

Single-Site Laparoscopic Surgery for Inflammatory Bowel Disease

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ABSTRACT

Background and Objectives: Single-site laparoscopic colorectal surgery has been firmly established; however, few reports addressing this technique in the inflammatory bowel disease population exist.

Methods: We conducted a case-matched retrospective review of 20 patients who underwent single-site laparoscopic procedures for inflammatory bowel disease compared with 20 matched patients undergoing multiport laparoscopic procedures. Data regarding these patients were tabulated in the following categories: demographic characteristics, operative parameters, and perioperative outcomes.

Results: A wide range of cases were completed: 9 ileocolic resections, 7 cases of proctocolectomy with end ileostomy or ileal pouch anal anastomosis, 2 cases of proctectomy with ileal pouch anal anastomosis, and 2 total abdominal colectomies with end ileostomy were all matched to equivalent multiport laparoscopic cases. No single-incision cases were converted to multiport laparoscopy, and 2 single-incision cases (10%) were converted to an open approach. For single-incision cases, the mean length of stay was 7.7 days, the mean time to oral intake was 3.3 days, and the mean period of intravenous analgesic use was 5.0 days. There were no statistically significant differences between single-site and multiport cases.

Conclusions: Single-site laparoscopic surgery is technically feasible in inflammatory bowel disease. The length of stay and period of intravenous analgesic use (in days) appear to be higher than those in comparable series examining outcomes of single-site laparoscopic colorectal

surgery, and the outcomes are comparable with those of multiport laparoscopy. This may be because of the nature of inflammatory bowel disease, limiting the benefits of a single-site approach in this population.

Key Words: Laparoscopy, Single incision, Colorectal, Inflammatory bowel disease.

INTRODUCTION

Many case reports and series have documented the feasibility and safety of single-site laparoscopic surgery for colorectal diseases.¹⁻³ Few reports exist regarding the feasibility of this approach in patients with inflammatory bowel disease (IBD),⁴⁻⁶ and in the few large multicenter studies that exist, a minority of patients in the series had IBD.⁷ Prior studies have shown laparoscopic surgery to be beneficial in patients with IBD, but they acknowledge that IBD offers distinct challenges to successful minimally invasive surgery.^{8,9} Significant inflammation, prior abdominal surgery, and infectious complications contribute to making these operations challenging. The frequently assumed benefits of laparoscopic surgery, such as reduced use of pain medicine and shorter hospital stay, may not be seen in inflammatory bowel patients.^{10,11} This report seeks to evaluate the feasibility and short-term results of single-site colonic surgery in the IBD population and compare these results with standard multiport laparoscopic cases.

METHODS

We retrospectively analyzed the records of 20 patients who underwent laparoscopic single-site procedures for IBD from 2009 through 2011. Twenty matching cases in which multiport laparoscopic procedures had been performed were then selected by use of the most recent cases performed by the same surgeons who performed the single-incision laparoscopic surgery (SILS) procedures; this was possible because these surgeons discontinued the SILS technique for IBD in 2012. The following data were recorded: demographic characteristics, body mass index (BMI), indication for operation, surgical procedure, length of stay, blood loss, operative time, date of proce-

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cedure, conversion to multiport laparoscopy or open surgery, complications, type of access device, type of laparoscopic camera, and presence of prior operations.

Surgical Technique

All operations were performed with patients under general anesthesia and in either the low lithotomy or supine position based on the type of operation. In all cases both arms were tucked, and the patients were thoroughly secured to the operative table to allow for significant Trendelenburg, reverse Trendelenburg, and airplane positioning.

Ileocolic and Right-Sided Colectomy

Access to the abdominal cavity was obtained by a 2- to 3-cm incision through the umbilicus. The linea alba was incised, and either a SILS port (Covidien, Mansfield, Massachusetts) or GelPoint device (Applied Medical, Rancho Santo Margarita, California) was placed in the abdominal cavity. Visualization was obtained with either a 5-mm 30° angled laparoscope (Karl Storz, Tuttlingen, Germany) or a 5-mm flexible-tip Olympus Endo Eye laparoscope (Olympus, Tokyo, Japan). The procedure was carried out in standard laparoscopic fashion, both by mobilizing the retroperitoneal attachments to the right colon and distal small bowel and by taking the mesenteric vessels with a radiofrequency energy device (Enseal; Ethicon Endo-Surgery, Cincinnati, Ohio). A primary vascular (medial-to-lateral) approach was preferred. After completion of the dissection, the specimen was extracted through the periumbilical incision and a stapled side-to-side functional end-to-end anastomosis performed. The periumbilical incision was lengthened to allow for extraction of larger specimens.

