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Factors Associated With Complications of Open Versus Laparoscopic Sigmoid Resection for Diverticulitis

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ABSTRACT

Background: This study critically reviews sigmoid colon resection for diverticulitis comparing open and laparoscopic techniques.

Methods: We conducted a retrospective review of all open and laparoscopic cases of diverticulitis between 1992 and 2001. Data analyzed included the following: indications for operation, postoperative complications, and incidence of laparoscopic conversion to laparotomy. Major and minor complications were analyzed in relation to patients' preoperative diagnosis, age, presence or absence of splenic flexure mobilization, length of stay, and laparoscopic sigmoid resection versus open sigmoid resection.

Results: Over a 10-year period, 166 resections for diverticulitis were performed including 126 open cases and 40 laparoscopic cases. No significant differences existed in patient characteristics between the groups. Major complications occurred in 14% of patients, and the laparoscopic conversion rate was 20%. The presence of abscess, fistula, or stricture preoperatively was associated with a higher complication rate only in patients ≥50 years old undergoing open sigmoid resection. The length of stay between patients undergoing laparoscopic resection was significantly less than in patients having open resection.

Conclusion: Advanced laparoscopic sigmoid resection is an alternative to open sigmoid resection in patients with diverticulitis and its complications. Open sigmoid resection in patients >50 years may have a higher complication rate in complicated diverticulitis when compared with laparoscopic sigmoid resection (all patient ages) and open sigmoid resection (patients <50 years old). Regarding complications, no difference existed between the length of stay in patients with open vs. laparoscopic resection.

Key Words: Laparoscopy, Sigmoid resection, Diverticulitis.

INTRODUCTION

Diverticular disease and its relation to diverticulitis were described in the early 1700s.[1] The complications of diverticular disease are bleeding and diverticulitis. Mild diverticulitis is treated with oral antibiotics, but in severe episodes of diverticulitis hospitalization and intravenous antibiotics and bowel rest are necessary. Patients with multiple episodes of diverticulitis or complicated diverticulitis, such as fistula, stricture, phlegmon, are indicated for sigmoid colon resection. Historically, patients >50 years old with 2 episodes and patients ≤50 years old with 1 episode of diverticulitis are recommended to undergo sigmoid resection. Open sigmoid resection (OSR) has been the mainstay of treatment of diverticulitis and its complications. Laparoscopic bowel resection was introduced in the early 1990s.[2] The purported advantages of laparoscopic bowel resection, ie, shorter length of stay (LOS) and convalescence, have led to its more widespread application in colon and rectal resections.[3–8] The complications of diverticulitis, such as failure of medical management, multiple episodes, phlegmon, abscess, stricture, or fistulae, are the major indicators for operative management. The potential for postoperative complications may be predicted based on some of these preoperative factors. The optimal operative approach has yet to be conclusively determined despite wider acceptance of laparoscopic bowel resection. We have reviewed our experience with operative resection for diverticulitis comparing open and laparoscopic sigmoid resections (LSR). We also looked at factors related to both techniques that might influence the likelihood of complications. We present a critical review of our experience and relate factors associated with operative outcome.

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METHODS

Between 1992 and 2001, we retrospectively reviewed our experience with operative resection for diverticulitis and compared the laparoscopic group with those undergoing open resection. All operations were primarily performed by 6 attending surgeons with an average of 12 years of private practice. The study included 166 patients, 40 who underwent LSR and 126 who underwent OSR. The average age of patients treated by open and laparoscopic operations was 56 and 52 years old, respectively. The indications for surgery were the same in both groups. The most common indication for surgery in both groups was recurrent episodes of diverticulitis **(Table 1)**. Collected data include diagnosis requiring operation, both major and minor complications **(Tables 2 and 3)**, and length of stay (LOS). Laparoscopic resection was performed with a Storz laparoscopic 0° camera (Karl Storz, Culver City, CA). All elective procedures received a mechanical bowel preparation as well as preoperative oral and intravenous antibiotics before skin incision. Emergent procedures were defined as patients who required operation before completing mechanical bowel preparation. Complications were subsequently analyzed taking into account the patient age, which was divided into > or <50 years old and whether splenic flexure mobilization was performed. These data were then separated into laparoscopic and open sigmoid resections and further stratified into grouping complications based on the preoperative diagnosis and the patient's age. The laparoscopic conversion rate was also recorded and analyzed. Statistical analysis was performed by using hypothesis testing for proportions. A P value of ≤ 0.05 was considered statistically significant.

