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# The role of elective surgery following acute colonic diverticulitis

## O papel da cirurgia electiva na diverticulite aguda do cólon

Catarina Tavares Machado<sup>1</sup>, Luís S. Malheiro<sup>2</sup>

<sup>1</sup> Interna de formação específica de Urologia, Mestrado Integrado em Medicina, Serviço de Urologia, Hospital Geral de Santo António

<sup>2</sup> Assistente Graduado Sénior de Cirurgia Geral, Serviço de Cirurgia Geral, Hospital de São João

### ABSTRACT

The surgical treatment following acute diverticulitis (DV) has been an ongoing subject of debate. During the first half of the 20th century, only complicated cases of acute DV were surgically treated. During the second half, some studies suggested that patients with recurrent episodes of uncomplicated DV had an increased risk of complicated disease, morbidity, and mortality, and, for that reason, surgery was indicated also for these patients. In 1995, the ASCRS recommended elective bowel resection after two episodes of uncomplicated acute DV (or one episode for patients younger than 50), or after one episode of complicated DV. Recent studies have questioned these three recommendations. First, although acute DV is particularly aggressive during its first episode, subsequent episodes tend to be significantly more benign and successfully manageable with non-operative treatment. Elective surgery decreases neither the likelihood of emergency surgery nor the overall mortality due to DV complications. Moreover, elective surgery is not risk free, and some patients still experience acute DV episodes post-operatively. Second, in patients under 50, the disease does not seem to be as aggressive as previously implied. The response to medical treatment and post-operative morbidity and mortality remain similar to older patients. Third, regarding episodes of complicated DV, whether surgery is always necessary after successful percutaneous abscess drainage has also been a matter of debate. International guidelines are consensual when indicating precocious surgical resection for patients chronically immunosuppressed, who have collagen-vascular disease, or chronic renal disease. While waiting for the results of the first randomized clinical trials comparing different treatment strategies for acute DV, the present paper reviews the debate regarding the indications for elective surgery.

**Key words:** *Diverticulitis; Elective Surgical Procedure; Guidelines.*

### RESUMO

O tratamento cirúrgico de doentes com antecedentes de diverticulite (DV) aguda tem sido alvo de debate ao longo dos últimos anos. Na primeira metade do século XX, apenas os casos de DV aguda complicada eram submetidos a intervenção cirúrgica. Na segunda metade, alguns estudos sugeriram que doentes com episódios de DV aguda não complicada teriam um risco acrescido de desenvolver doença complicada, com morbilidade e mortalidade significativas, estando assim o tratamento cirúrgico indicado. Em 1995 a ASCRS recomendou a sigmoidectomia eletiva após dois episódios de DV não complicada (ou um episódio se o doente tivesse menos de 50 anos) ou após um episódio de DV complicada. Estudos recentes colocaram em causa estas recomendações. Em primeiro lugar, apesar de a DV aguda ser uma doença particularmente agressiva aquando do primeiro episódio, os episódios subsequentes tendem a ser significativamente mais benignos e passíveis de tratamento conservador eficaz. Nestes casos, a cirurgia eletiva não reduz o risco de cirurgia urgente nem a mortalidade global devido a complicações da DV. Aliás, a cirurgia eletiva não é desprovida de riscos e alguns doentes poderão ainda desenvolver episódios de DV aguda após a intervenção. Em segundo lugar, nos doentes com menos de 50 anos, a doença não aparenta ser tão agressiva como previamente sugerido. Por último, relativamente aos episódios de DV complicada, é questionável se a sigmoidectomia eletiva será sempre necessária após uma drenagem percutânea eficaz de um abscesso. As guidelines internacionais são no entanto consensuais ao recomendarem a cirurgia eletiva precoce em doentes cronicamente imunodeprimidos, com doença do colagénio ou doença renal crónica. Enquanto aguardamos pelos resultados dos primeiros ensaios clínicos randomizados que comparam abordagens de tratamento distintas em doentes com episódios de DV aguda, o presente artigo visa resumir o debate relativo às indicações para realizar cirurgia eletiva.

**Palavras chave:** *Diverticulite; Cirurgia Electiva; Guidelines.*



## INTRODUCTION

Diverticular disease of the colon is one of the most common diseases in developed Western countries. The prevalence increases with age, and by age 60 the risk of having colonic diverticulosis is close to 50%<sup>1, 2</sup>. It is thus an important clinical entity, especially in the aging population. Despite its frequency and substantial morbidity, few scientific studies have investigated the disease. For this reason, it has been repeatedly referred to as a neglected disorder<sup>3</sup>.

