

## Retrospective Cohort Study

**Laparoscopic approach in complicated diverticular disease**

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**Abstract**

**AIM:** To analyze the results of laparoscopic colectomy in complicated diverticular disease.

**METHODS:** This was a retrospective cohort study conducted at an academic teaching hospital. Data were collected from a database established earlier, which comprise of all patients who underwent laparoscopic colectomy for diverticular disease between 2000 and 2013. The series was divided into two groups that were compared: Patients with complicated disease (abscess, perforation, fistula, or stenosis) (G1) and patients undergoing surgery for recurrent diverticulitis (G2). Recurrent diverticulitis was defined as two or more episodes of diverticulitis regardless of patient age. Data regarding patient demographics, comorbidities, prior abdominal operations, history of acute diverticulitis, classification of acute diverticulitis at index admission and intra and postoperative variables were extracted. Univariate analysis was performed in both groups.

**RESULTS:** Two hundred and sixty patients were included: 28% (72 patients) belonged to G1 and 72% (188 patients) to G2. The mean age was 57 (27-89) years. The average number of episodes of diverticulitis before surgery was 2.1 (r 0-10); 43 patients had no

previous inflammatory pathology. There were significant differences between the two groups with respect to conversion rate and hospital stay (G1 18% *vs* G2 3.2%,  $P = 0.001$ ; G1: 4.7 d *vs* G2 3.3 d,  $P < 0.001$ ). The anastomotic dehiscence rate was 2.3%, with no statistical difference between the groups (G1 2.7% *vs* G2 2.1%,  $P = 0.5$ ). There were no differences in demographic data (body mass index, American Society of Anesthesiology and previous abdominal surgery), operative time and intraoperative and postoperative complications between the groups. The mortality rate was 0.38% (1 patient), represented by a death secondary to septic shock in G2.

**CONCLUSION:** The results support that the laparoscopic approach in any kind of complicated diverticular disease can be performed with low morbidity and acceptable conversion rates when compared with patients undergoing laparoscopic surgery for recurrent diverticulitis.

**Key words:** Complicated diverticulitis; Laparoscopy; Recurrent diverticulitis; Sigmoid colectomy; Outcomes

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**Core tip:** Several studies have shown clear benefits of the use of laparoscopic colectomy in diverticular disease. However, this approach is not well defined in patients with complicated disease. In the current study, the results support that laparoscopic surgery can be performed with acceptable results for any indication of diverticular disease.

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## INTRODUCTION

Traditionally, the surgical treatment of complicated diverticular disease involved the sigmoid resection and Hartmann's procedure. Over time, many authors demonstrated good results with the use of primary anastomosis with or without protective ostomy<sup>[1-3]</sup>. Today, it is clear that the laparoscopic approach has become the gold standard for the surgical treatment of patients with recurrent diverticulitis<sup>[4,5]</sup>. However, the application of this procedure in complicated diverticular disease remains controversial. Even more questionable is the use of the technique in patients with complicated diverticulitis on the emergency setting and the possibility of sigmoid resection in one step. The main objective of this study was to evaluate the results of the laparoscopic approach in patients with any type of complicated diverticular

disease.

## MATERIALS AND METHODS

Data were collected prospectively from all patients who underwent laparoscopic sigmoid resection for diverticular disease between 2000 and 2013. Those patients with any other colorectal disease were excluded. All surgeries were performed or supervised by two surgeons with similar experience in laparoscopic surgery.

The series was divided into two groups: Patients with complicated diverticular disease (G1) and patients operated for recurrent diverticulitis without evidence of any complication (G2).

Patients with at least one of the following signs were considered to have a complicated diverticular disease: Presence of chronic abscess or severe sequelar inflammation at the time of surgery; fistula; stenosis; or free perforation with purulent or faecal peritonitis.

Demographic characteristics, previous abdominal surgeries and the number of previous episodes of diverticulitis were considered for analysis. Intraoperative variables (e.g., operative time, intraoperative complications and conversion rate were evaluated). Finally, recovery parameters, length of hospital stay and morbidity and mortality were studied.

