Chapter

Complicated Colonic Diverticular Disease – Diagnostic and Therapeutic Difficulties

Cristian Mesina, Theodor Viorel Dumitrescu, Mihai Calin Ciorbagiu, Cosmin Vasile Obleaga and Mihaela-Iustina Mesina Botoran

Abstract

Diverticular disease is one of the most common problems encountered by general surgeons and gastroenterologists. The term refers to complications that occur from colonic diverticulosis. In diverticular colonic disease the sigmoid colon is usually the most commonly involved, while right acute colonic diverticulitis is rarer. In establishing the diagnosis of ALCD, objective clinical examination plays an important role in addition to biological paraclinical examinations (C-reactive protein - CRP and increased leukocyte count) and radiological paraclinical examinations: CT abdomen. CRP is a useful tool in predicting the clinical severity of acute diverticulitis. The treatment applied to patients with uncomplicated colonic diverticular disease can be represented by antibiotic therapy, water regime, hydroelectrolytic rebalancing. In patients with multiple comorbidities, hemodynamic instability, the Hartmann procedure is recommended for the treatment of acute peritonitis caused by perforated colonic diverticulitis and in hemodynamically stable patients without comorbidities, colonic resection with primary anastomosis with or without stoma is suggested.

Keywords: acute left colonic diverticulosis, acute right colonic diverticulitis, hartmann segmental colectomy, hemorrhagic colonic diverticulosis, perforating diverticular disease, acute fistulized diverticulitis

1. Introduction

Diverticular disease is one of the most common problems encountered by general surgeons and gastroenterologists. The term refers to complications that occur from colonic diverticulosis, including lower gastrointestinal bleeding, inflammation, pain, abscess formation, fistula, strictures, perforation, and death [1]. It is an important cause of morbidity and a significant economic burden [1, 2]. Acute left colonic diverticulosis is common in Western countries, with its prevalence increasing worldwide, which is probably due to lifestyle changes [1]. Although left colonic diverticulosis remains more common in elderly patients, a dramatic increase in its incidence has been observed in younger age groups in recent years [2]. Recent evidence suggests that the risk of developing acute left colonic diverticulitis (ALCD)

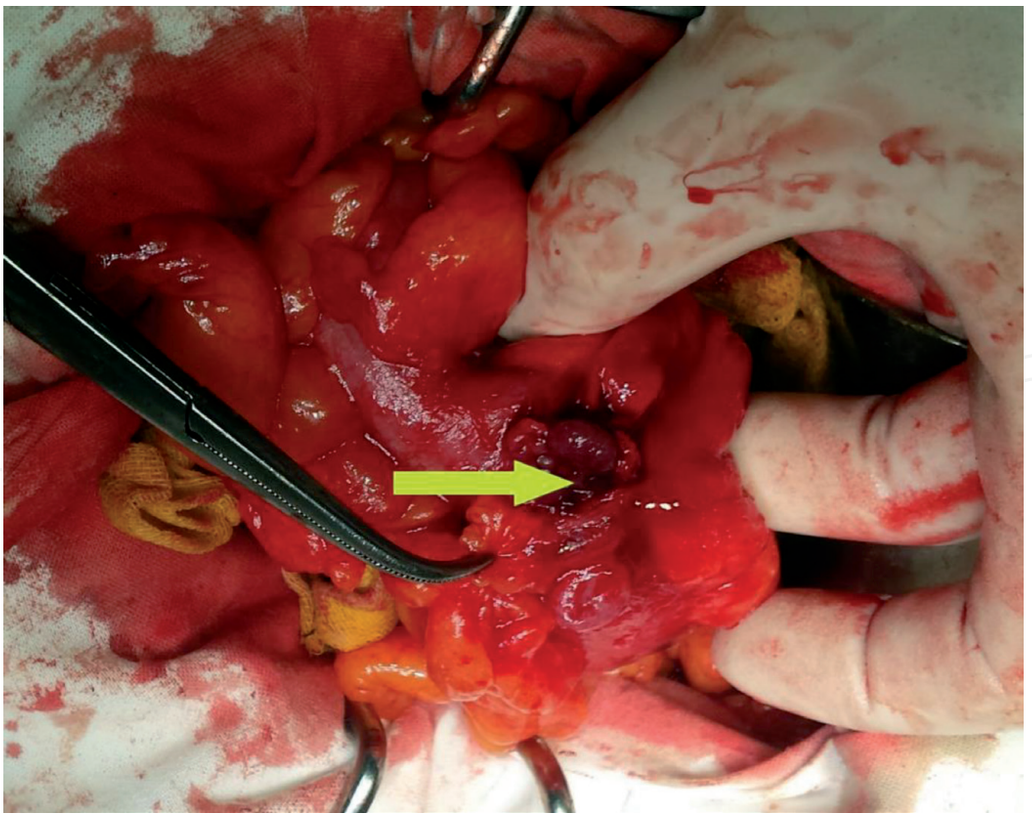

Figure 1.
Intraoperative demonstration of the colo-bladder fistula. Surgical examination of the pelvic peritoneal cavity showed a colo-bladder fistula with a diameter of 0.4 cm (yellow arrow).

for life is approximately 4% in patients with diverticulosis [3], and data from Western populations suggest that up to one-fifth of patients with acute diverticulitis have less than 50 years of age [4–6]. ALCD is a common problem encountered by Western surgeons in the acute context. The sigmoid colon is usually the most commonly involved, while right acute colonic diverticulitis (ARCD) is rarer, but much more common in non-Western populations. A diagnosis of diverticular disease should not be overlooked in younger patients, as hospitalization rates in those under the age of 40 have increased significantly in the last decade. In most cases, uncomplicated acute diverticulitis can be treated medically with antibiotics and digestive rest or with a clear liquid diet. Uncomplicated acute diverticulitis can be managed on an outpatient basis in selected patients who do not have comorbidities (including the immunocompromised state) and can tolerate a liquid diet in the absence of fever, significant leukocytosis, or evidence of complicated imaging disease. Recurrent diverticulitis or diverticulitis complications, including abscess, perforation, fistulizing disease (**Figure 1**), and strictures/obstruction usually require surgery.

2. Classification of colonic diverticular disease

In 2016, the guidelines of the World Society of Emergency Surgery (WSES) were published [7], and in 2020 the guidelines were revised in accordance with the GRADE methodology [8, 9]. The GRADE system is a hierarchical evidence-based tool that systematically evaluates the available literature. Following the study of the available literature, it was concluded that there are several classification systems for ALCD. Hinchey and colleagues rated the severity of acute diverticulitis at 4 degrees [10] in patients with clinical findings of intra-abdominal abscesses:

1. Abscess around the colon

2. Pelvic, intra-abdominal or retroperitoneal abscess

3. Generalized purulent peritonitis

4. Generalized fecal peritonitis

In recent years, computed tomography (CT) has become a diagnostic tool in the staging of patients with ALCD, so the Hinchey classification has been changed [11–15]. Thus, Neff et al. [11] presented a new classification in 5 stages, from stage 0 (uncomplicated) to stage 4 (pneumoperitoneum with abundant free fluid in the peritoneal cavity).

