

Laparoscopic Sigmoidectomy for Diverticulitis: a Prospective Study

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ABSTRACT

Background: Surgical treatment of complicated colonic diverticular disease is still debatable. The aim of this prospective study was to evaluate the outcome of laparoscopic sigmoid colectomy in patients with diverticulitis. Patients offered laparoscopic surgery presented with acute complicated diverticulitis (Hinchey type I, II, III), chronically recurrent diverticulitis, bleeding, or sigmoid stenosis caused by chronic diverticulitis.

Method: All patients who underwent laparoscopic colectomy within a 12-year period were prospectively entered into a database registry. One-stage laparoscopic resection and primary anastomosis constituted the planned procedure. A 4-trocar approach with suprapubic minilaparotomy was performed. Main data recorded were age, sex, postoperative pain, return of bowel function, operation time, duration of hospital stay, and early and late complications.

Results: During the study period, 260 sigmoid colectomies were performed for diverticulitis. The cohort included 104 male and 156 female patients; M to F ratio was 4:6. Postoperative pain was controlled by NSAIDs or weak opioid analgesia. Fifteen patients (5.7%) required conversion from laparoscopic to open colectomy. The most common reasons for conversion were directly related to the inflammatory process, abscess, and peritonitis. Mean operative time was 130 ± 54 . Average postoperative hospital stay was 10 ± 3 days. A longer hospital stay was recorded for Hinchey type IIb patients. Complications were recorded in 30 patients (11.5%). The most common complications that required reoperation were hemorrhage in 2 patients (0.76) and anastomotic leak in 5 patients (only 3 of them required reoperation). The mortality among them was 2 patients (0.76%).

Conclusions: Laparoscopic surgery for diverticular disease is safe, feasible, and effective. Therefore, laparo-

scopic colectomy has replaced open resection as standard surgery for recurrent and complicated diverticulitis at our institution.

Key Words: Sigmoid diverticulitis, Laparoscopic surgery, Hinchey classification, Colectomy.

INTRODUCTION

Progress in laparoscopy has resulted in its wide use in dealing with a broad spectrum of surgical diseases in both complicated elective and emergency settings. Surgical treatment of complicated colonic diverticular disease is still debatable, especially in relation to elderly patients with concurrent medical diseases.¹

The Hinchey classification, modified according to Wexner, provides criteria for evaluating the severity of sigmoid diverticulitis, suggesting indications for selective surgical management.² Resection of the involved colonic tract after attacks of complicated sigmoid diverticulitis was advocated in 1995 by the standard task force of the American Society of Colon and Rectal Surgeons.³

The advent of laparoscopic techniques for colorectal surgery in 1991 seemed to increase indications for early resection. However, the laparoscopic technique is not widely practiced among surgeons, particularly for diverticulitis complicated by fistula (Hinchey IIb) or generalized purulent peritonitis (Hinchey III). The existence of fecal peritonitis (Hinchey IV) is unanimously considered a contraindication to laparoscopy,^{4,5,6,7,8,9,10,11,12,13} even though some surgeons used to perform a 2-stage laparoscopic procedure to treat early presentation of fecal peritonitis.^{9,14}

Multicenter studies^{5,10} have confirmed that laparoscopic resection for diverticulitis can be performed without additional morbidity in cases with Hinchey type I and with reduced hospital stay in patients with Hinchey type I or II.

Data from 260 consecutive patients with sigmoid diverticulitis over a 12-year period were prospectively collected to review laparoscopic resections for sigmoid diverticulitis performed in a single center and to evaluate patient se-

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lection criteria and the indication for the safe laparoscopic resection in patients with sigmoid diverticulitis.