Colonic diverticulosis results from a multifactor pathogenic process. One of the most studied etiologic factors is diet. A low-fiber diet may explain the higher rates of colonic diverticula in industrialized western populations when compared to developing countries<sup>3</sup>. The absence of insoluble fiber in the colon, responsible for the formation of high caliber bulky stool, increases intra-colonic pressure during peristalsis, exaggerating the natural segmentation process. This elevated pressure in the sigmoid colon may be responsible for the formation of pseudo-diverticula at the most fragile points of the colonic wall, namely where the vasa recta penetrate<sup>3, 4</sup>.

The main complication occurring in patients with colonic diverticulosis is acute diverticulitis. About 10 to 25% of patients develop an episode of acute diverticulitis during their lifetime<sup>5</sup>, with significant complications in 10 to 15% of them<sup>2, 6</sup>. An episode of acute diverticulitis can range from mild left-quadrant abdominal pain to an acute abdomen caused by a perforated diverticula with generalized peritonitis<sup>4</sup>. For this reason, acute diverticulitis (DV) is divided into two main categories, uncomplicated and complicated episodes.

Uncomplicated DV accounts for more than 75% of cases. The patient usually experiences lower left quadrant pain, irregular bowel habits, fever and occasional urinary symptoms<sup>5</sup>. Blood tests normally reveal leukocytosis with a left shift; a CT scan is necessary to confirm the diagnosis. Treatment consists of a 7-to-10 day course of oral antibiotics, liquid or low-residue diet, and pain management. Depending

on clinical status and complementary diagnostic test results, patients may require hospitalization<sup>4</sup>.

Complicated DV includes abscess formation, perforation, fistulas or stenosis. The disease may present with different stages of severity, which are expressed in the Hinchey classification system. Although invented before the use of CT scan, this system remains the most commonly used in the modified version of Wasvary et al (Table 1). Treatment modality depends on the complication. For abscesses, treatment varies with their size and location: bowel rest and intravenous antibiotics for small localized abscesses, percutaneous drainage for large abscesses. In either case, elective surgery (ES) likely follows. For perforation, emergency surgery has been the treatment of choice<sup>7</sup>.

Elective surgical treatment after acute DV generally consists of sigmoid resection with subsequent anastomosis between the descending colon and upper rectum. It is of utmost importance to remove the entire sigmoid colon<sup>9-11</sup>. This ensures a colorectal anastomosis, as opposed to a colosigmoid anastomosis, which reduces the rates of recurrent disease from 13-23% to 6%<sup>4</sup>. As for the proximal resection, there are no clear guidelines regarding the extent of colon that should be removed<sup>12</sup>. Most studies recommend excising the thickened or inflamed colonic segment; in some cases, the proximal margin may need to extend well into the descending colon, or even into the left transverse colon<sup>9, 12</sup>. The anastomosis should then be made in a region of soft pliable bowel, in which a stapled or hand-sewn anastomosis can be carried out without the inclusion of any diverticula<sup>4, 10, 12</sup>.

TABLE 1 – Modified Hinchey Classification

Modified Hinchey Classification by Wasvary et al. <sup>8</sup>	
Stage	Description
0	Mild clinical diverticulitis
Ia	Confined pericolic inflammation or phlegmon
Ib	Pericolic or mesocolic abscess
II	Pelvic, distant intra-abdominal or retroperitoneal abscess
III	Generalized purulent peritonitis
IV	Generalized fecal peritonitis



Other aspects of surgical procedure are not consensual and may be patient specific (e.g., the need for mobilization of the splenic flexure or the preservation of the inferior mesenteric artery<sup>12</sup>).

The surgical approach can also vary between open or laparoscopic surgery. A recent meta-analysis shows that both types of surgery are associated with a low mortality rate (0.4-0.5%), but the laparoscopic approach has significantly lower morbidity and complication rates<sup>13</sup>. Other advantages of laparoscopic surgery in general must also be considered, such as less postoperative pain, shorter hospital stay, faster return to normal activities, and better cosmetic results<sup>4, 9, 14</sup>.

Indications for surgical treatment of diverticular disease have been debated over the last few decades. For patients with multiple episodes of uncomplicated DV, ES has been indicated because recurrent episodes seemed to associate with increased morbidity and mortality. However, recent studies have not confirmed this association and have thus challenged former guidelines. For individuals with complicated DV, surgery may be an option in two different settings: in the form of emergent surgery for complications such as perforation, or in the form of ES, for example, after conservative abscess treatment. These surgical indications, while not debated as frequently as those for uncomplicated disease, may also need to be revised in the light of new treatment modalities.