Laparoscopic Sigmoid Resection: Technical Considerations

Although only 5 of the 6 surgeons had previously performed LSR, basic laparoscopic principals were adhered to for all the procedures. The mobilization of the sigmoid colon was performed from the medial to the lateral approach first isolating the left ureter through the "mesenteric window" and then dividing the inferior mesenteric artery and vein with the endovascular GIA. Then mobilization of the sigmoid and descending colon was completed along the white line of Toldt. The splenic flexure was then mobilized by dissecting the omentum from the distal transverse colon and the splenic flexure. This facilitated the splenic flexure and the proximal descending colon. The rectosigmoid was divided at the pelvic brim with the endogastrointestinal stapler, usually requiring 2 or 3 firings. Then one of the trocar sites, either the umbilical, left lower quadrant, or suprapubic, was extended to allow for exteriorization of the sigmoid and descending colon. The sigmoid colon was divided and a purse string was placed in the proximal colon and tied around the anvil of a CDH stapler. Then the colon was placed back into the abdomen, the incision closed, the abdomen re-

Table 1.
Indications for Resection and Comparison of Complications

Diagnosis/Complications	OSR >50 yr*	OSR <50 yr*	LSR >50 yr*	LSR <50 yr*
No. of episodes				
1	1/0	3/0	0	0
2	11/0	6/0	2/0	9/2
3	16/1	8/1	7/3	3/1
4	12/0	8/1	5/2	3/3
5 or >	5/0	4/0	2/0	1/0
Phlegmon	6/0	5/1	3/0	0
Perforation	3/1	3/1	0	0
Abscess	10/3	3/0	0	2/0
Structure	12/4	1/0	1/0	0
Fistula	8/3	2/0	1/0	1/0
Total no. of complications	84/12	42/4	20/5	20/6
Total no. of Complications (%)	14%	09%	20%	30%

*OSR = open sigmoid resection; LSR = laparoscopic sigmoid resection.

Table 2.
Early and Late: Major and Minor Complications

Complications*	OSR†	LSR†
Major		
Anastomotic Complications		
Bleeding	1	2
Leak	2	1
Stenosis	2	1
Deep Vein Thrombosis	1	1
Facial Dehiscence	1	0
Enterotomy (Small Bowel)	0	1
Intraoperative Hemorrhage	1	1
Pelvic Abscess	1	0
Pulmonary Embolus	1	0
Small Bowel Obstruction	2	2
Splenic Injury	2	0
Ureter Injury	0	1
Total Major Complications	14	10
Minor		
Postoperative Diarrhea	1	0
Thrombophlebitis (Superficial)	0	1
Trocar Site Bleeding		1
Wound Infection (Superficial)	2	1
Total Minor Complications	3	3

*Average follow-up, 11 months; range, 2 to 37.

†OSR = open sigmoid resection; LSR = laparoscopic sigmoid resection.

insufflated, and the transanal anastamosis constructed and tested.

RESULTS

The open group comprised 84 patients >50 years old and 43 patients ≤50 years old. The laparoscopic group comprised 20 patients >50 years old and 20 patients ≤50 years old. Overall, 58 of 166 patients (38%) were ≤50 years old. The average age of patients undergoing open resection was 56 years (range, 23 to 90), and in the laparoscopic group it was 52 years (range, 33 to 80). Laparoscopic and open resection complications as they relate to age, which is a preoperative indicator of inflammation severity, are depicted in **Table 1**. The overall major complication rate was 14%, including 25% in the LSR group and 11% in the OSR group. When complications were examined based on the presenting diagnosis, it was noted that the majority of complications occurred in patients >50 who underwent OSR. Furthermore, it appears that these complications were related to OSR for complicated diverticulitis. Specifically, patients who presented with abscess, fistula, or strictures had a statistically greater proportion of the overall complications compared with patients ≤50 years old. The LSR group as a whole sustained a statistically higher number of complications compared with those undergoing OSR that did not relate to any preoperative or intraoperative factors. The complication rate did not differ in incidence between procedures performed early versus those performed later in the experience with open resection. With laparoscopic resection, however, a statistically significant decrease occurred in the complication rate when comparing the first 6 years of the experience with the last 4. A high LSR conversion OSR rate (20%) occurred in our study compared with that presented in the literature.[9,10] Reasons for conversion varied, including difficult dissections, intraoperative bleeding, unclear anatomy, and intraoperative discovery of complications. Splenic flexure mobilization, or lack thereof, did not contribute to the complication rate **(Table 4)**. **Table 3** reviews the major and minor complications. No single complication oc-

Table 3.
Percent of Major Complications

Major Complications	Total	OSR	LSR
Total number of patients	166	126	40
Patients with complications	24	14	10
Percent of complications	14%	11%	25%

†OSR = open sigmoid resection; LSR = laparoscopic sigmoid resection.

Table 4.
Effect of Mobilization of Splenic Flexure on Complications

Splenic Flexure Mobilization*	Yes	No
LSR	30	10
Complications	8 (26.7%)	3 (30%)
OSR	79	43
Complications	10 (12.7%)	6 (13.95%)
Total no. of complications	16.5%	16.98%

*LSR = laparoscopic sigmoid resection; OSR = open sigmoid resection.

curred significantly more frequently than any others. Further, no notable difference existed between the types of complications that occurred in the laparoscopic cases compared with that in the open cases. The anastomotic leak rate with both techniques was 2%. The length of stay related to LSR and OSR is depicted in **Table 5**. Patients undergoing uncomplicated LSR had a significantly shorter LOS compared with that in similar patients who underwent OSR. The occurrence of a complication significantly prolonged the LOS in both laparoscopic and open operations. No significant difference existed in LOS between laparoscopic or open surgery once patients encountered complications though. Follow-up was an average of 11 months (range, 2 to 37 months). Eight percent of open operations were performed emergently and required a colostomy.