0 - Uncomplicated diverticulitis; diverticula, thickening of the wall, increased density of pericolic fat
1 - Complicated local with local abscess
2 - Complicated with pelvic abscess
3 - Complicated with distant abscess
4 - Complicated with other complications at a distance

In 2002, Ambrosetti et al. [12] classified ALCD as moderate disease and severe disease based on CT examination. Moderate diverticulitis was defined by thickening of the colon walls ≥5 mm and signs of inflammation of the fat around the affected colon and severe diverticulitis was defined by thickening of the colon walls, accompanied by abscess, extraluminal gas or extraluminal contrast substance:

1. Moderate diverticulitis

   a. Thickening of the wall of the localized sigmoid colon (≥ 5 mm)

   b. Infiltration of fat around the colon

2. Severe diverticulitis

   a. Abscess

   b. Extraluminal gas

   c. Extraluminal contrast

In 2005, Kaiser and colleagues [13] modified the Hinchey classification in accordance with the CT examination. Thus diverticulitis was classified into 5 stages:

Stage 0: mild clinical form diverticulitis
Stage 1a: limited inflammation around the colon
Stage 1b: limited abscess around the colon
Stage 2: pelvic or distal intra-abdominal abscess
Stage 3: generalized purulent peritonitis
Stage 4: fecal peritonitis at presentation

Mora Lopez and co-workers [14] in 2013 proposed a change to the Neff classification by dividing stage 1 of the Neff classification into:

- stage 1a - pneumoperitoneum located in the form of gas bubbles
- stage 1b - abscess <4 cm

The Mora Lopez classification is as follows:

- stage 0 - uncomplicated diverticulitis: colonic diverticulum, thickening of the colon wall, increased density of fat around the colon
- stage 1 - locally complicated diverticulitis:
  - 1a Pneumoperitoneum located in the form of gas bubbles
  - 1b Abscess (<4 cm)
- stage 2 - complicated diverticulitis with pelvic abscess. Abscess>4 cm in the pelvis
- stage 3 - complicated diverticulitis with distant abscess. Abscess in the abdominal cavity (outside the pelvis)
- stage 4 - complicated diverticulitis with other distant complications. Abundant pneumoperitoneum and / or free intra-abdominal fluid

Sallinen et al. [15] conducted a retrospective study on patients treated for ALCD and established the following staging:

stage 1 - Uncomplicated diverticulitis
stage 2 - Complicated diverticulitis with small abscess (<6 cm)
stage 3 - Complicated diverticulitis with large abscess (≥ 6 cm) or distant intraperitoneal or retroperitoneal gas
stage 4 - Generalized peritonitis without organ dysfunction
stage 5 - Generalized peritonitis with organ dysfunction

In 2015, the WSES study group [16] proposed a classification of ALCD based on CT examination of the abdomen:

- uncomplicated diverticulitis: thickening of the colon wall, increasing the density of fat around the colon
- complicated diverticulitis which is divided into 4 stages depending on the extent of the infectious process:

Stage 1

1A Air bubbles around the affected colon or small amount of fluid around the colon without abscess (5 cm from the inflamed intestinal segment).
1B Abscess ≤4 cm

Stage 2

2A Abscess>4 cm
2B Gas at a distance (> 5 cm from the inflamed intestinal segment)

Stage 3 - Diffuse fluid without free gas at a distance
Stage 4 - Diffuse fluid with free gas at a distance

3. Establishing the diagnosis of acute diverticulitis

In establishing the diagnosis of ALCD, objective clinical examination plays an important role in addition to biological paraclinical examinations (C-reactive protein - CRP and increased leukocyte count) and radiological paraclinical examinations: CT abdomen. CRP has been identified as a useful biomarker of inflammation and may be useful in predicting the clinical severity of acute diverticulitis, as demonstrated by several recent studies [17–19]. To investigate the value of CRP and other laboratory parameters of patients in predicting the clinical severity of acute diverticulitis, a retrospective study was published in 2014 [17]. The authors concluded that CRP is a useful tool in predicting the clinical severity of acute diverticulitis. A mild episode is very likely in patients with CRP less than 170 mg/l. Those with higher CRP values are more likely to undergo surgery or percutaneous drainage.

Mäkelä and colleagues [19] published a study comparing CRP values in 350 patients who first experienced symptoms of acute diverticulitis with CT results and clinical parameters, both by univariate and multivariate analyzes. The CRP limit value of 149.5 mg / l significantly discriminated uncomplicated acute diverticulitis from complicated diverticulitis (specificity 65%, sensitivity 85%, area under curve 0.811, p = 0.0001). In the multivariate analysis, a CRP value above 150 mg/l and advanced age were independent risk factors for complicated acute diverticulitis. The mean CRP was significantly higher in deceased patients (mean CRP of 207 mg/l) than in those who survived (mean CRP of 139 mg/l). In addition, a CRP value above

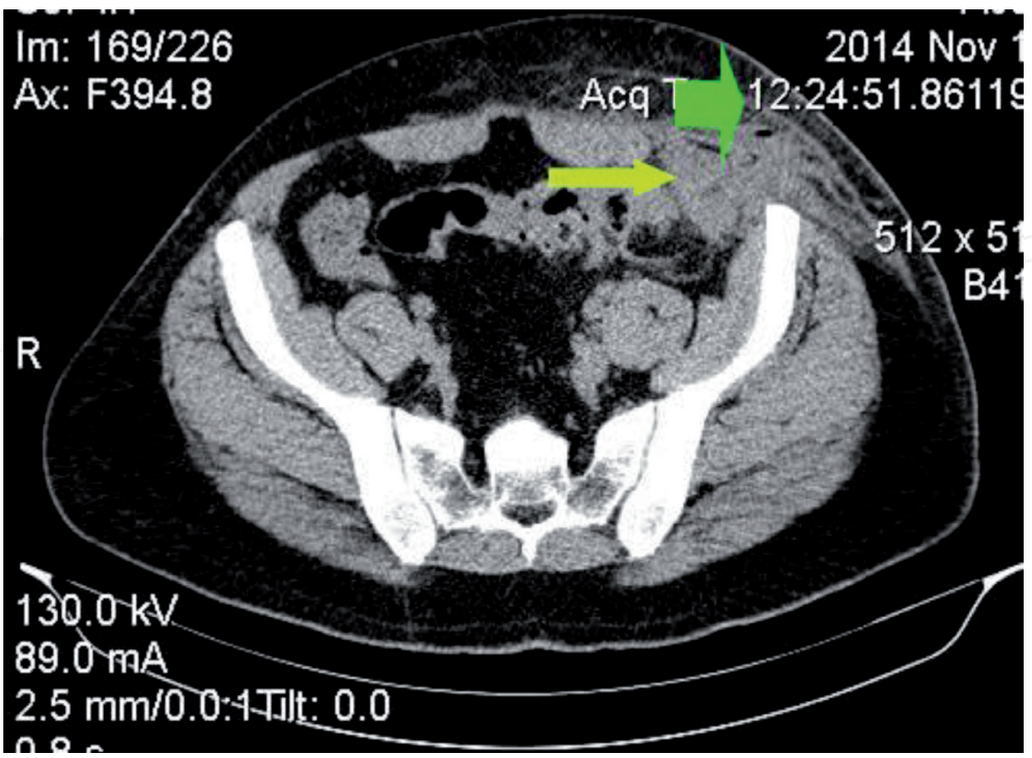

Figure 2.
CT abdomen and pelvis in a patient with colonic diverticulosis complicated by colo-cutaneous fistula: the presence of a fluid collection and areas of air bubbles in the muscles of the abdominal wall (green arrow) and the disappearance of the cleavage plane of the small intestine (yellow arrow).