Conversion was considered when an unplanned incision was made or when other maneuvers beyond the extraction of the specimen were performed over the planned incision<sup>[6]</sup>.

Complications were categorized according to the classification of Dindo *et al.*<sup>[7]</sup>. Mortality related with the procedure was considered when it occurred during hospitalization or within 30 d after surgery.

### Statistical analysis

G1 to G2 were compared using univariate statistical analysis. The student's *t*-test or ANOVA were used to analyze continuous variables, whereas the  $\chi^2$  or Fisher test were used for categorical variables.

## RESULTS

In a 14-year period, 260 laparoscopic sigmoid resections were performed due to diverticular disease. Seventy-two (28%) patients were included in G1 and 188 (72%) in G2.

The patients characteristics from G1 were: 31 (43%) with pericolic or pelvic abscesses; 21 (29%) with perforation; 12 (17%) with fistulae (9 colovesical and 3 colocolic); and 8 (11%) with stenosis.

Procedures performed in G1 were: 65 (90%) sigmoid resections with primary anastomosis; 5 (7%) sigmoid resections with primary anastomosis and protective stoma and 2 (3%) Hartmann's procedures. Fifty-two patients (72%) were operated on emergency setting without significant differences when compared with patients operated for subacute disease. In G2, sigmoid resection with primary anastomosis was performed in all cases.

**Table 1 Preoperative variables *n* (%)**

Examined variables	Complicated diverticular disease (G1) [ <i>n</i> = 72 (28)]	Uncomplicated diverticular disease (G2) [ <i>n</i> = 188 (72)]	<i>P</i> value
Sex			0.474 (N/S)
Females	24 (33)	73 (39)	$\chi^2$
Males	48 (67)	115 (61)	
Age (yr)	58 ± 12 (29-84)	57 ± 11 (27-89)	0.178 (N/S)
			<i>t</i> -test
BMI (kg/m <sup>2</sup> )	26 ± 4 (19-41)	26 ± 4 (17-41)	0.112 (N/S)
			<i>t</i> -test
ASA			
I	16 (22)	50 (27)	0.057 (N/S)
II	47 (65)	128 (68)	$\chi^2$
III	9 (13)	10 (5)	
Previous abdominal surgery	37 (51)	107 (57)	0.605 (N/S)
			$\chi^2$
Previous episodes of diverticulitis	1.36 ± 1.4 (0-5)	2.42 ± 1.3 (0-10)	< 0.05
			<i>t</i> -test

N/S: No statistical significance; BMI: Body mass index; ASA: American Society of Anesthesiology.

**Table 2 Intraoperative variables *n* (%)**

Examined variables	Complicated diverticular disease (G1) [ <i>n</i> = 72 (28)]	Uncomplicated diverticular disease (G2) [ <i>n</i> = 188 (72)]	<i>P</i> value
Operative time (min)	193 ± 66 (80-345)	156 ± 58 (65-400)	< 0.05
			<i>t</i> -test
Intra-operative complications	3 (4)	4 (2)	0.892 (N/S)
	2 iatrogenic colonic/rectal perforation 1 bladder injury	1 epigastric vessels lesion 2 spleen injuries 1 ureteric injury	$\chi^2$
Conversion rate	13 (18)	6 (3)	< 0.05
			$\chi^2$
Length of colon resected (cm)	23 ± 8 (11-4.5)	22 ± 8 (10-53)	0.531 (N/S)
			<i>t</i> -test

N/S: No statistical significance.

Demographic data were homogeneous between the groups but G2 patients presented more previous episodes of diverticulitis [G1: 1.36 ± 1.4 (0-5) vs G2: 2.42 ± 1.3 (0-10), *P* < 0.05] (Table 1).