Total Abdominal Colectomy, Proctectomy, and Proctocolectomy

Access to the abdominal cavity was obtained through a right lower quadrant incision, located at the site of the planned ileostomy if the procedure involved ileostomy placement. In all cases this began with a 3-cm transverse right lower quadrant incision performed in a muscle-splitting fashion through the rectus abdominis muscle. Either a SILS port or a GelPoint device was placed as a single working port. A 5-mm Endo Eye flexible-tip laparoscope was used for visualization. For total abdominal colectomy and proctocolectomy, dissection began in a medial-to-lateral fashion at the sigmoid colon with the surgeon on the patient's right side. After mesenteric tran-

section and mobilization of the descending colon and splenic flexure, the surgeon moved to the left side of the patient. From this position, the greater omentum was separated from the transverse colon, the lesser sac was entered, and dissection continued to the right side to mobilize the hepatic flexure. The cecum and right side of the colon were dissected in the medial-to-lateral fashion by division of the ileocolic vascular pedicle. To complete the procedure, the surgeon divided the transverse mesocolon by retracting the transverse colon toward the pelvis, allowing identification and division of the mesentery from the cephalad side of the mesocolon. In the case of total abdominal colectomy, the rectosigmoid was divided in an intracorporeal manner; in proctocolectomy the rectum was mobilized and transected at the level of the pelvic floor with the use of a 60-mm endoscopic stapler (Echelon Flex; Ethicon Endo-Surgery). Specimen extraction was performed by grasping the cecum through the single access site and exteriorizing the specimen by removing it in a proximal-to-distal manner.

RESULTS

The patients' demographic data are presented in **Table 1**, and the type of procedure performed is shown in **Table 2**. The population was skewed toward women, with 17 female patients and 4 male patients. The mean age was 44 years, with a range of 18 to 78 years, and the mean BMI

	SILS	Multiport	P Value
No. of patients	20	20	
Male/female	4/16	3/17	>.99 ^a
Age (y)	43.6 ± 16.7	35.6 ± 14.7	.08 ^a
BMI (kg/m ²)	24.8 ± 6.4	25.8 ± 7.5	.69 ^a
Crohn disease	12	12	>.99 ^b
Ileocolic disease	9	9	>.99 ^b
Proctocolitis	3	3	>.99 ^b
Ulcerative colitis	8	8	>.99 ^b
Chronic	7	7	>.99 ^b
Fulminant	1	1	>.99 ^b
SILS port/GelPoint	11/10	NA	NA
Flexible-tip laparoscope/ straight laparoscope	16/4	0/20	.11 ^b

^aStudent *t* test, two tailed.
^bFisher exact test, two tailed.

Table 2.
Type of Procedure Performed

Type of SILS Procedure	No. of Patients	Access Device		Laparoscope	
		SILS Port	GelPoint	Flexible Tip	Straight
Ileocolic resection (n = 7)/right colectomy (n = 2)	9	4	5	5	4
Proctocolectomy with EI ^a (n = 5) or IPAA ^a (n = 2)	7	3	4	7	0
Proctectomy with IPAA	2	1	1	2	0
Total abdominal colectomy with EI	2	2	0	2	0

^aEI = end ileostomy; IPAA = ileal pouch anal anastomosis.

Table 3.
Intraoperative Parameters

Parameter	No. of Patients	SILS			Multiport			P Value
		Mean ± SD	Range	n (%)	Mean ± SD	Range	n (%)	
Operative time (min)	20	218 ± 109	97–469		193 ± 83	93–360		.28 ^b
Right-sided resection	9	121 ± 19	97–154		131 ± 32	93–177		.48 ^b
Abdominal colectomy, proctectomy, IPAA ^a	11	299 ± 81	179–469		245 ± 76	140–360		.20 ^b
EBL ^a (mL)	20	130 ± 135	10–500		136 ± 165	10–700		.89 ^b
Right-sided resection	9	77 ± 66	10–200		101 ± 90	10–250		.35 ^b
Abdominal colectomy, proctectomy, IPAA	11	174 ± 163	30–500		165 ± 207	20–700		.92 ^b
Incision length (cm)	18	4.0 ± 1.3	3–8		NR	NR		NA
Intraoperative complications	20			0			0	>.99 ^c
Conversion to laparoscopy	20			0			NA	NA
Conversion to open approach	20			2 (10%)			1 (5%)	>.99 ^c

^aEBL = estimated blood loss; IPAA = ileal pouch anal anastomosis.

^bStudent *t* test, two tailed.