150 mg/l and free abdominal fluid in CT were independent variables that predicted postoperative mortality. The study confirmed that CRP is useful for predicting the severity of acute diverticulitis on admission. The authors concluded that patients with a CRP value greater than 150 mg/l have an increased risk of complicated diverticulitis and should always undergo a CT scan.

CT abdomen with contrast agent is the radiological examination that is used to evaluate patients with suspected ALCD. This approach is the gold standard for both diagnosis and staging of patients with ALCD due to its excellent sensitivity and specificity [20–22]. CT can also rule out other diagnoses, such as ovarian pathology or abdominal aortic aneurysm. CT findings in patients with ALCD may include diverticulosis with associated colonic wall thickening, increased fat density around the affected colon, extraluminal gas, pneumoperitoneum, abscess formation, or free intra-abdominal fluid (**Figure 2**).

4. Acute diverticulitis: treatment

4.1 ALCD in immunocompromised patients

Immunocompromised patients have an increased risk of complicated ALCD [23–26]. As such, most of these patients require urgent surgery, and this is associated with a significantly higher mortality rate [27]. A recent study by Biondo et al. [28] analyzed the relationship between the different causes of immunosuppression (IMS) and ALCD. Immunocompromised patients were divided into 5 groups according to the causes of IMS: group I, chronic corticosteroids; group II, transplant patients; group III, malignant neoplasm disease; group IV, chronic renal failure; and group V, other immunosuppressive treatments. The rate of emergency surgery was high (39.3%) and was required more frequently in group I (chronic corticosteroid therapy). In this study, postoperative mortality was 31.6%, and the recurrence rate after a successful non-operative control occurred in 30 patients (27.8%).

4.2 Antibiotic treatment in patients with uncomplicated acute colonic diverticulitis

Uncomplicated acute diverticulitis is an intra-abdominal infection in which the infectious process does not extend beyond the affected colon, while in complicated acute diverticulitis the infectious process extends beyond the colon, producing either localized peritonitis or diffuse peritonitis [29]. Studies have been done on the use of antibiotics in uncomplicated acute diverticulitis. A multicenter study published by Chabok and colleagues in 2012 [30], performed in surgical clinics in Sweden and Iceland on 623 patients with uncomplicated acute diverticulitis confirmed by CT examination, showed that antibiotic treatment applied to uncomplicated acute diverticulitis did not lead to a more accelerated cure of the disease nor to the prevention of complications or recurrence of the disease.

Therefore, antibiotic treatment for uncomplicated acute diverticulitis is not indicated and antibiotics should be reserved for complicated acute diverticulitis only. However, the high mortality associated with sepsis requires the clinician to maintain a high index of clinical suspicion in patients who are prone to an increased risk of sepsis [31]. Thus, in patients with uncomplicated acute diverticulitis confirmed by CT examination, having an increased risk of sepsis such as patients with clinical manifestations of infection or in elderly patients, immunocompromised or with comorbidities that decrease the immune response, spectrum antibiotic therapy is suggested. Must cover gram-negative and anaerobic bacilli.

In 2009, a randomized controlled trial of oral antibiotic therapy versus intravenous antibiotic therapy (ciprofloxacin and metronidazole) was performed for patients with uncomplicated acute diverticulitis [32]. Intravenous antibiotic therapy has not been shown to be more effective than oral antibiotic therapy in uncomplicated acute diverticulitis. For patients with uncomplicated ALCD and without comorbidities, it is suggested that treatment be performed in a specialty outpatient setting. It is necessary to re-evaluate at 7 days, and if the clinical condition deteriorates, the re-evaluation must be done earlier and the patients with significant comorbidities who have vomiting, the hydro-electrolytic rebalancing will be done by hospitalization.

4.3 Treatment of patients with uncomplicated ALCD

Etzioni et al. [33] published a retrospective study in 2010, showing that outpatient treatment was effective for 94% of patients with acute diverticulitis. A systematic review of the outpatient management of uncomplicated acute diverticulitis has recently been published [34]. Jackson et al. concluded that current evidence suggested that outpatient treatment for most cases of uncomplicated acute diverticulitis was warranted. Rodríguez-Cerrillo et al. [35] have recently shown that elderly patients with comorbidities can also be treated safely at home, avoiding hospitalization. The DIVER trial [36] demonstrated that outpatient treatment can be safe and effective in selected patients with uncomplicated acute diverticulitis without comorbidities and can reduce costs without negatively affecting the quality of life of these patients. This multicenter study included patients over 18 years of age with uncomplicated acute diverticulitis. Confirmation of uncompleted acute diverticulitis was made by abdominal CT examination. The first dose of antibiotic was given intravenously to all patients in the emergency department, and then the patients were either hospitalized or discharged. Out of a total of 132 patients, treatment failure was recorded in 4 hospitalized patients and in 3 at home they developed treatment failure (there were no differences between groups ($p = 0.62$)). The overall cost of healthcare per episode was 3 times lower in the outpatient group, with significant cost savings of EUR 1124.70 per patient. No differences were observed between groups in terms of quality of life.

4.4 Treatment in patients with acute diverticulitis discovered on CT by the presence of gas around the colon

The best treatment in patients with complicated acute diverticulitis confirmed by CT examination that shows the presence of free gas around the affected colon, the WSES group recommends a non-operative treatment with antibiotic therapy [16]. Among patients hospitalized for acute diverticulitis, 15–25% of patients have an abscess around the affected colon, detected by CT examination [37]. When the size of the abscess around the affected colon is around 4–5 cm, an antibiotic treatment can be tried, but with a failure rate of 20% and a mortality rate of 0.6% [38]. Percutaneous drainage of the abscess combined with antibiotic treatment [39–43] is also discussed in these patients. Surgical treatment is required in these patients when they show clinical signs of sepsis. In 2015, a retrospective study was published by Elagili et al. [44] comparing antibiotic-only treatment of diverticular abscess versus percutaneous drainage. In this study, 32 patients were treated with antibiotics alone and 114 underwent percutaneous drainage. Surgery was required to remove the abscess in 8 patients who underwent antibiotic therapy alone (25%) and in 21 patients (18%) who underwent percutaneous drainage. In patients with percutaneous drainage, special attention should be paid to the drainage catheter.

Removal of this drainage catheter should be considered when the drainage flow has decreased significantly and on CT examination with contrast medium, no identifiable cavity remains around the catheter, in which case the catheter will be removed. If a decrease in the abscess is not noticed on the CT examination and the patient does not show any improvement in the clinical situation, the following therapeutic decisions may be necessary: additional drainage, repositioning of the drainage catheter or an abscess removal surgery.