While awaiting the results of the first randomized clinical trials comparing different treatment strategies for acute DV<sup>15-17</sup>, the present paper will summarize the debate surrounding the indications for ES. The first part of the paper traces the history of surgical treatment of acute DV; the second part reviews the controversies surrounding ES. In the third and final part, we draw some implications of the studies mentioned in part 2 for the treatment of acute DV.

## **A BRIEF HISTORY OF THE SURGICAL TREATMENT FOLLOWING ACUTE DIVERTICULITIS**

Surgical treatment for patients experiencing acute DV has evolved immensely since 1907, when Mayo

reported the first colonic resection for perforated diverticulitis<sup>18</sup>. During the first half of the 20th century, only complicated cases of acute diverticulitis (e.g., perforation, obstruction and fistula) were surgically treated<sup>19, 20</sup>. Treatment usually consisted of a proximal diverting colostomy, intended to be closed after sigmoid inflammation subsided<sup>20</sup>. The outcome of this procedure was generally poor, for in half of the cases, colostomy reversal was impossible; and in the other half, after closing the colostomy, the disease tended to be exacerbated<sup>21</sup>.

During the 1950's, widespread use of antibiotics and general improvement in operative antisepsis decreased operative morbidity and mortality<sup>19</sup>. Many surgeons started to advocate a more aggressive approach during the early stages of the disease. A report by Smithwick emphasized the importance of resecting the involved bowel to obtain the best results<sup>20</sup>. Although Smithwick preferred the 3 stage surgical procedure, others suggested more radical approaches such as the Hartman procedure, or even a single stage surgery with primary anastomosis. These one- or two-stage surgical procedures, when applied to selected groups of patients, were associated with less mortality and fewer colostomies than those involving three stages<sup>21</sup>.

At that time, other surgeons suggested the operative treatment for recurrent cases of uncomplicated DV. In 1953, Welch et al. stated that "repeated attacks of DV are a real hazard to the life of the patient" and proposed an elective surgical procedure with primary anastomosis after resection of the affected colon. This strategy was indicated for patients: with repeated attacks of DV, under 50 years of age, with urinary symptoms indicating colovesical fistula, or with severe deformity of the sigmoid on radiologic examination<sup>20</sup>.

In the 1990's, DV treatment guidelines recommended elective bowel resection after two episodes of uncomplicated acute diverticulitis (after one if younger than 50) or after one episode of complicated diverticulitis. Many of these guidelines were based on Parks' studies<sup>22, 23</sup>. In his classic 1969 study, the author analyzed 455 cases of acute DV requiring inpatient treatment<sup>24</sup>. Seventy per cent of patients received



antibiotics and bowel rest, whereas the remaining thirty per cent received surgical treatment. Parks followed these patients over a 15-year period. This unusually long follow-up of almost 100% of the patients allowed a novel view of the natural history of diverticular disease. During the follow-up, 25% of patients in the medically treated group were readmitted with one or more recurring attacks. During recurrent episodes, response to medical treatment declined and disease-related mortality rose. Parks concluded that medical treatment becomes less rewarding with each recurrence of acute DV. This statement was frequently quoted to support early surgical treatment, specifically ES after 2 episodes of uncomplicated DV.

Notwithstanding its importance, Parks' study was severely limited, particularly concerning diagnostic accuracy. Because the study was conducted before the widespread use of CT scan, patients were diagnosed based on clinical evaluation and barium enema. However, more than half of the barium enemas were not compatible with acute DV. Another factor suggesting diagnostic inaccuracy is that one third of the patients had recurrent symptoms, both in the surgical and medically treated group. These symptoms could be due to a different underlying condition, such as irritable bowel syndrome. If this were true, some of the "recurrent episodes" may not have been acute DV. After reviewing Parks data, Janes et al. concluded that even if recurrent episodes were in fact acute DV, ES after a second attack would have only prevented 17 readmissions and would imply 61 unnecessary surgical interventions. Keeping in mind the substantial postoperative mortality rate reported in Parks' study, the risk associated with ES would outweigh any potential benefit<sup>25</sup>.

Subsequent studies of treatment outcomes for acute DV failed to reproduce Parks' major findings and therefore called into question the guidelines issued from his studies. In what follows, we summarize these studies, first those addressing the treatment of uncomplicated episodes of acute DV, and next those addressing complicated episodes.

## UNCOMPLICATED ACUTE DIVERTICULITIS

In 1995, the American Society of Colon and Rectal Surgeons (ASCRS) issued guidelines (revised in 2000<sup>1</sup>) on the management of recurrent uncomplicated diverticulitis. Given that, according to Parks' 1969 study, "with each recurrent attack the patient is less likely to respond to medical therapy", the ASCRS recommended resection after two attacks of uncomplicated DV. In 1999, the American College of Gastroenterology<sup>26</sup> and the European Association of Endoscopic Surgeons<sup>27</sup> issued similar guidelines. In addition to Parks, other small retrospective studies conducted between 1960 and 1990 (e.g., Hackford 1985, Chappius 1988 and Colcock 1958 cited in<sup>22</sup>) also suggested that recurrent episodes of DV were associated with an increased likelihood of complicated disease, morbidity due to permanent colostomies, and mortality. However, recent studies have shown consistently opposite results.