G1 patients had longer operative time [G1: 193 ± 66 (80-345) min vs G2: 156 ± 58 (65-400) min, *P* < 0.05] and higher conversion rate [G1: 13/72 (18%) vs G2: 6/188 (3.2%), *P* < 0.05]. The reasons for conversion in G1 included: Presence of a bulky inflammatory tumor (5 cases); adhesions (3 cases); otherwise unclear anatomy (2 cases); hemorrhage (2 cases); and bladder injury (1 case). In G2, the causes of conversion were: Inability to identify anatomy (4 cases); spleen injury (1 case); and ureteric injury (1 case).

In patients with complicated diverticular disease, a sigmoid resection with primary anastomosis without protective stoma was performed in 65 cases (90%). In 5 cases of purulent perforation (7%), a sigmoid resection with primary anastomosis with protective stoma was necessary, whereas in 1 case of stenosis and other case of fecal peritonitis a Hartmann procedure was the surgery of choice. In 29 (40%) of these cases, a splenic flexure mobilization was performed. In patients with uncomplicated diverticular disease, a sigmoid resection

with primary anastomosis without protective stoma was performed in all cases (*P* < 0.05), with necessity of splenic flexure mobilization in 73 cases (39%, *P* = 0.887).

There were no differences in the rate of intraoperative complications (Table 2). In two cases of G1, an iatrogenic bowel perforation was found without necessity of conversion for its resolution. However, in one case of bladder injury, conversion was required. The intraoperative complications in G2 were: 1 epigastric vessels lesion; 2 spleen injuries; and 1 ureteric lesion. A conversion was necessary in one spleen injury and in the ureteric lesion.

Table 3 shows the variables of postoperative recovery. Patients in G1 had slower intestinal transit slower oral intake comparing with G2. For these reasons, among others, the hospital stay was longer in this group [G1: 4.7 ± 3.1 (2-15) vs G2: 3.3 ± 1.8 (1-17) d, *P* < 0.05]. The postoperative complication rate was also higher in G1 [G1: 16/72 (22%) vs G2: 23/188 (12%), *P* < 0.05], but there were no major complications in assessing differences (Grade III, IV and V) (Table 4). The mortality rate was 0.38% (1 patient), represented by a death secondary to septic shock in G2 without evidence of anastomotic fistula. There was no reason to believe that the death was related to the procedure.

**Table 3** Gastrointestinal recovery

Examined variables	Complicated diverticular disease (G1) <i>n</i> : 72 (28%)	Uncomplicated diverticular disease (G2) <i>n</i> : 188 (72%)	<i>P</i> value
Intake > 1000 mL	Day 2.1 ± 2.1 (0-10)	Day 1 ± 0.8 (0.5)	< 0.05 <i>t</i> -test
Intake normal diet	Day 3.1 ± 2.2 (1-11)	Day 1.8 ± 1 (0-7)	< 0.05 <i>t</i> -test
Bowel sound +	Day 1 ± 0.6 (0-3)	Day 0.6 ± 0.6 (0-4)	< 0.05 <i>t</i> -test
Gases +	Day 1.9 ± 1.4 (0-7)	Day 1.4 ± 0.7 (0-5)	< 0.05 <i>t</i> -test
Length of stay (d)	4.7 ± 3.1 (2-15)	3.3 ± 1.8 (1-17)	< 0.05 <i>t</i> -test

**Table 4** Postoperative complications *n* (%)

Examined variables	Complicated diverticular disease (G1) [ <i>n</i> = 72 (28)]	Uncomplicated diverticular disease (G2) [ <i>n</i> = 188 (72)]	<i>P</i> value
Grade I	8 (11.1) 1 urinary retention 1 vomits 1 surgical site hematoma 5 ileus > 72 h	6 (3.19) 1 urinary retention 2 vomits 2 surgical site hematoma 1 ileus	< 0.05 $\chi^2$
Grade II	6 (8.3) 1 phlebitis 4 surgical site infection 1 fever syndrome with normal CT	9 (4.78) 4 surgical site infection 2 urinary infection 3 fever syndrome with normal CT	0.426 (N/S) $\chi^2$
Grade IIIA	0 (0)	1 (0.53) 1 pancreatic fistula	0.610 (N/S) $\chi^2$
Grade IIIB	2 (2.7) 2 anastomotic leak	6 (3.1) 2 hemoperitoneum 4 anastomotic leak	0.897 (N/S) $\chi^2$
Grade IV	0 (0)	0 (0)	-
Grade V	0 (0)	1 (0.53)	0.610 (N/S) $\chi^2$
Total	16 (22)	23 (12)	0.053 (N/S) $\chi^2$

N/S: No statistical significance; CT: Computed tomography.

