Y, Keeley BR, Tam I, Wu K, Strate LL, *et al.* Adherence to a Healthy Lifestyle is Associated with a Lower Risk of Diverticulitis among Men. *The American Journal of Gastroenterology.* 2017; 112: 1868–1876.
- [10] Feuerstein JD, Falchuk KR. Diverticulosis and Diverticulitis. *Mayo Clinic Proceedings.* 2016; 91: 1094–1104.
- [11] Kechagias A, Rautio T, Kechagias G, Mäkelä J. The role of C-reactive protein in the prediction of the clinical severity of acute diverticulitis. *The American Surgeon.* 2014; 80: 391–395.
- [12] van de Wall BJ, Draaisma WA, van der Kaaij RT, Consten EC, Wiezer MJ, Broeders IA. The value of inflammation markers and body temperature in acute diverticulitis. *Colorectal Disease.* 2013; 15: 621–626.
- [13] Mäkelä JT, Klintrup K, Takala H, Rautio T. The role of C-reactive protein in prediction of the severity of acute diverticulitis in an emergency unit. *Scandinavian Journal of Gastroenterology.* 2015; 50: 536–541.
- [14] Sartelli M, Weber DG, Kluger Y, Ansaloni L, Coccolini F, Abu-Zidan F, *et al.* 2020 update of the WSES guidelines for the management of acute colonic diverticulitis in the emergency setting. *World Journal of Emergency Surgery.* 2020; 15: 32.
- [15] Toorenvliet BR, Bakker RFR, Breslau PJ, Merkus JWS, Hamming JF. Colonic diverticulitis: a prospective analysis of diagnostic accuracy and clinical decision-making. *Colorectal Disease.* 2010; 12: 179–186.
- [16] Laméris W, van Randen A, van Gulik TM, Busch ORC, Winkelhagen J, Bossuyt PMM, *et al.* A clinical decision rule to establish the diagnosis of acute diverticulitis at the emergency department. *Diseases of the Colon and Rectum.* 2010; 53: 896–904.
- [17] Andeweg CS, Knobben L, Hendriks JCM, Bleichrodt RP, van Goor H. How to diagnose acute left-sided colonic diverticulitis: proposal for a clinical scoring system. *Annals of Surgery.* 2011; 253: 940–946.

- [18] Sartelli M, Catena F, Ansaloni L, Coccolini F, Griffiths EA, Abu-Zidan FM, *et al.* WSES Guidelines for the management of acute left sided colonic diverticulitis in the emergency setting. *World Journal of Emergency Surgery.* 2016; 11: 37.
- [19] Andeweg CS, Wegdam JA, Groenewoud J, van der Wilt GJ, van Goor H, Bleichrodt RP. Toward an evidence-based step-up approach in diagnosing diverticulitis. *Scandinavian Journal of Gastroenterology.* 2014; 49: 775–784.
- [20] Kaiser AM, Jiang J, Lake JP, Ault G, Artinyan A, Gonzalez-Ruiz C, *et al.* The management of complicated diverticulitis and the role of computed tomography. *The American Journal of Gastroenterology.* 2005; 100: 910–917.
- [21] Ambrosetti P, Becker C, Terrier F. Colonic diverticulitis: impact of imaging on surgical management – a prospective study of 542 patients. *European Radiology.* 2002; 12: 1145–1149.
- [22] Shabanzadeh DM, Wille-Jørgensen P. Antibiotics for uncomplicated diverticulitis. *Cochrane Database of Systematic Reviews.* 2012; 11: CD009092.
- [23] Chabok A, Pahlman L, Hjern F, Haapaniemi S, Smedh K. Randomized clinical trial of antibiotics in acute uncomplicated diverticulitis. *The British Journal of Surgery.* 2012; 99: 532–539.
- [24] Mali JP, Mentula PJ, Leppäniemi AK, Sallinen VJ. Symptomatic Treatment for Uncomplicated Acute Diverticulitis: a Prospective Cohort Study. *Diseases of the Colon and Rectum.* 2016; 59: 529–534.
- [25] Daniels L, Ünlü Ç, de Korte N, van Dieren S, Stockmann HB, Vrouenraets BC, *et al.* Randomized clinical trial of observational versus antibiotic treatment for a first episode of CT-proven uncomplicated acute diverticulitis. *The British Journal of Surgery.* 2017; 104: 52–61.