### **1. Complicated DV usually occurs during the first episode and, from then on, the disease runs a relatively benign course**

Several studies have shown that for most patients a complicated episode of acute DV generally occurs during the first presentation of the disease<sup>22, 23, 24, 28</sup>. Approximately 75 to 85% of the patients with free perforation have no previous history of acute DV<sup>22, 30, 31</sup>. Hence, considering that complicated episodes typically are not preceded by other manifestations of the disease and, in addition, recurrent DV episodes tend to be uncomplicated, ES may not be appropriate after the first one or two episodes of uncomplicated DV. ES in these cases will decrease neither the likelihood of emergency surgery nor the overall mortality due to complications<sup>9, 25, 32</sup>. The foregoing conclusion is consistent with three studies:

- Chapman showed that of 337 patients admitted for complicated DV, more than half did not have a history of the disease<sup>22</sup>. Similarly, 89.5% of the



patients who died from perforation had never experienced a previous episode of acute DV.

- In a subsequent study, Chapman et al. found that of 157 patients with complicated acute DV, 53.4% had no previous history of diverticulitis, and mortality was more probable in this group of patients<sup>32</sup>. The author concludes that ES after the first event may not reduce morbidity or mortality.
- Makela et al. analyzed 977 cases of acute DV requiring hospital admission during a twenty year period<sup>33</sup>. Complicated cases requiring urgent operation occurred in 10% of the patients admitted for the first time, in 6% of the patients admitted for the second and in 8% of the patients admitted for the third time. Two thirds of the patients with complicated episodes had no history of acute DV. Once again, the disease does not seem to have the progressive nature implied previously. The authors also remark that the many elective operations performed after two or three episodes of uncomplicated DV during the 1990s and early 2000s seem not to have reduced the number of complications of the disease.

Thus, complications such as perforation are seen mainly at the initial presentation. Moreover, after the first episode, the disease appears to run a relatively benign course. After reviewing several studies, Janes et al. concluded that only one patient per 2000 patient-years would require an urgent Hartmann's resection due to an episode of recurrent DV<sup>25</sup>. Given the available evidence, it seems inappropriate to propose ES to avoid emergent surgery or permanent colostomy.

## **2. Multiple episodes of acute DV may decrease rates of perforation**

Multiple episodes of acute DV seem to reduce the rates of perforation – perhaps the recurrent inflammation associated with the disease produces adhesion

formation. This conclusion is supported by the following studies:

- Chapman et al. found that patients with fewer prior episodes of DV had more perforations than patients with more than 2 episodes<sup>22</sup>. Moreover, the two sets of patients had similar morbidity due to perforation, that is, patients with multiple episodes of DV did not show higher risk of postoperative complications.
- Somasekar et al. found that patients with a history of DV presented an overall mortality rate of 2.5% versus a 10% rate in patients with no history<sup>30</sup>.
- Ritz et al. found that free perforation was more common during the first episode of acute DV and became less common with each additional prior episode<sup>35</sup>. A multivariate analysis identified the variable “first episode” as a risk factor for perforation, but the association between perforation and recurrent episodes was not statistically significant.

## **3. Recurrent episodes do not show a decline in response to medical treatment**

Another argument used to support early ES stated that medical treatment lost effectiveness with each additional acute DV episode. However, recent studies, such as Makela et al., have shown that response rate is not affected by number of previous episodes<sup>33</sup>. Similarly, an Italian multicenter study with 1046 patients treated for acute DV during a 9-year period showed that conservatively treated DV recurrences do not significantly affect the likelihood of treatment success and that, in most cases, patients remain asymptomatic after resolution of the acute episode<sup>36</sup>.

The fact that most current studies report high success rates in conservatively treated patients may stem from better medical treatments over the last years, including more accurate diagnoses based on CT scans, new treatment modalities, more effective antibiotics, and improved critical care<sup>23</sup>. Regardless of its explanation,



it is clear that medical management of recurrent attacks is more effective than previously believed.