## DISCUSSION

Historically, the surgical management of complicated diverticular disease has consisted of laparotomy, colonic resection and end-colostomy (Hartmann's procedure). Today, controversy exists regarding the role of primary colorectal anastomosis with or without fecal diversion<sup>[3]</sup> and the feasibility of the use of the laparoscopic approach.

Several series have demonstrated that laparoscopic sigmoid resection can be performed with acceptable morbidity and mortality for both inflammatory and neoplastic diseases<sup>[8-10]</sup>. The laparoscopic approach demonstrated several advantages, such as smaller wounds, shorter ileus, early resumption of dietary intake and reductions in hospital stay<sup>[11]</sup>. Furthermore, as shown by Jensen *et al.*<sup>[12]</sup>, it results in decreased costs and equivalent quality of life, making it the preferred approach in suitable patients. Laparoscopic sigmoidectomy has been shown to be safe, feasible and equivalent to open surgery for uncomplicated diverticulitis<sup>[4,5,13]</sup>. When expertise is available, the laparoscopic approach to elective colectomy is preferred<sup>[14]</sup>.

Since the minimally invasive approach offers important benefits, laparoscopic sigmoid resection due to recurrent diverticulitis is one of the most common procedures performed in colorectal surgery.

A prospective study published by Alves *et al.*<sup>[5]</sup> comparing open vs laparoscopic elective sigmoidectomy for uncomplicated diverticular disease found that the minimally invasive approach has a low postoperative complications rate, with a conversion rate of 15.3%, whereas the overall morbidity rate was 16%.

A recent randomized controlled trial by Klarenbeek *et al.*<sup>[15]</sup> comparing laparoscopic vs open sigmoidectomy for diverticular disease has shown significant advantages of laparoscopic surgery, with a 27% reduction in major morbidity for patients who underwent this approach.

The present series shows favorable results in patients who underwent laparoscopic resection for uncomplicated diverticulitis and found a 3% conversion rate to open surgery, with a 12% of morbidity rate.

Currently, the operative management of complicated diverticulitis has progressed to include laparoscopic surgical techniques. In 1978, Hinchey's classification was

described to determine which patients should undergo primary anastomosis after resections and this remains the system used in the majority of the publications<sup>[16]</sup>. As shown in a retrospective study published by Li *et al*<sup>[17]</sup>, there has been an increase in the use of nonoperative and minimally invasive strategies in treating patients with a first episode of acute diverticulitis. However, the Hartmann procedure remains the most frequently used urgent operative approach<sup>[17]</sup>. The laparoscopic approach has demonstrated acceptable morbidity and mortality rates, although the frequency of conversion increases with the severity of adhesions and the presence of fistulas or abscesses<sup>[18,19]</sup>. Recently, some studies have been published that include patients with complicated diverticular disease who underwent laparoscopic sigmoid resections. These studies report a conversion rate of between 11.5% and 37% and a postoperative complication rate of between 11.5% and 28%<sup>[20-22]</sup>. In the present series no differences in global morbidity were identified between the groups.

The safety of laparoscopic management for complicated and fistulizing diverticular disease has been previously addressed<sup>[21,23]</sup>. Despite the fact that laparoscopic resection for complicated disease would be expected to be challenging, reports have demonstrated no differences in operative time or conversion rate<sup>[24]</sup>.