- [26] van Dijk ST, Daniels L, Ünlü Ç, de Korte N, van Dieren S, Stockmann HB, *et al.* Long-Term Effects of Omitting Antibiotics in Uncomplicated Acute Diverticulitis. *American Journal of Gastroenterology.* 2018; 113: 1045–1052.
- [27] Ridgway PF, Latif A, Shabbir J, Ofriokuma F, Hurley MJ, Evoy D, *et al.* Randomized controlled trial of oral vs intravenous therapy for the clinically diagnosed acute uncomplicated diverticulitis. *Colorectal Disease.* 2009; 11: 941–946.
- [28] Biondo S, Golda T, Kreisler E, Espin E, Vallribera F, Oteiza F, *et al.* Outpatient versus hospitalization management for uncomplicated diverticulitis: a prospective, multicenter randomized clinical trial (DIVER Trial). *Annals of Surgery.* 2014; 259: 38–44.
- [29] van Dijk ST, Bos K, de Boer MGJ, Draaisma WA, van Enst WA, Felt RJF, *et al.* A systematic review and meta-analysis of outpatient treatment for acute diverticulitis. *International Journal of Colorectal Disease.* 2018; 33: 505–512.
- [30] Cirocchi R, Randolph JJ, Binda GA, Gioia S, Henry BM, Tomaszewski KA, *et al.* Is the outpatient management of acute diverticulitis safe and effective? A systematic review and meta-analysis. *Techniques in Coloproctology.* 2019; 23: 87–100.
- [31] Hong MK, Tomlin AM, Hayes IP, Skandarajah AR. Operative intervention rates for acute diverticulitis: a multicentre state-wide study. *ANZ Journal of Surgery.* 2015; 85: 734–738.
- [32] Bridoux V, Regimbeau JM, Ouaisi M, Mathonnet M, Mauvais F, Houivet E, *et al.* Hartmann's Procedure or Primary Anastomosis for Generalized Peritonitis due to Perforated Diverticulitis: a Prospective Multicenter Randomized Trial (DIVERTI). *Journal of the American College of Surgeons.* 2017; 225: 798–805.
- [33] Lambrechts DPV, Vennix S, Musters GD, Mulder IM, Swank HA, Hoofwijk AGM, *et al.* Hartmann's procedure versus sigmoidectomy with primary anastomosis for perforated diverticulitis with purulent or faecal peritonitis (LADIES): a multicentre, parallel-group, randomised, open-label, superiority trial. *The Lancet Gastroenterology and Hepatology.* 2019; 4: 599–610.
- [34] Hall JF, Roberts PL, Ricciardi R, Read T, Scheirey C, Wald C, *et al.* Long-Term Follow-up after an Initial Episode of Diverticulitis: what are the Predictors of Recurrence? *Diseases of the Colon & Rectum.* 2011; 54: 283–288.
- [35] Morris AM, Regenbogen SE, Hardiman KM, Hendren S. Sigmoid diverticulitis: a systematic review. *The Journal of the American Medical Association.* 2014; 311: 287–297.
- [36] Chapman JR, Dozois EJ, Wolff BG, Gullerud RE, Larson DR. Diverticulitis: a progressive disease? do multiple recurrences predict less favorable outcomes? *Annals of Surgery.* 2006; 243: 876–883.
- [37] Francis NK, Sylla P, Abou-Khalil M, Arolfo S, Berler D, Curtis NJ, *et al.* EAES and SAGES 2018 consensus conference on acute diverticulitis management: evidence-based recommendations for clinical practice. *Surgical Endoscopy.* 2019; 33: 2726–2741.
- [38] Bone RC, Balk RA, Cerra FB, Dellinger RP, Fein AM, Knaus WA, *et al.* Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. the ACCP/SCCM Consensus Conference Committee. American College of Chest Physicians/Society of Critical Care Medicine. *Chest.* 1992; 101: 1644–1655.
- [39] Schein M, Rogers PN. Schein's Common Sense Emergency Abdominal Surgery. In Moshe Schein, Paul Rogers, Ahmad Assalia (eds.). Springer: Berlin Heidelberg. 2015.

How to cite this article: Jurij Janež, Gašper Horvat. Management of acute colonic diverticulitis in the general and surgical emergency departments. *Signa Vitae.* 2022; 18(4): 8-14. doi: 10.22514/sv.2021.254.