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ORIGINAL ARTICLE

Laparoscopic Surgery for Diverticular Fistulas: Outcomes of 111 Consecutive Cases at a Single Institution

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Abstract

Background The purpose of this study was to review our experience with laparoscopic colectomy and fistula resection, evaluate the frequency of conversion to open, and to compare the perioperative courses of the complete laparoscopic and conversion groups.

Methods This study is a retrospective analysis of 111 consecutive adult patients with diverticular fistulae diagnosed clinically or radiographically over 11 years at a single institution. Five patients were excluded for preoperative comorbidities. The remaining 106 consecutive patients underwent minimally invasive sigmoid colectomy with primary anastomosis. Preoperative, intraoperative, and postoperative variables were collected from the colorectal surgery service database. A retrospective cohort analysis was performed between laparoscopic and converted groups.

Results Within the group, 47% had colovesical fistulas, followed by colovaginal, coloenteric, colocutaneous, and colocolonic fistulas. The overall conversion rate to laparotomy was 34.7% ($n = 37$). The most common reason for conversion was dense fibrosis. Mean operative time was similar between groups. Combined postoperative complications occurred in 26.4% of patients (21.4% laparoscopic and 37.8% converted, $p = 0.075$). Length of stay was significantly shorter in the laparoscopic group (5.8 vs 8.1 days, $p = 0.014$). There were two anastomotic leaks, both in the open group. There were no 30-day mortalities.

Conclusions Laparoscopic sigmoid colectomy for diverticular fistula is safe, with complication rates comparable to open sigmoid resection. We identify a conversion rate which allows the majority of patients to benefit from minimally invasive procedures.

Keywords Diverticulitis · Sigmoid colectomy · Fistula · Minimally invasive · Laparoscopy

Introduction

Diverticulosis is a common condition in America, affecting 60% of the population by age 60. Diverticulitis develops in about 15% of those with diverticulosis. Approximately 15% of those with diverticulitis will require surgical intervention.[1] Fistulae complicate about 20% of these cases. Symptoms of fistulae depend on which organs are involved, most commonly the bladder (65–69%), vagina (25%), intestine (6%), or skin (6%). While fistulae do not mandate surgical correction, they seldom close spontaneously and their symptoms depreciate quality of life.[2]

Currently, the American Society of Colon and Rectal Surgeons Practice Parameters recommends the laparoscopic approach for elective colectomies when the expertise is available, secondary to reduced risk of morbidity when compared to the open surgical approach.[3] Recent studies have shown that laparoscopic colectomy can be safely utilized for cases of complicated diverticulitis, which may necessitate more urgent intervention and can be technically more challenging.[4–7] In addition, several retrospective case series have suggested both safety and feasibility of laparoscopic management of diverticular fistula disease when offered to a highly selected group of patients. These reviews suggest conversion-to-open rates of 0–36%, earlier return of bowel

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function, and decreased hospital length of stay with low overall morbidity.[7–10]

This study encompasses a review of our experience with laparoscopic colectomy and fistula resection for management of diverticular fistulas. The aim was to quantify the feasibility of this minimally invasive approach in cases of complicated diverticulitis in a large, minimally selected cohort. The frequency of conversion to open was evaluated, and the perioperative courses of the total laparoscopic (LAP) and conversion (CON) groups were compared. Our hypothesis is that a laparoscopic approach can offer the benefits of minimally invasive surgery to patients with diverticular fistulae without need for aggressive patient selection and exclusion.

Materials and Methods

Demographics

An IRB-approved retrospective review, protocol #4545, was performed between February 2005 and October 2016, during which 111 consecutive patients with diverticula fistulae were identified. Only five patients were not felt to be candidates for laparoscopic surgery secondary to significant preoperative comorbidities or disease acuity. The first had a prior history of open sigmoid resection for diverticular disease and presented with a large parasacral abscess, colocutaneous fistula, and profound fibrotic changes in the pelvis. The second had a 8 × 7-cm abscess inaccessible by interventional radiology and immediately adjacent to the bladder, which had been enlarging over a 2-month time period. The third patient required concomitant open repair of a vesico-vaginal fistula. The fourth was diagnosed with bacteremia with sepsis secondary to both colocutaneous fistula and multiple pelvic abscesses, 2.5 weeks post cholecystectomy for gangrenous cholecystitis, and not felt to be a candidate for repeat laparoscopic procedure. Lastly, the fifth was not fit for pneumoperitoneum secondary to severe cardiovascular disease.