In patients with acute diverticulitis with findings on CT examination, free gas at a distance without diffuse intra-abdominal fluid, a non-operative treatment is suggested, only if a careful and continuous monitoring of the patient can be performed. Of these patients, about 25% treated non-operatively may require emergency surgery [45]. If these patients show signs of acute peritonitis at the clinical examination, then emergency surgery, hydro-electrolytic rebalancing, antibiotic therapy are required. Dharmarajan et al. [46] reported a high success rate for nonoperative management in patients with acute diverticulitis and free gas on CT examination, but excluding those with hemodynamic instability. Sallinen et al. [47] concluded that non-operative treatment can be applied to patients with acute diverticulitis and distant free gas highlighted by CT examination, but in the absence of diffuse acute peritonitis or fluid in the bottom of the Douglas sac. The appearance of a massive pneumoperitoneum or the presence of gas in the retroperitoneal space even in the absence of generalized acute peritonitis, was associated with a non-operative treatment failure rate of 57–60%. Surgery in patients with clinical signs of acute peritonitis with acute perforated diverticulitis should be surgical resection of the affected colon and anastomosis with or without stoma, in stable patients without comorbidities and the Hartmann procedure (HP) in hemodynamically unstable patients or in patients with multiple comorbidities [16].

4.5 Follow-up of patients treated for colonic diverticular abscess

In patients with uncomplicated acute diverticulitis confirmed by non-operative CT examination, a routine assessment of the colon is not recommended, while in patients with non-operatively treated diverticular abscess an early assessment of the colon at 4–6 weeks is recommended. A perforated colon cancer with localized colon abscess, although less common but possible, may mimic acute colonic diverticulitis with abscess around the colon [48, 49]. It has been shown that the risk of malignancy after uncomplicated acute diverticulitis proven by CT is low, so that a routine colonoscopy, in the absence of other indications, is not necessary. In 2014, a study [50] was published investigating the rate of colorectal cancer (CRC) discovered by colonoscopy after an episode of uncomplicated diverticulitis. A total of 2,490 patients with uncomplicated diverticulitis were included in the study. 17 patients were diagnosed with CRC (1.16%). Hyperplastic polyps were observed in 156 patients (10.6%), low-grade adenoma in 90 patients (6.1%) and adenoma with aggravated dysplasia in 32 patients (2.2%). This study shows that routine colonoscopic evaluation in the absence of other clinical signs of CRC is not necessary in patients who have had an episode of uncomplicated acute diverticulitis.

4.6 Treatment of patients with acute peritonitis caused by perforated colonic diverticulitis

In patients with acute diffuse peritonitis due to diverticular perforation, lavage and laparoscopic drainage are suggested only in carefully selected patients. A minimally invasive approach using laparoscopic peritoneal lavage and drainage has been debated in recent years as an alternative to colon resection [51]. This therapeutic

procedure consists of laparoscopic aspiration of the pus followed by copious washing of the peritoneal cavity and placement of abdominal drainage tubes, which remain many days after this procedure. In 2013, a retrospective Dutch analysis of 38 patients [52] with perforated acute colonic diverticulitis peritonitis was published. In 7 patients, this approach did not control sepsis, 2 patients died from multiple organ dysfunction syndrome (MODS) and 5 patients required additional surgery (3 Hartmann resections, 1 stoma and 1 perforation suture). Predictors for the failure of conservative therapy (drainage and laparoscopic lavage) were: multiple comorbidities, high CRP levels and a high Manheim index of peritonitis. In 2015, the results of the SCANDIV study were published [53]. According to this study, laparoscopic lavage is not supported for the treatment of acute perforated colonic diverticulitis. The LADIES study published in 2015 [54] showed that laparoscopic lavage was not superior to sigmoidectomy for the treatment of acute perforated diverticulitis. So in acute Hinchey III diverticulitis, laparoscopic lavage is marred by an increased failure rate with the need for reintervention for intra-abdominal abscess.

In patients with multiple comorbidities, hemodynamic instability, the Hartmann (HP) procedure is recommended for the treatment of acute peritonitis caused by perforated colonic diverticulitis and in hemodynamically stable patients without comorbidities, colonic resection with primary anastomosis with or without stoma is suggested. The HP is considered a therapeutic option in acute peritonitis caused by acute perforated colonic diverticulitis in patients presented in the emergency department with critical conditions and multiple comorbidities (**Figures 3** and **4**). However, restoration of intestinal transit continuity is associated with significant morbidity [55] and therefore many of these patients do not undergo digestive transit restoration surgery and thus remain with a permanent stoma [56]. A study that included 2729 patients [57] evaluated patients with acute perforated diverticulitis who were treated either by colon resection with primary anastomosis and protective ileostomy or by the HP. Most patients were treated by the HP and only 208 (7.6%) patients were treated by colon resection with primary anastomosis and protective ileostomy. Mortality rates for patients undergoing the HP and colon resection with the primary anastomosis were 7.6% and 2.9%, respectively. The authors concluded that colon resection with primary anastomosis and protective ileostomy may be the optimal therapeutic strategy for carefully selected patients with acute peritonitis caused by perforated colonic diverticulitis.

Oberkofler et al. [58] conducted a randomized colonic resection study in 2012 with primary anastomosis and protective ileostomy versus the HP in patients with

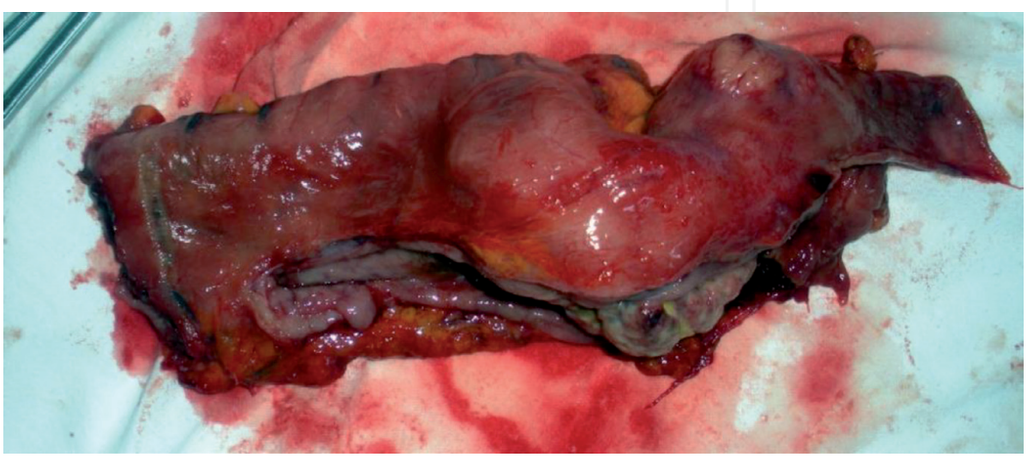

Figure 3.
Sigmoid colon resected in a patient with perforated sigmoid colonic diverticulosis.