PATIENTS AND METHODS

From June 1994 to May 2006, 260 patients underwent laparoscopic sigmoid colectomy due to colonic diverticulitis (156 female and 104 male) with a mean age of 62 years (range, 36 to 93). The following factors were evaluated: age, sex, severity of the disease, operative findings, postoperative course, and follow-up evaluation by the attending surgeon and family doctor. The preoperative status was defined according to the American Society of Anesthesiology (ASA) classification, and the severity of the disease was defined by the extent of the inflammatory process at the time of laparoscopic exploration. The indications for surgery varied from recurrent attacks of diverticulitis to diverticulitis complicated with stenosis, bleeding, and perforation. All Hinchey IV cases presenting as fecal peritonitis and a severe form of Hinchey III were excluded from the study and were treated with the open method.

The resected colonic segment underwent histopathological examination. The operative mortality and morbidity were defined as death occurring within 4 weeks after surgery. All surgical and medical complications were included in the analysis. The attending surgeon followed patients for 3 months postoperatively, and a systematic inquiry about bowel habits and function was conducted.

A colonoscopy examination was advised and performed in the majority of patients 1 year after surgery as a routine follow-up procedure. Stenosis and stricture of the anastomosis was defined as a lumen that could not be passed by a 17-mm sigmoidoscope. All the above detailed information was entered into a PC database registry.

Preoperative Evaluation and Preparation

In cases of Hinchey I, a preoperative workup included USS, CT scan, barium or water soluble contrast enema, while percutaneous drainage of a distant (pelvic) abscess was indicated in Hinchey IIa, and in case of fistulous complications, barium enema was indicated to demonstrate the fistulous tract. Flexible endoscopy was indicated only for patients with chronic obstructive conditions or bleeding. Whenever possible, bowel preparation was obtained. Preoperative antibiotic prophylaxis consisted of cephalosporin and metronidazole intravenously. Prophylaxis against thromboembolism was achieved by S/C LMWT heparin started preoperatively.

Surgical Technique

The patients are positioned supine, in a modified lithotomy position, with the legs abducted and slightly flexed at the knees. The patient's right arm is alongside the body, whereas the left arm is usually placed at a 90° angle. Adequate padding is used to avoid compression on bone prominences.

The upper body should be 15 degrees under (Trendelenburg position) and the whole table to the right side, which allows the adjustment of the patient's position intraoperatively. In the stage of left flexure mobilization, the body is kept in an anti-Trendelenburg position to move the small bowel toward the pelvis.

The surgeon is usually on the right side of the patient, and the second assistant is also on the right side. The first assistant stands on the patient's left side, and the scrub nurse stands at the left foot side of the table. It is preferred to use a laparoscopic unit with 2 to 3 monitors and the monitors adjusted accordingly intraoperatively (**Figure 1**).

Four trocars are used, with the first trocar introduced via incision 4cm above the umbilicus by an open Hasson technique, and a pneumoperitoneum is insufflated to 12mm Hg to 14mm Hg. Second and third trocars are placed under direct vision respectively at the left hypochondrial and right lumbar regions, and a fourth trocar is placed 4cm above the pubic bone (**Figure 2**).

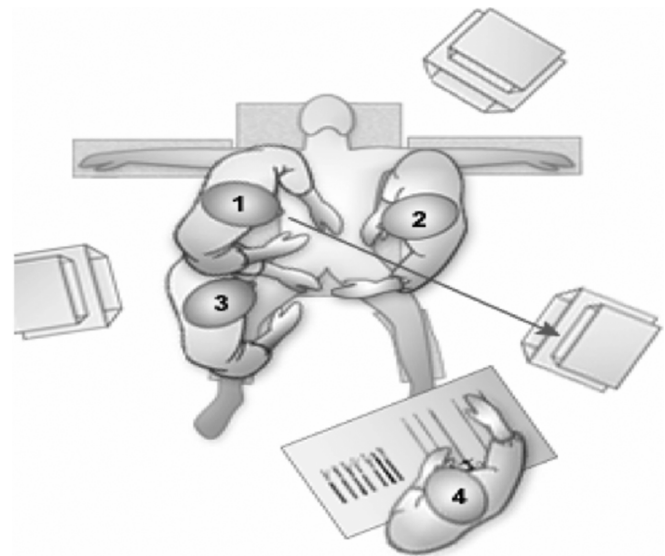


Figure 1. Position of the surgical team for laparoscopic sigmoidectomy.