Of the remaining 106 patients, 102 were offered laparoscopic sigmoid colectomy with primary anastomosis as the initial approach for elective intervention. Four patients underwent robotic approach as this adjunct has become more prevalent in our practice. All of the cases were performed by four surgeons at a large tertiary care center (EL, BV, JC, and ADC). Patient data was collected through electronic medical record systems for inpatient (Cerner Soarian) and outpatient (Allscripts Health Care Solutions Inc., Allscripts Web 6A) care. Data included age, gender, body mass index (BMI), previous abdominal operations, type of fistula (colovesical, colovaginal, coloenteric, colocutaneous, and colocolonic), American Society of Anesthesiology (ASA) class, number of previous diverticulitis attacks, and number of attacks requiring hospitalization. A diverticular attack was defined as either a physician-documented or a self-reported episode of left lower quadrant abdominal pain and tenderness, with or without fever or leukocytosis.

Operative Technique

Our operative technique entailed a four-port laparoscopic approach with selective takedown of the splenic flexure, mandatory identification of the left ureter, exteriorization through a 4-cm infraumbilical midline incision, intracorporeal end-to-end anastomosis, followed by a pneumatic leak test. Four patients required use of a hand port and were sorted within the CON cohort. While it has previously been shown that short-term outcomes for hand-assist colectomies can be similar to laparoscopy, this approach is not traditionally utilized at this institution and was only introduced in a situation where the procedure could not be completed via laparoscopy alone. All four surgeons utilized the same platform. Operative variables included intraoperative Hinchey class (as described by Hinchey et al, 1978), estimated blood loss (EBL), operative time, and complications.[11] The cases utilizing robotic assist applied the same principles as described above. All robotic assist case did not require conversion to open and were included in the Lap cohort.

Postoperative Measurements

Outcomes of interest included conversion to laparotomy, time to return of bowel function (ROBF), hospital length of stay (HLOS), morbidity, and mortality. ROBF was defined as the postoperative day when patients reported passage of flatus and/or bowel movement. Postoperative ileus was defined as the intolerance of oral intake or the absence of flatus by the seventh postoperative day, or persistent emesis requiring nasogastric intubation. Postoperative morbidity included superficial surgical site infection (SSI), organ space SSI, anastomotic leak, *Clostridium difficile* infection, hemorrhage, deep venous thrombosis (DVT)/ pulmonary embolism (PE) and small bowel obstruction measured over a 3-month time period.

Statistical Analyses

The LAP and CON subgroups were compared retrospectively. All p values were two-sided, and a p value of < 0.05 was considered statistically significant. Additionally, chi-square and Fisher's exact test were used for analysis as appropriate. Statistical analyses were conducted using Stata version 14.0 (StataCorp College Station, TX).

Results

During the 11-year study period, 111 patients presented for non-emergent sigmoid colectomy for diverticulitis with

Table 1 Patient characteristics. Body mass index (*BMI*), America Society of Anesthesiologists physical status classification system (*ASA*), abdominal (*abd*)

Variable	Total population	Total laparoscopic	Conversion to open	*p* Value
Mean age (years)	60.9	60.6	61.9	*0.720*
Female gender (%)	54.7	56.7	51.3	*0.260*
Mean BMI (kg/m^2)	29.2	28.1*	31.3*	*0.019*
ASA class (%)				
1	0.9	0.1	0.0	*0.151*
2	51.9	57.9	40.5	
3	41.5	37.7	48.6	
4	5.7	2.9	10.8	
Prior abd operations (% yes)	56.6	58.0	54.0	*0.724*
Mean number of attacks	1.9	2.0	1.8	*0.978*
Number of hospitalizations	0.7	0.7	0.6	*0.472*

*Statistical significance

fistulous disease. Five patients were excluded as described previously. The 106 otherwise unselected patients were approached laparoscopically. We identified a 34.9% conversion to open rate ($n = 37$).

The mean age of the cohort was 60.9 (range 27–88), with 54.7% female gender ($n = 58$). The mean BMI was 29.2 (range 15.2–51.4) and the majority of patients were ASA 2 or 3 (51.9 and 41.5% respectively). Preoperative demographics were similar between the LAP and CON groups with the exception of BMI; 28.1 kg/m^2 in LAP group and 31.3 kg/m^2 in CON group ($p = 0.019$) (Table 1).

Of the 106 patients, colovesical fistula was the most frequent diagnosis (46.3%) (Fig. 1). Conversion rate was highest for patients with colovesical fistulae (46.9%).