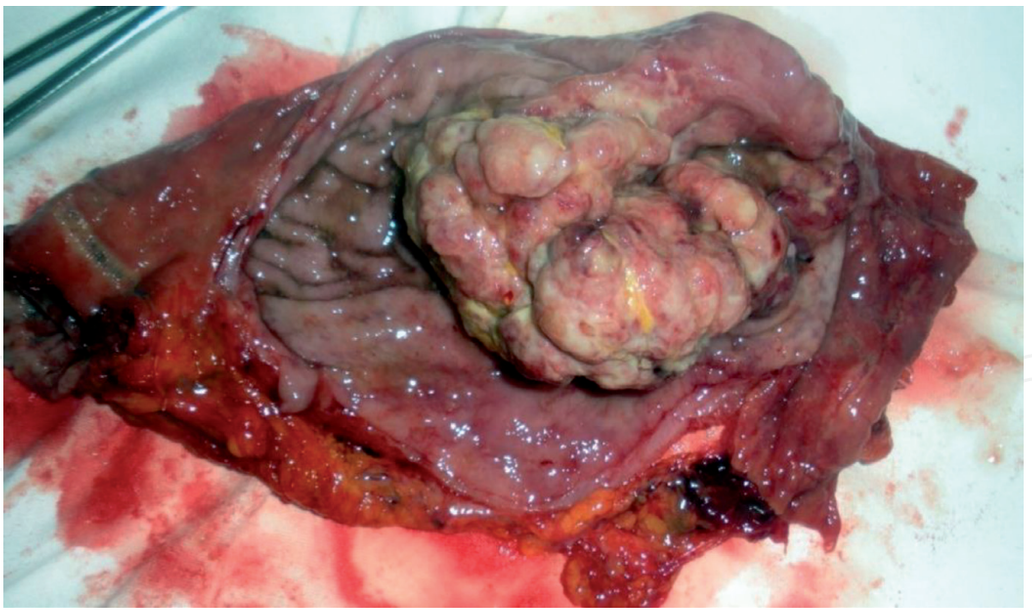

Figure 4.
Macroscopic appearance of a perforated sigmoid colonic diverticulosis on the sigmoidectomy resection piece.

acute peritonitis caused by perforated acute colonic diverticulitis. 62 patients with left colonic perforation (Hinchey III and IV) were randomized for the HP (30 patients) and for colon resection with primary anastomosis and protective ileostomy (32 patients). A planned operation to reintegrate the intestine into the digestive tract was performed at 3 months. The study did not report any difference in mortality and initial morbidity (mortality 13% vs. 9% and morbidity 67% vs. 75% in the HP versus colon resection with primary anastomosis), but found a reduction in hospital stay, lower costs, fewer serious complications in the colon resection group with primary anastomosis and protective ileostomy. The LADIES study [59] performed in 2019 in immunocompetent patients, hemodynamically stable, less than 85 years of age, showed that colon resection with primary anastomosis is preferable compared to the HP for the treatment of acute peritonitis by diverticulitis, acute perforated colon (Hinchey's disease III or IV). In this study were eligible patients aged 18 to 85 years who showed clinical signs of acute peritonitis caused by acute perforated colonic diverticulitis and CT abdomen showed free gas and fluid in the peritoneal cavity. Patients with Hinchey I or II diverticulitis were not eligible for inclusion.

A systematic review of the literature on the surgical management of Hinchey diverticulitis III and IV was published in 2019 [60]. 3596 patients were included in this study. Overall mortality in HP patients was 10.8% in observational studies, and at colon resection with primary anastomosis, mortality was lower, being 8.2% in observational studies.

4.7 The role of laparoscopic surgery in the treatment of diffuse acute peritonitis caused by acute perforated diverticulitis

Emergency laparoscopic sigmoidectomy is recommended in patients with diffuse acute peritonitis caused by perforated acute diverticulitis, only if technical skills and equipment are available. In 2015, a systematic review of laparoscopic sigmoidectomy in emergencies was published [61]. A total of 104 patients were included in the study: HP was performed in 84 patients and colon resection with primary anastomosis was performed in 20 patients. The average duration of hospitalization varied between 6 and 16 days, 3 patients died in the postoperative period.

This study showed that emergency laparoscopic sigmoidectomy is possible for the treatment of acute perforated sigmoid diverticulitis with generalized peritonitis, but laparoscopic sigmoidectomy was performed on selected patients and was performed in experienced centers. To demonstrate the benefits of laparoscopic sigmoidectomy compared to classic open surgery sigmoidectomy, high-quality prospective or randomized studies are needed.

4.8 Therapeutic strategy in diffuse acute peritonitis produced by acute perforated diverticulitis

Diffuse acute peritonitis caused by perforated acute colonic diverticulitis is a life-threatening condition that requires prompt emergency surgery. To improve the results, in recent years a treatment algorithm has been developed in patients with generalized acute peritonitis caused by acute perforated colonic diverticulitis, which consists of peritoneal lavage, segmental resection of the affected colon or closure of the perforation and the second surgery is performed at 3–6 months to restore bowel continuity [62, 63]. Patients who are hemodynamically unstable are not candidates for immediate complex surgery. Initial surgery in hemodynamically unstable patients with multiple comorbidities should be limited to controlling the source of peritoneal infection, for example primary closure of perforation / limited resection of the affected colon (HP) after which the patient is taken to the intensive care unit for rebalancing hydro-electrolytic, acid–base, correction of anemia, possibly correction of respiratory and circulatory deficits. In 2012, a prospective observational study was published by Kafka-Ritsah et al. [51]. In this study were enrolled 51 patients (28 women), with a mean age of 69 years with diverticulitis Hinchey III (40 patients - 78%) and Hinchey IV (11 patients - 22%). The hospitalized patients were initially treated by segmental resection of the affected colon, peritoneal lavage, followed by an operation at 24–48 hours to restore bowel continuity in 36 patients (84%), of which 4 patients underwent a protective ileostomy. There were 5 anastomotic fistulas. The overall mortality rate was 9.8%. WSES recommends using an open abdomen approach in selected patients with ongoing sepsis disorders [64]. In patients with ongoing severe sepsis, the open abdomen technique can be used with the application of therapy with negative active peritoneal pressure [65].

4.9 Factors considered for a segmental colonic resection in cases of non-operatively treated acute colonic diverticulitis

It is recommended that after an acute episode of ALCD conservatively treated, a segmental resection of the affected colon be performed, especially in immunocompromised patients. Older clinical trials have reported that about one-third of patients with acute diverticulitis will have a recurrent attack, often within 1 year [66, 67]. After a 4-year follow-up, El Sayed et al. [68] on an English study of 65,000 patients treated non-operatively for the first episode of acute colonic diverticulitis, found a recurrence rate of approximately 11.2%. The DIRECT, multicenter randomized trial was performed on 109 patients, performed on 26 hospitals in the Netherlands. Patients in the study had persistent and recurrent abdominal pain after an episode of acute colonic diverticulitis [69]. After this 6-month follow-up, the sigmoidectomy performed led to a better quality of life compared to non-operative management, evaluation performed through several specific questionnaires. Currently, the decision to segmental colectomy of the colon, performed after one or more episodes of acute colonic diverticulitis, must be made on a case-by-case basis taking into account risk factors, complications, age, severity of recurrent episodes, personal pathological history and comorbidities. (e.g. immunosuppressed patients) [70].