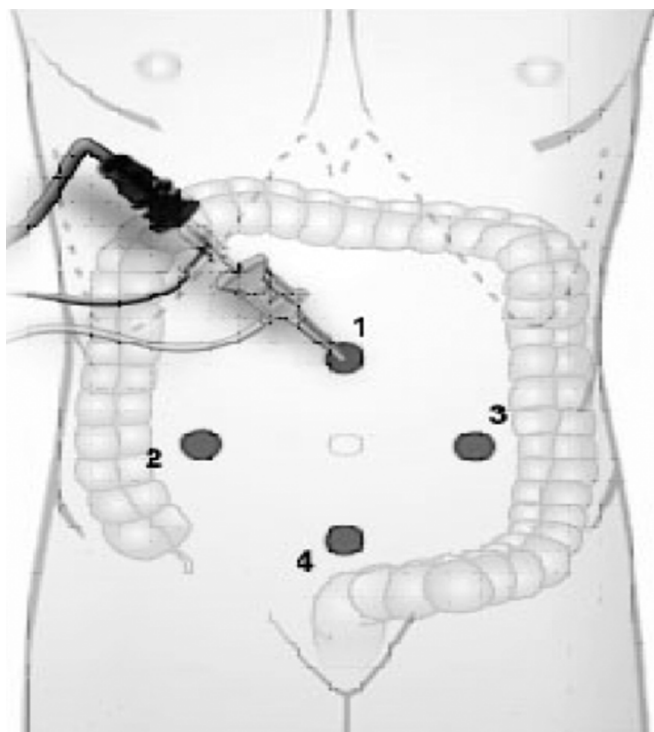


Figure 2. Positions of the trocars in laparoscopic sigmoidectomy.

A 30-degree laparoscope is introduced through the supraumbilical trocar. After visual inspection of the peritoneal cavity, the complicated diverticular lesion is approached first to bring the anatomy of the surgical field as close to normality as possible.

After anatomic normality is restored, a laparoscopic colonic resection is performed according to well-established steps. This in turn allows avoidance of injuries due to the thickening of the inflamed structures, especially in the identification and dissection of the vessels and ureters.

Dissection usually begins at the sigmoid colon; mobilization of the sigmoid colon begins by dividing natural attachments to the lateral abdominal wall, retroperitoneum, and other adjacent organs. These attachments can be divided either by using monopolar or bipolar electrocautery or the ultrasonic scalpel. The division continues along the peritoneal reflection and proceeds cephalad and caudal. Then the peritoneum overlying the medial aspect of the mesentery is dissected to expose the iliac vessels, the left ureter, the gonadal vessels, and the hypogastric nerves. Two spaces between the mesentery and the Toldt fascia are created, above and below the inferior mesenteric artery. The artery is divided by using a vascular linear

stapler beyond the origin of the left colonic artery and laterally to the hypogastric nerves. The inferior mesenteric vein is divided only when further mobilization is needed.

With the patient in an anti-Trendelenburg position, the gastrotocolic ligament is opened using the ultrasonic scalpel. The phrenocolic and splenocolic attachments are divided to mobilize the splenic flexure of the colon in some cases so a tension-free anastomosis can be easily created.

The dissection is completed with mobilization of the descending colon, the sigmoid tract, and the upper third of the rectum, which is divided by a linear stapler cutter. In the patient with the colovesical fistula (Hinchey IIb), the fistula is divided with the ultrasonic scalpel, and no attempt is made to close the bladder.

By extension of the suprapubic trocar opening, about a 3-cm to 6-cm minilaparotomy is performed. A wound protector is placed, and the sigmoid colon is extracted to perform a sigmoidectomy. A 29-head circular stapler (anvil) is inserted in the colonic stump and tied with a 2.0 polypropylene purse-string suture. The colonic stump is returned to the peritoneal cavity and the incision is sutured in layers.