The majority had previously undergone one or more abdominal operation (56%). Eighty-six percent of patients had one or more previous diverticular attacks (Table 2). The patients who did not report prior attacks presented with symptoms of the fistula, including fecaluria, pneumaturia, stool per vagina, and abdominal wall abscess. Half of the patients had prior hospitalizations for management of diverticulitis, and three patients were already inpatient at the time of their colorectal evaluation and surgery. No statistically significant differences were identified between LAP and CON groups regarding prior abdominal surgeries, diverticulitis-associated hospitalizations, or number of attacks.

Intraoperative Findings

There was no significant difference in the operative time of the LAP versus the CON (157.1 min versus

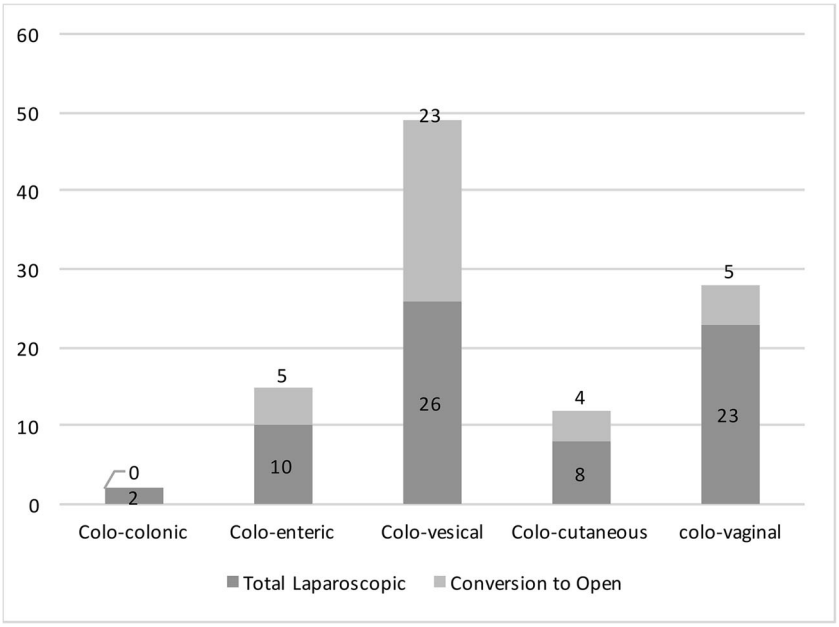

Fig. 1 Fistula sub-type

Table 2 Intraoperative measurements. Estimated blood loss (*EBL*)

Variable	Total population	Total laparoscopic	Conversion to open	*p* Value
	–	65.9% ($n = 69$)	34.9% ($n = 37$)	
Mean operative time (min)	162.2	157.1	171.6	*0.233*
Intraoperative Hinchey Score (%)				
I	45.2	47.9	40.5	*0.516*
II	54.7	52.2	59.5	
Mean EBL (mL)	143.6	99.6*	225.5*	*0.000*
Ostomy creation (*n*)	5	2	3	*0.228*

*Statistical significance

171.6 min, $p = 0.233$). Estimated blood loss was significantly higher in the CON group versus the LAP group (225.5 versus 99.6 mL, $p < 0.001$). A concurrent procedure was performed in 55.7% of cases ($n = 59$). These included small bowel resection, flexible sigmoidoscopy, appendectomy, cholecystectomy, salpingectomy, removal of infected mesh, suprapubic catheter placement, and umbilical hernia repair. There was no significant difference in frequency of concurrent procedures in the LAP versus CON cohorts ($p = 0.131$) (Table 2).

The most frequent reason for conversion was documented as severe inflammation/dense fibrosis impeding safe dissection or ureteral visualization. Four cases utilized a hand assist port (3 colovesical and 1 coloenteric) and were included in the conversion group (Fig. 2). Two cases required a sutured anastomosis after failure of stapled anastomosis on two attempts. Five patients had a diverting loop ileostomy, 2 in laparoscopic group, and 3 in the conversion group.

Postoperative Outcomes

Overall postoperative complication rate was 26.4% ($n = 31$), which was similar between the LAP and CON cohorts (21.4 vs 37.8%, $p = 0.075$). Superficial SSI was the most common complication overall at a rate of 10.4%, followed closely by postoperative ileus at 9.4%. The rate of ileus and deep SSI was higher in the CON group, but this did not reach statistical significance (5.8 vs 16.2%, $p = 0.094$ and 1.5 vs 5.4%, $p = 0.278$, respectively). Length of stay was significantly shorter in the LAP group (5.8 vs 8.1 days, $p = 0.014$).