#### **4. The risk of emergent surgery or colostomy during recurrent attacks is low**

Few patients experience several attacks of acute DV during their lifetime. Given the rarity of the disease, studies need to include large samples of patients. A case in point is Anaya et al.'s study, the largest to date, which included 25 thousand patients admitted for an initial episode of acute DV<sup>37</sup>. Of the more than 20 thousand patients (80.3%) who received initial conservative treatment, 19% had a subsequent episode, and, of these, 18% required an emergency surgical intervention during the recurrent attack. The authors concluded that only 5.5% of patients who recover from an initial episode will ever require emergency colectomy or colostomy<sup>22, 37</sup>.

In the same year, Broderick-Villa conducted another population-based study<sup>38</sup>. Of 3165 patients with acute DV, 81% underwent conservative treatment. Of the patients who received conservative treatment and did not have ES at a later point, 222 had a second episode and 92 had a third episode during the 8.9 mean years of follow-up. The risk of re-recurrence was significantly higher than the risk of recurrence (29.3% vs 13.3%). The authors concluded that each new episode of acute DV predicts a higher risk of recurrence, up to about 3 recurrences. However, the overall risk of recurrence remains low (13.3%), with an annual recurrence rate of about 2% per year.

Given a recurrence rate of about 2% per year and the fact that patients presenting a first episode of acute DV average 65 years and have a life expectancy of around 14 years, the probability of such a patient developing a recurrent episode during his/her life is approximately 21%<sup>39</sup>. This value, which is similar to that reported in most studies, also speaks against ES for all patients after the first few episodes. If ES were routinely applied, then 79% of the patients would not benefit from this procedure, but would incur the costs of the morbidity and mortality associated with surgery.

#### **5. ES is less beneficial than expectant management along multiple end points**

Numerous retrospective and observational studies have compared ES to expectant management. Their data were used by Salem et al. to conduct a decision analysis, a tool used to compare treatment strategies in the setting of multiple end points and high clinical complexity<sup>40</sup>. The authors compared ES performed according to guidelines (i.e., after a second episode of uncomplicated DV in patients over 50, and after the first episode in younger patients) to postponing ES until after the fourth episode. Because only a very small percentage of patients (around 0.3%) will have more than four episodes, this analysis essentially compares ES to expectant management. Using a population-based cohort, the analysis showed that operating after a fourth episode resulted in fewer deaths, fewer colostomies, more quality-adjusted life years, and less financial costs. The authors concluded that in both age groups, postponing ES until after the fourth episode of recurrence was the best strategy according to all end points<sup>38</sup>.

Richards and Hammitt reached similar conclusions<sup>41</sup>. Their decision analysis compared the outcomes of ES performed after the first, second, or third episode of acute DV. Elective colectomy after the third episode was the most cost-saving strategy and yielded more quality-adjusted life years.

An important and frequently overlooked end point in most studies is the patient's quality-of-life (QOL) after recovering from acute DV<sup>6</sup>. An estimated one third of patients experience chronic symptoms (e.g., abdominal pain, altered bowel habits) after an initial DV episode<sup>42</sup>. Whether these symptoms are due to colonic diverticular disease or to other underlying conditions such as irritable bowel syndrome or inflammatory bowel disease remains, in most cases, unknown. Hence, for these patients, it is difficult to ascertain whether elective sigmoidectomy would reduce chronic symptoms and restore quality of life. Forgiione et al. questioned 46 patients undergoing laparoscopic elective colectomy for acute DV<sup>43</sup>. Health-related QOL was





assessed by the Gastro-intestinal QOL questionnaire administered preoperatively and multiple times during the first postoperative year. Postoperative scores were significantly higher at each subsequent assessment, reflecting a general improvement of symptoms over time. They were also inversely correlated with the patient's preoperative score. Other retrospective studies (van de Wall 2013, Levack 2012, Ambrosetti 2007) showed symptom reduction and improved quality of life after ES in the majority of patients. However, a minority of patients maintain persistent abdominal complaints or even report symptom worsening after ES. A repeatedly identified limitation of these studies is the absence of pre-operative symptom assessment.

## **6. ES is not risk-free and does not completely prevent further episodes of acute DV**

To recommend ES, the morbidity and mortality of subsequent attacks must outweigh the risks of a surgical procedure<sup>25</sup>. Although ES is generally a safe procedure, it is not devoid of risks. For example, 3 to 4% of patients may develop post-operative fistulas, while incomplete bladder emptying and ejaculatory problems may also ensue<sup>44</sup>

ES does not fully prevent new episodes of acute DV. Andeweg et al. conducted a prospective study with 183 patients who had undergone emergent or ES for pathology-proven diverticular disease<sup>29</sup>. During the mean 7.2 years of follow-up, 8.7% of the patients experienced another episode of acute DV. This value is consistent with the post-operative recurrence rate of 2.6 to 10% reported in other studies<sup>23</sup>. Although the absolute recurrence rate of 8.7% was relatively low, the estimated risk of recurrence over a 15-year period, equaled 16%.