The pneumoperitoneum is recreated, and a circular stapler is advanced via the anus. The pin of the stapler is pushed directly above the center of the stapler line at the upper third of the rectum, and a double-stapled anastomosis is obtained. Saline lavage through the anus is performed to test the efficacy of the anastomosis. Paraanastomotic drainage is left in place routinely, the trocars are removed, and the deep fascias of the ports are closed.

RESULTS

Laparoscopic primary sigmoid resection with intracorporeal anastomosis was offered to all patients with Hinchey I through III. Hinchey IV cases were excluded from this study. Patients with Hinchey I and IIb underwent adequate bowel preparation and were operated on in elective surgery settings. For patients with Hinchey IIa, a CT scan-guided drainage of the pelvic abscess was done initially, and the elective surgery was postponed for 4 weeks to 6 weeks. Emergency surgical intervention was performed within 6 hours from the time of admission for patients with a clinical diagnosis of diffuse peritonitis (Hinchey III). **Tables 1 and 2** summarize the characteristics of the patient population.

Patients with Hinchey IIb (colovesical fistula) were treated with dissection by using an ultrasonic scalpel followed by

urinary catheterization for 10 days. Most of the patients were female (M/F) 104/156 (mean age 62 ± 11 , range 36 to 93). The average ASA score was 1.8 ± 0.7 with ASA 2 being the most common (169/260: 65%), and 31 patients (11.9%) were ASA 1 and 60 patients (23%) were ASA3. **Table 1** describes the indications for surgery; the main indication was 2 or more attacks of diverticulitis (69%) when the patients were >50 years old. Resection was performed after one attack in 12 patients (4.6%) <50 years of age, and for 21 patients (8%) resection was performed because of stenosis of the diseased segment. Diverticular disease was present in the sigmoid colon of all patients; 3 patients (1.15%) had diverticular disease of the descending colon.

Three intraoperative complications had occurred, 2 of which were visceral injuries. One was a urinary bladder injury in a patient with Hinchey III that had resulted from

Table 1.

Surgical Indications for 260 Patients, According to Hinchey Classification (with Wexner modification)

Stage	Pathology	Patient (N)	%
I	Diverticulitis with or without pericolic abscess	230	88.3
Ila	Diverticulitis with pelvic abscess	6	2.1
I Ib	Diverticulitis with internal fistula	1	0.3
III	Diverticulitis (perforated) with peritonitis	23	9.3

Table 2.

Gender of 260 Patients According to Hinchey Classification (Modified by Wexner)

Stage	Number	Gender M/F
I	230	87/143
Ila	6	2/4
I Ib	1	1/0
III	23	14/9

Table 3.

Intraoperative Morbidity in 260 Cases of Sigmoid Diverticulitis Managed with Laparoscopy According to Hinchey Classification (with Wexner Modification)

Intraoperative Morbidity	H(I)	H(II)	H(III)	Total	Management
Anastomotic failure	—	—	1	1	Conversion
Anatomic difficulties	2	1	11	14	Conversion
Small bowel injury	—	1	—	1	Laparoscopic repair
Urinary bladder injury	—	1	—	1	Laparoscopic repair

difficulties in dissection as a consequence of the intense inflammatory process and extensive adhesion. The bladder injury was repaired by laparoscopic suturing. The other visceral injury was a small bowel injury in Hinchey IIa patients, which was repaired laparoscopically also. The third intraoperative complication was anastomotic failure that was attributable to stapler defect, and treated by conversion to the open technique. **Table 3** shows the intraoperative morbidity.

There were only 15 conversions to an open surgical technique due to generalized peritonitis and extensive adhesion in 11 cases, anastomotic failure in 1 case, and anatomic difficulties in 3 cases. The median length of surgery was 130 ± 54 minutes (range, 80 to 210). The splenic flexure was mobilized in 167 (59.6%). The most frequent procedure was sigmoid colectomy down to colorectal junction ($n=248$, 95%). The other procedures were left hemicolectomy in 3 patients (1.15%) and anterior resection in 9 patients (3.4%). There were 39 associated procedures, all performed electively for patients with Hinchey I (**Table 4**). As **Table 5** shows, 15 patients (5.7%) had postoperative complications; 5 of them required laparotomy.