Few groups have reported their experience in laparoscopic management of colovesical or colovaginal fistula<sup>[23,25,26]</sup>. These cited studies did not identify differences in hospital stay or postoperative complications when compared to open approach. Conversion rate ranged between 7% to 25%<sup>[27,28]</sup>. The present series included 9 patients with colovesical and 3 patients with colocutaneous fistulas. All of these patients were successfully operated by laparoscopy.

Regarding colonic stenosis, studies have reported favorable outcomes but with an increased conversion rate<sup>[29,30]</sup>. In this series eight patients were treated successfully due to stenosis, with a conversion rate of 12.5%.

Historically, the treatment of perforated diverticulitis was performed in stages, as in Hartmann's procedure, which remains the procedure of choice in Hinchey III-IV diverticulitis and is considered the best therapeutic option by many surgeons<sup>[31-35]</sup>. However, this technique has a low level of recommendation based on the literature evidence. Moreover, a further disadvantage of this approach is that the majority of these patients will never have a stoma reversal<sup>[35,36]</sup>.

Recently, several studies have demonstrated the benefits of laparoscopic sigmoid resection with primary anastomosis without protective stoma<sup>[37-40]</sup>.

Richter *et al*<sup>[2]</sup> reported that colon resections with primary anastomosis could be performed with high degree of safety in 90% of patients, although the risk increases in immunosuppressed patients or in patients with kidney or liver chronic failure.

A systematic review found no significant differences in mortality rate or other complications for patients with

Hinchey III-IV who underwent Hartmann's procedure or resection with primary anastomosis<sup>[38]</sup>.

In our series, 11 Hinchey III-IV patients were treated by laparoscopic sigmoid resection without any stoma protection and only one of them was converted to open surgery. The postoperative complication rate was 10%. Neither anastomotic leaks nor mortality rate were registered.

Recently, other groups have described the use of laparoscopic peritoneal lavage (LPL) and drainage for diverticular peritonitis, with or without posterior elective surgery<sup>[41-44]</sup>. Karoui *et al*<sup>[45]</sup> reported that LPL in Hinchey III complicated diverticulitis is an effective and safe alternative to colon resections with primary anastomosis or protective stoma, and demonstrate that it shortens the hospital stay, avoids a stoma in the majority of patients and decreases postoperative abdominal morbidity. Rogers *et al*<sup>[46]</sup> reported lower mortality and morbidity than those in whom resection was considered necessary. This procedure appears promising in selected patients. However, more studies comparing LPL against laparoscopic sigmoid resection with primary anastomosis should be performed before clinical recommendations can be given.

## COMMENTS

### Background

Diverticular disease is among the most common diseases in developed countries. It is estimated that approximately 20% of patients with diverticulosis develop diverticulitis over their lifetime. Surgical treatment can be evaluated emergently or electively, based on the stage of the disease and clinical presentation. Laparoscopic surgery is now widely accepted for the treatment of elective diverticular disease. The benefits include reduced blood loss, pain, morbidity and length of stay. Its use for complicated diverticulitis remains controversial.

### Research frontiers

In the present study, the authors reported the results of seventy-two patients with complicated diverticular disease treated by laparoscopic surgery.

### Innovations and breakthroughs

In literature the laparoscopic surgery is widely recommended for diverticular disease. However, this approach is not well defined in patients with complicated disease.

### Applications

The study suggests that the laparoscopic approach can be applied for the patients with any kind of complicated diverticulitis.

### Terminology

A diverticulum is a saclike protrusion in the colonic wall that develops as a result of herniation of the mucosa and submucosa through points of weakness in the muscular wall of the colon. Diverticulitis describes the presence of an inflammatory process associated with diverticula. Complicated diverticular disease is defined as diverticulitis with associated abscess, phlegmon, fistula, obstruction, bleeding, or perforation.

### Peer-review

This paper gives an accurate description about the role that the laparoscopy may have in the treatment of complicated acute diverticulitis, which frequency is constantly increasing in our society. This paper well structured and presented, giving to the reader, the opportunity to easily understand it.

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