DISCUSSION

Patients with complicated diverticulitis, particularly abscess, stricture, and fistula, who underwent open resection appear to have a higher incidence of postoperative complications. In our study, patients with these preoperative presentations have gone on to experience postoperative complications in about one third of cases. Schlachta et al[11] attempted to identify factors during laparoscopic resection that could predict occurrence of postoperative complications. He identified preoperative fistula as a factor that was associated with postoperative complications, though again this association was mainly with laparoscopic cases.[11]

Conversely, Stevenson et al[12] in their study that looked at the outcome of 100 consecutive patients undergoing laparoscopic-assisted sigmoid colectomy for diverticulitis found that the complication rate did not differ between resection for complicated vs. uncomplicated diverticulitis.[12] Intuitively, it seems reasonable that patients who present with fistulae, stricture, or abscess would be more likely to have a complicated postoperative course than a patient with 2 or 3 mild to moderate recurrent episodes. In our review, these complications only occurred with any significance in patients ≥50 years of age who underwent OSR. Patients ≥50 may have a higher complication rate because of the greater chance of having associated comorbidities such as diabetes, hypertension, and cardiac disease. Complications, such as dehiscence, pneumonia, or pulmonary embolus, could be predicted to occur more readily with a laparotomy incision in these older patients. However, splenic injury, which occurred only in open cases, or ureteral transection, which occurred only in laparoscopic cases, has more to do with operative technique. These data suggest that laparoscopic resection might be of greater value in this older population. Older, more fragile patients may benefit from the smaller incisions, more rapid recovery, and shorter length of stay associated with laparoscopic resection; particularly if already compromised with complicated diverticulitis. Certainly, a prospective trial might be aimed at this question. In this study, patients with LSR had a greater complication rate than did patients with OSR. The reported incidence of complications in the literature generally ranges from 6% to 30%.[3,5,9,13] It is important to note that LSR patients had complications and those who were converted to open for reasons other than OSR were still reported as laparoscopic complications. Both perioperative and late complications were reported. Current reports often fail to include late postoperative complications, including anastamotic stenoses, small bowel obstructions, and incisional hernias. Some authors suggest that the incidence of complications with laparoscopic bowel resection is related to a technical learning curve. In actuality, this number is variable; some reports quote up to 150 cases before the incidence of complications leveled off or declined.[10,14,15] Every new procedure has a learning curve that is operator- and procedure-dependent. Our data represent a compilation of experiences of 5 different surgeons, only 2 of whom had performed ≥150 laparoscopic bowel resections. Our data did reflect a significant decrease in LSR (55% vs. 17%) over the duration of the study. Splenic flexure mobilization or lack of mobilization was looked at to determine its effect on complications. Mobilization of the flexure decreases the tension on the anastomosis potentially lessening the occurrence of anastamotic leakage or stricture. We did not find any correlation between the incidences of complications related to mobilization of the splenic flexure in either LSR or OSR groups. The incidence of anastomotic leakage was 1.8% for OSR and 2.5% for LSR. Though more complications occurred with LSR, only 2 (bowel injury [n=1] and ureter injury [n=1]) were major intraoperative laparoscopic complications.

Table 5.
Comparison of Open Sigmoid Resection and Laparoscopic Sigmoid Resection on Length of Stay

Length of Stay	OSR*	LSR*	*P* Value
Patients with complications	14.2	11	0.479
P value	0.005	0.011	—

*OSR = open sigmoid resection; LSR = laparoscopic sigmoid resection.

The learning curve is also thought to be a factor in the rate of conversion to open laparotomy. Many centers have noted conversion rates up to 20% to 40%.[2,16] More recent reports note an even lower conversion rate between 4% and 11%.[10,17] Fielding et al[15] noted an initial conversion rate of 10% with the first 100 cases. After these first cases, their conversion rate was about 5%. We converted 20% of LSR to OSR for several reasons, including difficult dissections, intraoperative bleeding, unclear anatomy, or intraoperative complications. Converting laparoscopic bowel resections to open bowel resections is regarded as a prudent decision when the level of hemorrhage or the anatomy makes further dissection uncomfortable.[17]

Our data are consistent with that in the literature, showing that LSR is associated with significant decreased LOS. The length of stay was 4.6 days for LSR, which was significantly less than the length of stay for OSR. Patients who underwent OSR without complications could expect a hospital stay of 7.4 days. Conversely, patients who incur complications have a similarly prolonged stay, no matter how the operation was performed.

CONCLUSION

In summary, advanced laparoscopic sigmoid resection is an alternative to open sigmoid resection in select patients. Open sigmoid resection may have a higher complication rate in complicated diverticulitis in patients who are >50 years old. Laparoscopic sigmoid resection was associated with a higher complication rate than was OSR. Advanced laparoscopic sigmoid resection is associated with a shorter LOS. However, when complications occur, in either OSR or LSR, no difference exists in LOS.

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