Anastomotic leak developed in 5 patients (1.9%), which was diagnosed radiologically between 2 days and 6 days postoperatively. In 3 of them, reoperation was necessary, with a total of 2 deaths. The first died due to sepsis, while the second death was due to pulmonary embolism. The third patient was treated with the Hartman procedure. The other 2 patients had small leaks treated successfully with antibiotics and total parenteral nutrition. Two patients had postoperative bleeding that required revision, and one patient had postoperative pelvic collection treated by CT scan-guided drainage and antibiotics. Two other patients (0.75%) had wound infections at the port site, both of them treated by antibiotics only.

The follow-up period was 12 months and was supervised by the surgical team and the family doctor. Late compli-

Table 4.

Laparoscopic Procedures Associated with Sigmoid Resection

Procedures	(N)
Inguinal hernia repair	
(one side)	6
(both sides)	2
Cholecystectomy	2
Fundoplication	1
Small bowel resection (jejunal resection)	2
Goldberg operation for rectal prolapsed	8
Anterior rectal resection (for rectal adenoma)	1
Left hemicolectomy	3
Paraumbilical hernia	4
Incisional hernia	2
Ileostomy	10

Table 5.

Postoperative Morbidity in 260 Cases of Sigmoid Diverticulitis Managed Through the Laparoscopic Approach

Early Complications	(N)	Management
Anastomotic leakage	5	3 reoperated on and 2 treated conservatively
Postoperative bleeding	2	Both treated by reoperation
Postoperative collection	1	CT scan-guided drainage
Wound infection	2	Antibiotic
Late Complications		
Adhesion	1	Conservative
Trocar hernia	2	Repair
Anastomotic stenosis	2	Endoscopic dilation

cations included anastomotic stricture in 2 patients, who presented in the follow-up period with a change in their bowel habits. The strictures were treated successfully by endoscopic dilatation. Temporary ileostomy was performed in 10 patients, one for the anterior rectal resection and the rest for anastomotic protection in sigmoid resection in Hinchey II and III. The choice of ileostomy was left to the decision of the surgeon and was not influenced by Hinchey stage. All ileostomies were reversed within 3 weeks to 6 weeks from the procedure date. For all the patients who underwent the laparoscopic technique, the nasogastric tube was routinely removed on the second postoperative day, the patients passed flatus for the first time postoperatively after a mean of 2.5 days, and they

commenced eating on the third postoperative day. The analgesic control was by NSAID and weak opioids. The median length of hospital stay was 10±3 days (range, 6 to 24).

DISCUSSION

The objective of our prospective study was to present our results regarding surgical treatment of diverticulitis of the sigmoid colon. The low rate of morbidity and mortality indicate the safety of this approach and support its use.

Diverticular disease of the sigmoid and large bowel is unusual in patients <45 years of age; its frequency then increases to 5% to 70% in the eighth decade. Nevertheless, this disease remains asymptomatic in 80% of patients and in cases of an acute attack, the chance for recurrent disease is only 30%. However, the positive response to medical therapy decreases from 70% in the first attack to 6% in the third attack.¹

Parks¹⁵ reported that operative mortality in surgery increases from 3% in the first attack to 7.7% in recurrences. Hence, the common tendency currently is toward early treatment of complicated diverticular disease, especially in younger patients. Primary resection and anastomosis, with or without protective colostomy or ileostomy, generally are considered the safest options for all stages of complicated diverticulitis.^{11,16,17}