4.10 Duration of optimal antibiotic therapy after surgical control of the source of sepsis in acute peritonitis caused by acute perforated colonic diverticulitis

It is suggested a duration of 4 days of postoperative treatment with antibiotics in complicated ALCD if the source of peritoneal infection has been surgically suppressed. The therapeutic regimen should depend on the severity of the infection, the pathogens suspected to be involved and the risk factors for developing antibiotic resistance [28]. The pathogens involved are Gram-negative and Gram-positive bacteria as well as anaerobic bacteria. The main threat of resistance in intra-abdominal infections is Enterobactericeae which produce extended spectrum beta-lactamase (ESBL) which is becoming more common in community-acquired infections worldwide [71]. The recent study by Sawyer et al. [72] showed that in patients with intra-abdominal infections, the results of antibiotic treatment with a duration of 4 days were similar to those with a longer duration of antibiotic treatment.

4.11 Principles of treatment of right acute colonic diverticulitis (ARCD)

The principles of diagnosis and treatment of patients with ARCD are similar to those of patients with ALCD, although studies have shown that the percentage of complications requiring surgery is higher in patients with ALCD than in patients with ARCD. Typically, the sigmoid colon is more involved in acute colonic diverticulitis than the right colon - ARCD [73]. ARCD has a lower rate of complicated diverticulitis [74] and ARCD occurs more frequently in middle-aged men. In particular, ARCD is located on the cecum, making differential diagnosis with acute appendicitis difficult. CT abdomen with contrast agent has an essential role in establishing the diagnosis of ARCD [75]. The diagnostic and treatment principles of ARCD are similar to those of ALCD. As a therapeutic option in ARCD, non-operative methods should be preferred in cases without acute diffuse peritonitis, although differentiation from malignant proliferative processes is difficult [76]. Surgical treatment is usually performed in cases of complicated ARCD [73, 77–79]. In experienced medical centers, laparoscopic resection of the affected colon with primary anastomosis can be performed [80, 81].

5. Conclusions

1. In diverticular colonic disease the sigmoid colon is usually the most commonly involved, while right acute colonic diverticulitis is rarer.

2. In establishing the diagnosis of ALCD, objective clinical examination plays an important role in addition to biological paraclinical examinations (C-reactive protein - CRP and increased leukocyte count) and radiological paraclinical examinations: CT abdomen. CRP is a useful tool in predicting the clinical severity of acute diverticulitis.

3. CT abdomen with contrast agent is the radiological examination that is used to evaluate patients with suspected ALCD. This approach is the gold standard for both diagnosis and staging of patients with ALCD due to its excellent sensitivity and specificity.

4. In patients with acute diverticulitis with findings on CT examination, free gas at a distance without diffuse intra-abdominal fluid, a non-operative

treatment is suggested, only if a careful and continuous monitoring of the patient can be performed.

5. The treatment applied to patients with uncomplicated colonic diverticular disease can be represented by antibiotic therapy, water regime, hydro-electrolytic rebalancing.

6. In patients with multiple comorbidities, hemodynamic instability, the Hartmann procedure is recommended for the treatment of acute peritonitis caused by perforated colonic diverticulitis and in hemodynamically stable patients without comorbidities, colonic resection with primary anastomosis with or without stoma is suggested.

7. In patients with uncomplicated acute diverticulitis confirmed by non-operative CT examination, a routine assessment of the colon is not recommended, while in patients with non-operatively treated diverticular abscess an early assessment of the colon at 4–6 weeks is recommended.

8. Emergency laparoscopic sigmoidectomy is recommended in patients with diffuse acute peritonitis caused by perforated acute diverticulitis, only if technical skills and equipment are available.

9. In patients with acute diffuse peritonitis due to diverticular perforation, lavage and laparoscopic drainage are suggested only in carefully selected patients.

10. The principles of diagnosis and treatment of patients with ARCD are similar to those of patients with ALCD, although studies have shown that the percentage of complications requiring surgery is higher in patients with ALCD than in patients with ARCD.

Conflict of interest

The authors declare no conflict of interest.

Abbreviations

ARCD	Acute right colonic diverticulitis
ALCD	Acute left colonic diverticulitis
CT	Computed Tomography
CRP	C-reactive protein
CRC	Colorectal Cancer
ESBL	Extended Spectrum beta-lactamase
HP	Hartmann Procedure
IMS	Immunosuppression
MODS	Multiple Organ Dysfunction Syndrome
WSES	World Society of Emergency Surgery

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References

[1] Rodky GV, Welch CE. Changing patterns in the surgical treatment of diverticular disease. Annals of surgery. 1984;**200**:466-478.

[2] Etzioni DA, Mack TM, Beart RW, et al. Diverticulisis in the United States: 1998-2005: Changing patterns of disease and treatment. Annals of surgery. 2009;**249**:210-217.

[3] Kozak LJ, DeFrances CJ, Hall MJ. National hospital discharge survery: 2004 annual summary with detailed diagnosis and procedure data. Vital and health statistics. 2006;**13**:1-209.

[4] Sandler RS, Everhart JE, Donowitz M, et al. The burden of selected digestive diseases in the United States. Gastroenterology. 2002;**122**: 1500-1511.

[5] Warner E, Crighton EJ, Moineddin R, et al. Fourteen-year study of hospital admissions for diverticular disease in Ontario. Canadian journal of gastroenterology. 2007;**21**:97-99.

[6] Painter NS, Burkitt DP. Diverituclar disease of the colon: A deficiency disease of Western civilization. British medical journal. 1971;**2**:450-454.

[7] 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.

[8] Guyatt GH, Oxman AD, Vist GE, Kunz R, Falck-Ytter Y, Alonso-Coello P, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. British medical journal. 2008;**336**:924-926.

[9] Brozek JL, Akl EA, Jaeschke R, Lang DM, Bossuyt P, Glasziou P, et al. Grading quality of evidence and strength of recommendations in clinical practice guidelines: part 2 of 3. The GRADE approach to grading quality of evidence about diagnostic tests and strategies. Allergy. 2009;**64**:1109-1116.

[10] Hinchey EJ, Schaal PH, Richards MB. Treatment of perforated diverticular disease of the colon. Advances in surgery 1978;**12**:85-109.

[11] Neff CC, van Sonnenberg E. CT of diverticulitis. Diagnosis and treatment. Radiologic clinics of North America. 1989;**27**:743-752.

[12] 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.

[13] Kaiser AM, Jiang JK, 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.

[14] Mora Lopez L, Serra Pla S, Serra-Aracil X, Ballesteros E, Navarro S. Application of a modified Neff classification to patients with uncomplicated diverticulitis. Colorectal disease. 2013;**15**:1442-1447.

[15] Sallinen VJ, Leppäniemi AK, Mentula PJ. Staging of acute diverticulitis based on clinical, radiologic, and physiologic parameters. The journal of trauma and acute care surgery. 2015;**78**:543-551.

[16] Sartelli M, Moore FA, Ansaloni L, Di Saverio S, Coccolini F, Griffiths EA, et al. A proposal for a CT driven classification of left colon acute diverticulitis. World journal of emergency surgery. 2015;**10**:3.

[17] 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.

[18] 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.

[19] 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.

[20] Laméris W, van Randen A, Bipat S, Bossuyt PM, Boermeester MA, Stoker J. Graded compression ultrasonography and computed tomography in acute colonic diverticulitis: meta- analysis of test accuracy. European radiology. 2008;**18**:2498-2511.