## **YOUNG PATIENTS**

Although colonic diverticulosis predominantly affects the elderly, the incidence of acute DV has been increasing in individuals younger than 50. Recent

reviews suggest young patients account for 18 to 34% of acute DV cases, figures significantly greater than the 2 to 7% formerly reported<sup>34, 45-47</sup>.

The 2000 ASCRS treatment guidelines for acute DV recommended ES after a single episode of acute DV for patients under 50 years of age<sup>1</sup>. In this age group, diverticulitis was said to be a “more virulent disease” with a higher incidence of complications, including higher failure rate of medical therapy and need of surgery. Younger age was also associated with a higher rate of recurrent DV episodes<sup>46</sup>.

In retrospect, the majority of studies that associated a more aggressive disease in the young were conducted before the widespread use of CT scan for diagnosis<sup>7</sup>. During the pre-CT scan period, around 48 to 88% of younger patients underwent unnecessary emergency operations because of preoperative misdiagnoses<sup>34</sup>. As a consequence, rates of emergency surgery in the younger age group were much higher than in the older group, not because of a more aggressive disease, but because of incorrect preoperative diagnoses<sup>37</sup>.

Another possible explanation for younger patient's poor outcome in previous studies was the delay in diagnosis and treatment. Since acute DV is rare in patients under 50, doctors frequently failed to consider this diagnosis. The consequent delay in correctly diagnosing and treating these patients may explain the aggressive forms of their disease<sup>48, 49</sup>.

Many recent reports have challenged the idea that age is an important predictor of outcome<sup>35, 46, 50</sup>. A retrospective review of 762 patients with acute DV carried out by Guzzo et al. found that 76% of the patients under age 50 improved with conservative treatment and that the risk of requiring surgery was similar in the two age groups. Furthermore, during the 5.2-mean years of follow-up, only 4 of the 196 conservatively treated patients below 50 required surgery due to a recurring episode, and only 1 had a perforation that led to colostomy<sup>47</sup>.

Another frequently referenced paper concerning young patients is Anaya et al.<sup>37</sup>. As mentioned before, the main goal of this study was to evaluate patients who received medical treatment and later required emergency



colectomy or colostomy. Overall, only 5.5% of the conservatively treated patients required subsequent emergency surgery, a percentage significantly lower than in previous smaller studies. Moreover, this percentage was similar in the groups of patients under and over 50. In contrast, the hazard ratio of requiring emergency surgery over time was approximately 40% higher in the younger group. Despite this increase in the relative risk in younger patients, their 5 to 7% absolute risk for an emergency operation after the first hospitalization was unremarkable. Had the guidelines to perform elective colectomy after the first DV episode in younger individuals been followed, 13 patients would have had ES to prevent emergency surgery in 1 patient<sup>37</sup>.

A 2013 meta-analysis examined the natural history of diverticulitis in the young. It included 11 of the most recent studies, all with patients with an acute DV diagnosis confirmed by CT scan<sup>45</sup>. The meta-analysis showed that younger patients do not seem to have a higher incidence of complicated DV. In addition, and despite the substantial variation in the percent of emergency surgery across studies, younger patients also did not seem to undergo more emergent surgical procedures than older patients. The only significant difference between the two age groups was a higher number of recurrences in patients under 50 (32% vs. 19%). This difference in recurrence rates is generally interpreted as a chronological phenomenon: younger individuals have a higher cumulative risk for complications of diverticular disease simply because they have a longer life expectancy. Other investigators<sup>9, 25</sup> suggest a different physiopathologic mechanism for the disease: diverticula in young patients may not be caused by the colonic wall fragility that leads to diverticula in the elderly. This hypothesis is consistent with findings of histopathological changes similar to irritable bowel syndrome surrounding diverticula in the younger age group<sup>29</sup>.

In contrast with the foregoing meta-analysis, other recent studies have not found higher recurrence rates in younger patients. For instance, in a multicenter study with 1441 patients, Ünlü et al. examined whether acute DV in patients under 50 was associated with higher

recurrence rates or with more severe outcomes<sup>50</sup>. The need for operative treatment (combining first- and multi-episode patients) was similar in the two age groups. The recurrence rate also was indistinguishable (25.6% in the younger group vs. 23.8% in the older group). With respect to prognosis, age was not a significant risk factor for poor outcome. The authors concluded that younger patients do not show a more aggressive form of the disease, nor have higher recurrence rates.