There were no 30-day mortalities (Table 3). One patient (CON group) expired after a prolonged hospital course, 41 days post-surgery.

Discussion

In this study, we evaluate outcomes of 106 consecutive cases of non-emergent laparoscopic sigmoid colectomies for

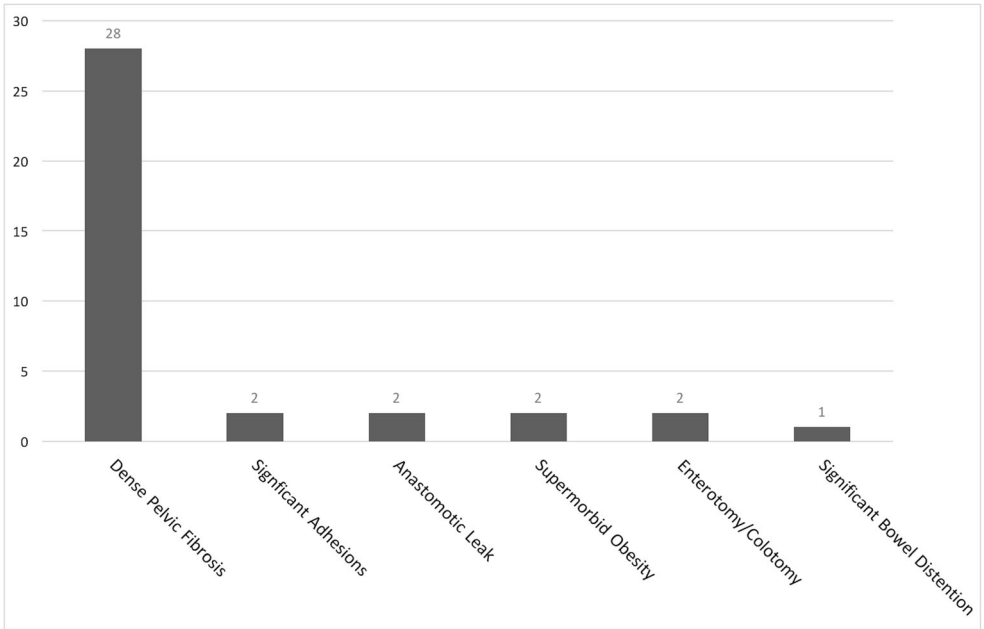

Fig. 2 Reason for conversion

Table 3 Postoperative outcomes and complications. Return of bowel function (*ROBF*), hospital length of stay (*HLOS*), surgical site infection (*SSI*), Clostridium Difficile (*C. Diff*), deep venous thrombosis (*DVT*), pulmonary embolus (*PE*), small bowel obstruction (*SBO*)

Variable	Total population	Total laparoscopic	Conversion to open	*p* Value
ROBF (days)	3.6	3.4	4.0	*0.121*
HLOS (days)	6.6	5.8*	8.1*	*0.014*
Overall complications (%)	26.4	21.4	37.8	*0.075*
Ileus	9.4	5.8	16.2	*0.094*
Superficial SSI	10.4	10.1	10.8	*1.000*
Organ/space SSI	2.8	1.5	5.4	*0.278*
Anastomotic leak	0.9	0.0	2.7	*0.349*
C. Diff colitis	0.0	–	–	–
DVT/PE	0.9	0.0	2.7	*0.349*
SBO	0.9	1.5	0.0	*1.000*
Bleed	3.8	1.5	8.1	*0.121*
Mortality	0.9	0.0	2.7	*0.350*

*Statistical significance

diverticular fistula. A conversion to open rate of a 34.9% was identified. Prior case reviews evaluating laparoscopic approach are limited to very small and highly selected subjects. Our study is the largest to date with minimal exclusion and demonstrates the safety of this procedure with an overall postoperative complication rate of 26.4%. There was an overall anastomotic leak rate of 0.9% and no 30-day mortalities. Comparably, a literature review of open sigmoid colectomies for both simple and complicated diverticulitis quote complication rates from 22 to 41%.[12–15] We feel that by attempting laparoscopic approach uniformly, we are providing the known benefits of laparoscopic surgery to a larger group of patients. Patients who required conversion to open, though found to have a trend towards higher complication rates when compared to those completed laparoscopically, were comparable to previously reported complication rates for open surgery.