[21] Liljegren G, Chabok A, Wickbom M, Smedh K, Nilsson K. Acute colonic diverticulitis: a systematic review of diagnostic accuracy. Colorectal disease. 2007;**9**:480-488.

[22] Ambrosetti P, Jenny A, Becker C, Terrier TF, Morel P. Acute left colonic diverticulitis–compared performance of computed tomography and water-soluble contrast enema: prospective evaluation of 420 patients. Diseases of the colon and rectum. 2000;**43**: 1363-1367.

[23] Hwang SS, Cannom RR, Abbas MA, Etzioni D. Diverticulitis in transplant patients and patients on chronic corticosteroid therapy: a systematic review. Diseases of the colon and rectum. 2010;**53**:1699-1707.

[24] Dalla Valle R, Capocasale E, Mazzoni MP, Busi N, Benozzi L, Sivelli R, et al. Acute diverticulitis with colon perforation in renal transplantation. Transplantation proceedings. 2005;**37**:2507-2510.

[25] Qasabian RA, Meagher AP, Lee R, Dore GJ, Keogh A. Severe diverticulitis after heart, lung, and heart-lung transplantation. The Journal of heart and lung transplantation. 2004;**23**:845-849.

[26] Lederman ED, Conti DJ, Lempert N, Singh TP, Lee EC. Complicated diverticulitis following renal transplantation. Diseases of the colon and rectum. 1998;**41**:613-618.

[27] Bordeianou L, Hodin R. Controversies in the surgical management of sigmoid diverticulitis. Journal of gastrointestinal surgery. 2007;**11**:542-548.

[28] Biondo S, Trenti L, Elvira J, Golda T, Kreisler E. Outcomes of colonic diverticulitis according to the reason of immunosuppression. American journal of surgery. 2016;**21**:384-390.

[29] Sartelli M, Chichom-Mefire A, Labricciosa FM, Hardcastle T, Abu-Zidan FM, Adesunkanmi AK, et al. The management of intra-abdominal infections from a global perspective: 2017 WSES guidelines for management of intra-abdominal infections. World journal of emergency surgery. 2017;12:29. Erratum in: World journal of emergency surgery. 2017;**12**:36.

[30] Chabok A, Påhlman L, Hjern F, Haapaniemi S, Smedh K, AVOD Study Group. Randomized clinical trial of antibiotics in acute uncomplicated diverticulitis. The British journal of surgery. 2012;**99**:532-539.

[31] Sartelli M, Viale P, Catena F, Ansaloni L, Moore E, Malangoni M, et al. 2013 WSES guidelines for management of intra-abdominalinfections. World journal of emergency surgery. 2013;**8**:3.

[32] 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.

[33] Etzioni DA, Chiu VY, Cannom RR, Burchette RJ, Haigh PI, Abbas MA. Outpatient treatment of acute diverticulitis: rates and predictors of failure. Diseases of the colon and rectum. 2010;**53**:861-865.

[34] Jackson JD, Hammond T. Systematic review: outpatient management of acute uncomplicated diverticulitis. International journal of colorectal disease. 2014;**29**:775-781.

[35] Rodrìguez-Cerrillo M, Poza-Montoro A, Fernandez-Diaz E, Matesanz-David M, Inurrieta RA. Treatment of elderly patients with uncomplicated diverticulitis, even with comorbidity, at home. European journal of internal medicine. 2013;**24**:430-432.

[36] 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.

[37] Andersen JC, Bundgaard L, Elbrønd H, Laurberg S, Walker LR, Støvring J, et al. Danish national guidelines for treatment of diverticular disease. Danish medical journal. 2012;**59**:C4453.

[38] Gregersen R, Mortensen LQ, Burcharth J, Pommergaard HC, Rosenberg J. Treatment of patients with acute colonic diverticulitis complicated by abscess formation: a systematic review. International journal of surgery. 2016;**35**:201-208.

[39] Ambrosetti P, Chautems R, Soravia C, Peiris-Waser N, Terrier F. Long-term outcome of mesocolic and pelvic diverticular abscesses of the left colon: a prospective study of 73 cases. Diseases of the colon and rectum. 2005;**48**:787-791.

[40] Brandt D, Gervaz P, Durmishi Y, Platon A, Morel P, Poletti PA. Percutaneous CT scan guided drainage versus antibiotherapy alone for Hinchey II diverticulitis: a case–control study. Diseases of the colon and rectum. 2006;**49**:1533-1538.

[41] Siewert B, Tye G, Kruskal J, Sosna J, Opelka F, Raptopoulos V, et al. Impact of CT-guided drainage in the treatment of diverticular abscesses: size matters. American journal of roentgenology. 2006;**186**:680-686.

[42] Singh B, May K, Coltart I, Moore NR, Cunningham C. The long-term results of percutaneous drainage of diverticular abscess. Annals of the Royal College of Surgeons of England. 2008;**90**:297-301.

[43] Kumar RR, Kim JT, Haukoos JS, Macias LH, Dixon MR, Stamos MJ, et al. Factors affecting the successful management of intra-abdominal abscesses with antibiotics and the need for percutaneous drainage. Diseases of the colon and rectum. 2006;**49**:183-189.

[44] Elagili F, Stocchi L, Ozuner G, Kiran RP. Antibiotics alone instead of percutaneous drainage as initial treatment of large diverticular abscess. Techniques in coloproctology. 2015;**19**:97-103.

[45] Feingold D, Steele SR, Lee S, Kaiser A, Boushey R, Buie WD, et al. Practice parameters for the treatment of sigmoid diverticulitis. Diseases of the colon and rectum. 2014;**57**:284-294.

[46] Dharmarajan S, Hunt SR, Birnbaum EH, Fleshman JW, Mutch MG. The efficacy of nonoperative management of acute

complicated diverticulitis. Diseases of the colon and rectum. 2011;**54**:663-671.

[47] Sallinen VJ, Mentula PJ, Leppäniemi AK. Nonoperative management of perforated diverticulitis with extraluminal air is safe and effective in selected patients. Diseases of the colon and rectum. 2014;**57**:875-881.

[48] Tsai HL, Hsieh JS, Yu FJ, Wu DC, Chen FM, Huang CJ, et al. Perforated colonic cancer presenting as intra-abdominal abscess. International journal of colorectal disease. 2007;**22**:15-19.

[49] Yeo ES, Ng KH, Eu KW. Perforated colorectal cancer: an important differential diagnosis in all presumed diverticular abscesses. Annals of the Academy of Medicine, Singapore. 2011;**40**:375-378.

[50] de Vries HS, Boerma D, Timmer R, van Ramshorst B, Dieleman LA, van Westreenen HL. Routine colonoscopy is not required in uncomplicated diverticulitis: a systematic review. Surgical endoscopy. 2014;**28**: 2039-2047.

[51] Rossi GL, Mentz R, Bertone S, Ojea Quintana G, Bilbao S, Im VM, et al. Laparoscopic peritoneal lavage for Hinchey III diverticulitis: is it as effective as it is applicable? Diseases of the colon and rectum. 2014;**57**:1384-1390.