A prospective study by Ritz et al. reached similar conclusions<sup>35</sup>. The study included 1019 patients, all with acute DV confirmed by triple contrast CT. Results showed a higher risk of perforation during the 1st episode of DV in both under- and over-50 age groups. Because the probability of a first episode is obviously higher in the younger age group, previous studies may have overestimated the risk of free perforation in these individuals. Also, when comparing first versus recurrent episodes, no significant differences in treatment modalities were found between the two age groups. The only exception was that ES was more frequent in younger patients. Regarding emergency surgery, although younger patients had a higher relative rate than older patients, after controlling for first vs. recurrent episodes, no significant differences remained. As for treatment results, success rates for conservative treatment showed no difference between the age groups, (failure rate was low in both, 3.4% for younger and 4.9% for older patients).

Most recent studies agree that the available data do not justify the earlier indication for ES in the younger population<sup>7, 10, 34, 46</sup>. The disease does not seem to be more aggressive than in the older patients: the percentage of complicated cases, the need for emergency surgery, and the response to medical therapy are similar in the two age groups. Although recurrences may be more likely in the younger group because of longer exposure time, the low morbidity and mortality associated with treatment of recurrent episodes do not seem to justify the risks of elective colectomy for most individuals. The 2014 ASCRS guidelines<sup>51</sup> now state that “Routine elective resection based on age (<50 years) is no longer recommended – grade of recommendation 1C.”



## IMMUNOSUPPRESSED PATIENTS

Advances in transplantation medicine and in the treatment of autoimmune diseases have drastically increased the number of patients on immunosuppressive medication. In this subpopulation, the management of acute DV has become increasingly relevant. Acute DV episodes are not only more common in the immunosuppressed (IS) than in the general population (1% vs 0.02% incidence), but also undergo a more virulent course and have more complicated recurrences<sup>52</sup>. These findings may be explained by a delay in diagnosis (for immunosuppression masks symptoms of acute DV) or by the greater difficulty in controlling the infectious process in patients with depleted immune systems.

Some authors have recommended ES after one episode of acute DV and others have even proposed prophylactic sigmoidectomy before the development of any acute DV episode<sup>53, 31, 32</sup>. However, recent studies have challenged these recommendations as they did not find a higher morbidity or mortality in IS patients following acute DV<sup>54</sup>. Most studies regarding the issue are based on retrospective data and consist of small cohorts. The only prospective multicenter study to date was presented by Al-Khamis et al. in 2016<sup>55</sup>. This study compared postoperative outcomes following sigmoidectomy for acute DV in immunocompetent and IS patients, both in emergency and elective surgery settings. Of the approximately 27 thousand patients, 4.9% were on immunosuppressive medication. In the patients that required emergency sigmoidectomy, immunosuppression was identified as a significant risk factor for mortality. Creation of a stoma and the use of an open surgical approach (instead of laparoscopy) also were more common in IS patients. In the patients proposed for ES, both groups showed a low risk for postoperative morbidity and mortality. However, there was a small but significant increase in major morbidity and wound dehiscence in IS patients. The authors stated that although mortality rates following emergency surgery are higher in IS patients, the higher morbidity rates in the elective setting must also be considered when

recommending ES for these patients. They concluded that “future studies will need to identify risk factors for a severe second attack of DV in IS patients to further delineate the indications for ES following an acute DV episode in this population”.

Concerning this subpopulation, the 2014 ASCRS guidelines state that IS patients (e.g. those on corticosteroid medication and who have had a transplant) as well as patients with chronic renal failure or collagen-vascular disease are at increased risk for recurrent, complicated DV requiring emergency surgery. Surgeons are advised to maintain a “low threshold” for recommending ES after a first hospitalization for acute DV<sup>51</sup>.

## COMPLICATED CASES OF ACUTE DIVERTICULITIS

### Perforation and Abscesses

Patients that present acute DV with microperforation develop localized abscesses, whereas those with macroperforation develop generalized peritonitis. Peritonitis, whether chemical or fecal, has been a standard indication for emergent surgical treatment<sup>4</sup>. However, new and less invasive options such as laparoscopic lavage are currently being tested and appear promising<sup>15, 16</sup>.

Regarding abscesses, treatment recommendations include antibiotic treatment, percutaneous abscess drainage (PAD) guided by US or CT, or surgery<sup>4, 34, 56</sup>. Size and location of the abscess influence decisions on whether non-surgical treatment is feasible. For abscesses less than 4 to 5 cm in diameter, conservative treatment with broad-spectrum antibiotics is generally successful<sup>56</sup>. For larger, clearly defined abscess, PAD may be an option, provided a safe abdominal or transgluteal access is feasible. In these cases, PAD has a high success rate<sup>34, 56</sup>. Even though the success rates for these non-surgical options are noteworthy, some patients will eventually require surgical treatment.