Two multicenter studies^{6,9} showed that laparoscopic sigmoidectomy with primary anastomosis for diverticular disease is feasible and safe as an elective procedure, whereas for complicated diverticulitis and cases with fistula, it is more likely to be associated with complications. In our series, patients with Hinchey I and III diverticulitis underwent surgery by experienced laparoscopic surgeons. Our mean operative time of 130±54 minutes compares favorably with the mean values reported in other series, which range from 141 to 300 minutes.^{4-6,8,9,18,19}

No recurrence of diverticulitis occurred in our study, because we resect the colorectal junction. The recurrence rate reported in the literature is 7% when the anastomosis is fashioned to the rectum, whereas it increases to 12% when the anastomosis is performed on the sigmoid.^{4,20} The anastomosis was performed end to end through the stapled rectal stump according to the technique described by Knight and Griffen²¹ mostly using 29-mm circular stapler. Others²² prefer to perform a hand-sewn anastomosis through a minilaparotomy after laparoscopic mobilization of the colon, which is sometimes difficult in some patients, especially obese ones.

Table 6.
Laparoscopic Colectomy for Diverticulitis in Recent Years for ≥ 100 Patients

Author	Year	Patients	Conversion Rate %	Morbidity %	Leak %	Stenosis %	Mean Operative Time (min)
Franklin et al ⁸	1997	148	10	5	0	1	120
Stevenson et al ²²	1998	100	8	21	4	—	230/150 ^a
Berthou and Charbenneau ¹³	1999	110	8	7	1	4	166
Trebuchet et al ¹⁰	2002	170	10	10	2.9	5.9	141 \pm 36
Pugliese et al ¹	2004	103	2.9	10	2	—	190
Boudart et al ²³	2008	268	—	38.4	—	—	—
Jones et al ²⁴	2008	500	2.8	11	—	—	120
Zehetner et al ²⁸	2009	200	1.5	19	—	—	121

^a20 first cases/20 last cases.

Management of complicated diverticulitis was achieved successfully by laparoscopy in 94.3% (n=245) of the cases. Our conversion rate was 5.7% (n=15). We attribute this low rate to our early laparoscopic experience. Our conversion rate can be compared favorably with that reported in other laparoscopic studies (Table 6^{1,8,10,13,22,23,24,28}). The main reasons for conversion were the intense inflammatory process, anatomic difficulties, and previous surgery in cases of Hinchey III (11 cases), Hinchey IIa (1 case), and Hinchey I (2 cases), and anastomotic failure in one case. We did not observe a rise in postoperative morbidity when the procedure was converted to laparotomy. In fact, no conversion was observed in the last 100 cases, and this is support that conversion decreases along the learning curve.^{8,13,23}

The mortality rate was 0.07% (2 cases), while intra- and postoperative morbidity occurred in 30 patients (11.4%). This rate compares favorably with that of other studies.^{22,23,26,27} We had 5 anastomotic leaks (1.9%), 3 patients required reoperation, and the rest were treated conservatively. In the literature, this rate ranges from 0%⁹ to 5.5%.³ Also we had 2 patients with postoperative bleeding who needed reexploration with an open approach. In our study, 2 wound infections occurred at the extraction site, both cases easily treated medically. Two visceral injuries occurred in our series and were treated laparoscopically by primary stitching. Other vascular or ureteral injuries did not occur.

The respective role of the mechanical suture and the laparoscopic technique are still matters in question. In a meta-analysis comparing hand-sewn and stapled anastomosis²⁸ after open surgery, postoperative strictures were more common in the stapled group. In our study, stricture

of the anastomosis occurred in 2 patients (0.7%). Both patients were treated by primary dilation with satisfactory results without surgery. This rate of stricture caused by stapled anastomosis is in agreement with the study by Detry et al,²⁹ which had a stricture rate of only 0.5% reported with the use of a circular stapler.

CONCLUSION

This study demonstrates that in experienced hands, laparoscopic colonic resection for sigmoid diverticulitis may be considered the gold-standard treatment for patients with Hinchey I, IIa, and IIb with a low rate of mortality and morbidity, but its apparent benefits for Hinchey III need further studies to prove its efficacy.

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