[52] Swank HA, Mulder IM, Hoofwijk AG, Nienhuijs SW, Lange JF, Bemelman WA. Dutch diverticular disease collaborative study G. early experience with laparoscopic lavage for perforated diverticulitis. The British journal of surgery. 2013;**100**:704-710.

[53] Schultz JK, Yaqub S, Wallon C, Blecic L, Forsmo HM, Folkesson J, et al. Laparoscopic lavage vs. primary resection for acute perforated diverticulitis: the SCANDIV randomized clinical trial. JAMA. 2015;**314**:1364-1375.

[54] Vennix S, Musters GD, Mulder IM, Swank HA, Consten EC, Belgers EH, et al. Laparoscopic peritoneal lavage or sigmoidectomy for perforated diverticulitis with purulent peritonitis: a multicentre, parallel-group, randomized, open-label trial. Lancet. 2015;**386**(10000):1269-1277.

[55] McCafferty MH, Roth L, Jorden J. Current management of diverticulitis. The American surgeon. 2008;**74**:1041-1049.

[56] Fleming FJ, Gillen P. Reversal of Hartmann's procedure following acute diverticulitis: is timing everything? International journal of colorectal disease. 2009;**24**:1219-1225.

[57] Lee JM, Bai P, Chang J, El Hechi M, Kongkaewpaisan N, Bonde A, et al. Hartmann's procedure vs. primary anastomosis with diverting loop ileostomy for acute diverticulitis: nationwide analysis of 2,729 emergency surgery patients. Journal of the American College of Surgeons. 2019;**229**:48-55.

[58] Oberkofler CE, Rickenbacher A, Raptis DA, Lehmann K, Villiger P, Buchli C, 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**:819-826.

[59] Lambrichts 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 fecal peritonitis (LADIES): a multicentre, parallel-group, randomized, open-label, superiority trial. The lancet. Gastroenterology & hepatology. 2019;**4**:599-610.

[60] Halim H, Askari A, Nunn R, Hollingshead J. Primary resection anastomosis versus Hartmann's procedure in Hinchey III and IV diverticulitis. World journal of emergency surgery. 2019;**14**:32.

[61] Vennix S, Boersema GS, Buskens CJ, Menon AG, Tanis PJ, Lange JF, et al. Emergency laparoscopic sigmoidectomy for perforated diverticulitis with generalized peritonitis: a systematic review. Digestive surgery. 2016; **33**:1-7.

[62] Kafka-Ritsch R, Birkfellner F, Perathoner A, Raab H, Nehoda H, Pratschke J, et al. Damage control surgery with abdominal vacuum and delayed bowel reconstruction in patients with perforated diverticulitis Hinchey III/IV. Journal of gastrointestinal surgery 2012;**16**:1915-1922.

[63] Ordóñez CA, Sánchez AI, Pineda JA, Badiel M, Mesa R, Cardona U, et al. Deferred primary anastomosis versus diversion in patients with severe secondary peritonitis managed with staged laparotomies. World journal of emergency surgery. 2010;**34**:169-176.

[64] Sartelli M, Catena F, Abu-Zidan FM, Ansaloni L, Biffl WL, Boermeester MA, et al. Management of intra-abdominal infections: recommendations by the WSES 2016 consensus conference. World journal of emergency surgery. 2017;**12**:22.

[65] Kirkpatrick AW, Coccolini F, Ansaloni L, Roberts DJ, Tolonen M, McKee JL, et al. Closed or open after laparotomy (COOL) after source control for severe complicated intra-abdominal sepsis investigators. Closed or open after source control laparotomy for severe complicated intra-abdominal sepsis (the COOL trial): study protocol for a randomized controlled trial. World journal of emergency surgery. 2018;**13**:26.

[66] Rafferty J, Shellito P, Hyman NH, Buie WD. Standards Committee of the American Society of colon and Rectal surgeons. Practice parameters for sigmoid diverticulitis. Diseases of the colon and rectum. 2006;**49**:939-944.

[67] 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 and rectum. 2011;**54**: 283-288.

[68] El-Sayed C, Radley S, Mytton J, Evison F, Ward ST. Risk of recurrent disease and surgery following an admission for acute diverticulitis. Diseases of the colon and rectum. 2018;**61**:382-389.

[69] van de Wall BJM, Stam MAW, Draaisma WA, Stellato R, Bemelman WA, Boermeester MA, et al. Surgery versus conservative management for recurrent and ongoing left-sided diverticulitis (DIRECT trial): an open-label, multicentre, randomized controlled trial. The lancet. Gastroenterology & hepatology. 2017;**2**:13-22.

[70] Klarenbeek BR, Samuels M, van der Wal MA, van der Peet DL, Meijerink WJ, Cuesta MA. Indications for elective sigmoid resection in diverticular disease. Annals of surgery. 2010;**251**:670-674.

[71] Halpenny DF, McNeil G, Snow A, Geoghegan T, Torreggiani WC. Prospective evaluation of the value of magnetic resonance imaging in suspected acute sigmoid diverticulitis. Diseases of the colon and rectum. 2009;**52**:1030-1031.

[72] Sawyer RG, Claridge JA, Nathens AB, Rotstein OD, Duane TM, Evans HL, et al. Trial of short-course antimicrobial therapy for intraabdominal infection. The New

England journal of medicine. 2015;**372**:1996-2005.

[73] Chiu TC, Chou YH, Tiu CM, Chiou HJ, Wang HK, Lai YC, et al. Right-sided colonic diverticulitis: clinical features, sonographic appearances, and management. Journal of medical ultrasound. 2017;**25**:33-39.

[74] Ha GW, Lee MR, Kim JH. Efficacy of conservative management in patients with right colonic diverticulitis. Australian and New Zealand journal of surgery. 2017;**87**:467-470.

[75] Kim SH, Byun CG, Cha JW, Choi SH, Kho YT, Seo DY. Comparative study of the clinical features and treatment for right and left colonic diverticulitis. Journal of the Korean Society of Coloproctology. 2010;**26**:407-412.

[76] Kim JY, Park SG, Kang HJ, Lim YA, Pak KH, Yoo T, et al. Prospective randomized clinical trial of uncomplicated right-sided colonic diverticulitis: antibiotics versus no antibiotics. International journal of colorectal disease. 2019;**34**:1413-1420.

[77] Destek S, Gül VO. Effectiveness of conservative approach in right colon diverticulitis. Turkish journal of trauma & emergency surgery. 2019;**25**:396-402.

[78] Chung BH, Ha GW, Lee MR, Kim JH. Management of colonic diverticulitis tailored to location and severity: comparison of the right and the left colon. Annals of coloproctology. 2016;**32**:228-233.

[79] Mesina C, Dumitrescu TV, Obleaga CV, Ciobanu D, Ischemic colitis problems of diagnosis and treatment, Archive of Clinical and Experimental Surgery. 2018;**7**:59-64.

[80] Meşină C, Vasile I, Paşalega M, Calotă F, Vîlcea D. Ischemia acută mezenterică, Chirurgia, 2008, **103**(4): 378-388.

[81] Vasile I, Meşină C, Paşalega M, Calotă F, Vîlcea ID, Ischemie acută mezenterică non-ocluzivă, Chirurgia, 2008, **103**(3):337-343.