Guidelines for surgical treatment of complicated DV episodes have been less debated than the guidelines



for uncomplicated DV. Antibiotic treatment and PAD are seen as temporary measures to avoid emergency surgical treatment. Therefore, ES is always advised after a patient experiences an episode of complicated DV that was conservatively managed<sup>51</sup>. The timing of surgery may vary from “early surgery”, performed during the same hospital admission, to “late surgery”, accomplished after a 6- to 8- week delay<sup>57</sup>. The second strategy seems to be advantageous, yielding lower conversion rates from laparoscopic to open surgery and fewer complications<sup>58</sup>.

When antibiotics or PAD successfully treat the abscess, should ensuing surgery be mandatory? Most studies failed to answer the question<sup>58</sup>. Some investigators suggest the decision to operate should be based on the abscess location: mesocolic abscesses, when compared to pelvic abscesses, are more responsive to non-operative treatment and as such may not always require ES<sup>59</sup>. However, current guidelines maintain that ES is always warranted after 1 episode of complicated disease due to the high recurrence rate for conservatively treated cases. However, Broderick-Villa’s study showed that of 34 patients subjected to PAD without subsequent surgery, only 13.3% had a recurrent episode<sup>38</sup>. This recurrence rate is similar to that of patients with uncomplicated DV episodes subjected to medical management. The authors conclude that ES after PAD may not be required to avoid higher rates of recurrent disease<sup>38, 58</sup>. In the previous section, we have also seen multiple studies that show complicated DV usually occurs during the first presentation of disease and seems to run a benign course afterwards.

## CONCLUSION

Indications for surgical treatment of acute DV have been extensively modified during the last century. Increasing knowledge on the natural history of the disease resulted in a more conservative approach to most cases. In the past, recurrent episodes of uncomplicated DV were thought to lead to an increase in complications of the disease with substantial morbidity and mortality.

Today, we know acute DV tends to be more aggressive during the first episode; recurrences are rare and relatively benign; in most cases they can be managed successfully with non-operative treatments.

Most national and international guidelines now state that the decision to perform ES after one or more episodes of uncomplicated DV should be tailored to the patient<sup>51</sup>. Factors such as severity of the attacks, presence of chronic or lingering symptoms, associated patient comorbidities and risks of operative treatment must be weighed. Also, patients should be inquired as to how the possibility of recurrent episodes may influence their lifestyle on a personal and profession level<sup>51</sup>.

In our opinion, the decision to perform ES should be preceded by an open and informed discussion with the patient. During this discussion, the following topics should be approached: quality of life after ES, the possibility of post-operative chronic abdominal symptoms, surgical risks and acute DV recurrence. Although ES seems to improve QOL in the majority of patients with chronic abdominal complaints, some complaints may persist or even develop after surgery (perhaps due to other underlying conditions). ES also reduces the risk of having further DV episodes, albeit does not eliminate the risk completely. Studies have demonstrated that elective laparoscopic sigmoidectomy is generally a safe and low-risk procedure, but post-operative complications such as anastomotic leak, infection and need for reoperation do occur.

As for patients chronically immunosuppressed, with chronic renal failure, or with a collagen-vascular disease, most authors agree that the threshold for ES must remain low. The probability of recurrence after medical management of acute DV is high and complicated DV requiring emergency surgery is more probable in this subpopulation.

Although remarkable advances have been made regarding treatment of patients with diverticular disease, many unanswered questions remain. Can certain chronic abdominal symptoms (e.g. pain, discomfort, altered bowl habits) be associated with diverticular disease? If so, how can we distinguish these patients from patients with other underlying conditions, such



as irritable bowel syndrome? Does ES improve QOL for patients with persistent abdominal complaints due to diverticular disease? Concerning patients with uncomplicated DV attacks, which ones benefit from ES? Which factors should be taken into account when deciding to whom ES should be offered? And as for complicated DV, is ES necessary after all successful abscess drainages? These questions would benefit from further studies.

The randomized clinical trial DIRECT<sup>17</sup> is currently underway in Holland. It compares conservative

treatment to ES in patients with chronic abdominal complaints after an acute DV episode. The comparison considers symptom relief, quality-of-life, morbidity, mortality, recurrence rates and associated costs. Clinical trials regarding the treatment of complicated acute DV also are underway. The long-awaited results of the clinical trials LADIES<sup>15</sup>, DILALA<sup>16</sup>, LapLAND, and SCANDIV will surely shed a new light on the competing treatment strategies for complicated DV, such as surgical treatment versus laparoscopic lavage.

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*Correspondência:*

CATARINA TAVARES MACHADO  
e-mail: mimed08051@med.up.pt

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