Several small retrospective studies have demonstrated safety of laparoscopy in managing diverticular fistulas, though with conversion rates ranging from 18.7 to 50.0%.[7,12,16–18] Typical reasons for conversion are bleeding, failure to progress, and difficulty with fistula division. The conversion rate of 34.9% recorded in this study can be attributed to both the complexity of the disease process and our lack of patient selection for minimally invasive intervention. The majority of converted cases were converted secondary to severe fibrosis impeding dissection and/or visualization of the ureter, followed by obese habitus. Importantly, while our numbers were small, number of prior abdominal surgeries and number of diverticular attacks did not increase risk for transition to open. This suggests that severity of adhesive disease and fibrosis are difficult to predict preoperatively but once identified should trigger early conversion. Additionally, this approach did not lengthen the overall operative time, likely attributed to the philosophy of early conversion.

BMI was found to be the single statistically significant difference between the LAP and CON cohorts. Obesity has previously been well described to increase this risk both conversion to laparotomy and risk of postoperative complications. This likely accounts for a significant component of the trend towards increased complications in the CON cohort.[19,20]

Patients with a preoperative diagnosis of a colovesical fistula were found to be the most frequently converted to open. A recent study by Badic et al. identified a conversion rate of 43% for a 47 patient study of colovesical fistulas, comparable to our rate of 42%.[4] The authors attribute this increased incidence of conversion to the inherent concern for enlarging the defect during the process of dissection, and an effort to avoid the need to involve a second surgeon, thus prolonging the procedure. As described by Engledowe et al., small fistulas with accompanying inflammation of the bladder wall were not formally closed in this study, and a foley catheter was left in place for decompression for 5–7 postoperative days.[9] There were no complications related to fistula takedown in these patients.

As anticipated, a statistically significant decrease in length of stay was documented in the LAP group, with an associated trend towards decreased ROBF and ileus. This finding correlates with prior studies that document increased time to ROBF in open cases versus laparoscopic, as well as a prior study by our own group. Bhakta et al. described that while laparoscopy decreased time to ROBF, complicated diverticulitis alone is a risk factor for increased time to ROBF, making this complication overall more likely in our entire cohort.[5]

Interestingly, of the four robotic cases performed in this study, none had to be converted to open. Robotic surgery is increasingly prevalent in management of colorectal disease and two randomized clinical trials comparing laparoscopic and robotic colectomies reported similar postoperative outcomes, though increased costs for robotic cases.[21,22] Maciel et al. reviewed their outcomes with 20 robotic colectomies for colovesical fistula in 2014 and had 0% conversion rate versus

14% in a laparoscopic group of similarly matched patient populations.[10] Robotic surgery offers improved visualization and articulated instruments which may confer benefit in dissecting severely inflamed tissue and warrants further investigation to evaluate the advantages of robotic surgery in managing diverticular fistula disease. Of course, one must consider that stringent patient selection for robotic approach may have augmented these outcomes.

It is important to note that while this is the largest cohort of its kind, it remains a relatively small sample size, increasing the possibility of a type II error and limiting our statistical analysis. There is also the bias inherent in a single-center, retrospective database. However, it bears repeating that we have described the entirety of our experience with the surgical management of diverticular fistulas with only a bare minimum of selection. Further, it is unlikely that a truly prospective, randomized study of this topic would be feasible or ethical given the accepted advantages of laparoscopy, the heterogeneity of patient presentations, and the variability of institutional experience. As such, we do feel that our results are valid and generalizable to the subset of experienced minimally invasive colorectal surgeons and look forward to future studies on this topic.

In this study, we evaluate outcomes of 106 consecutive cases of non-emergent minimally invasive sigmoid colectomies for diverticular fistula and demonstrate safety of the procedure with a low conversion to open rate.

Author Contribution Martinolich J contributed substantially to the conception, acquisition, analysis, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Croasdale DR contributed substantially to the conception, acquisition, analysis, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Bhakta A contributed substantially to the conception, acquisition, analysis, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Ata A contributed substantially to the conception, acquisition, analysis and interpretation, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Chismark AD contributed substantially to the conception, acquisition, analysis, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Valerian BT contributed substantially to the conception, acquisition, analysis, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Canete JJ contributed substantially to the conception, acquisition, analysis, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Lee EC contributed substantially to the conception, acquisition, analysis, drafting the work, and final approval and is accountable for the accuracy and integrity of the work.

Compliance with Ethical Standards

Competing Interests The authors declare that they have no conflicts of interest.

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