^cFisher exact test, two tailed.

was 25 kg/m², with a range of 14 to 35 kg/m². Of the 20 patients, 12 had Crohn disease and 8 had chronic ulcerative colitis; 1 patient with chronic ulcerative colitis underwent surgery for fulminant colitis. Single-port surgical devices were used for all cases, with approximately half of the cases receiving the SILS port and the other half receiving the GelPoint device. A flexible-tip laparoscope was used in 16 cases; 4 right-sided resections and 1 loop ileostomy were performed with a standard 30° angled laparoscope. The multiport cohort matched well with the SILS patients but did show a nonsignificant trend toward a younger age, with a mean age of 36 years and age range of 19 to 69 years. The BMI in the multiport patients was similar to that in the SILS patients, with a mean of 26 kg/m² and a range of 15 to 40 kg/m².

Operative results are shown in **Table 3**. The mean operative time for all SILS cases was 218 minutes; for multiport cases, it was 193 minutes. This difference was not significant ($P = .28$). The operative time was significantly longer for total colectomy and proctocolectomy as compared with right-sided resections. When evaluated separately, SILS patients with right-sided resections had a similar operative time to multiport patients (121 minutes vs 131 minutes, $P = .48$), whereas patients undergoing total abdominal colectomy, proctectomy, or ileal pouch anal anastomosis had a nonsignificant trend toward a greater operative time for SILS cases (299 minutes vs 245 minutes, $P = .20$). The mean blood loss for all SILS cases was 130 mL, which was similar to the multiport blood loss of 136 mL. One SILS patient and 3 multiport patients required

transfusion of 1 to 2 U of packed red blood cells during the operation. The mean incision length for cases completed by SILS was 4.0 cm, with a range of 3 to 8 cm; this was not recorded for multiport patients. There were no intraoperative complications in either group and no conversions to multiport laparoscopy. Two SILS patients were converted to an open procedure compared with 1 multiport case. In all 3 cases this was done within 20 minutes of starting the procedure.

Outcomes are shown in **Table 4**. The mean length of stay for SILS patients was 7.9 days, with a range of 3 to 26 days, compared with 7.6 days, with a range of 4 to 20 days, for multiport patients. Right-sided resection cases had a significantly shorter length of stay than abdominal colectomy

or proctectomy cases; no differences for either set of patients were noted between SILS and multiport patients. The mean time to tolerate oral intake, defined as taking at least 500 mL of clear liquids, was 3.4 days for SILS patients and 2.6 days for multiport patients. Again, this was noted to be longer in abdominal colectomy cases than in right-sided resection cases, and no difference was seen between the SILS and multiport cohorts. The mean period of intravenous analgesic use for SILS patients was 5.0 days, with a range of 0 to 22 days; for multiport patients, it was 6.9 days, with a range of 1 to 20 days. Within the SILS cohort, 4 patients had extended lengths of stay, significantly impacting these mean values. These comprised patients with either significantly advanced IBD (fulminant

Table 4.
Perioperative Outcomes

Outcome	No. of Patients	SILS			Multiport			P Value
		Mean ± SD	Range	n (%)	Mean ± SD	Range	n (%)	
Length of stay (d)	20	7.9 ± 6.7	3–26		7.6 ± 4.0	4–20		.82 ^b
Right-sided resection	9	5.6 ± 3.6	3–15		5.6 ± 1.3	4–7		>.99 ^b
Abdominal colectomy, proctectomy, IPAA ^a	11	9.8 ± 8.1	4–26		9.2 ± 4.7	5–20		.81 ^b
Time to tolerating oral intake (d)	20	3.4 ± 4.8	0–19		2.6 ± 2.4	1–11		.51 ^b
Right-sided resection	9	1.3 ± 1.1	0–4		1.8 ± 0.7	1–3		.17 ^b
Abdominal colectomy, proctectomy, IPAA	11	5.1 ± 5.9	1–19		3.3 ± 3.1	1–11		.41 ^b
Period receiving IV ^a analgesia (d)	20	5.2 ± 5.9	0–22		6.9 ± 4.2	1–20		.32 ^b
Right-sided resection	9	4.2 ± 4.2	1–15		5.9 ± 3.7	1–13		.50 ^b
Abdominal colectomy, proctectomy, IPAA	11	5.9 ± 7.0	0–22		7.7 ± 4.6	3–20		.50 ^b
Any complication	20			8 (40%)			7 (35%)	>.99 ^c
Abdominal wound infection	20			1 (5%)			1 (5%)	>.99 ^c
Perineal wound infection	20			2 (10%)			1 (5%)	>.99 ^c
Ileus	20			4 (20%)			1 (5%)	.34 ^c
Postoperative small bowel obstruction	20			1 (5%)			0 (0%)	>.99 ^c
Intra-abdominal abscess	20			2 (10%)			3 (15%)	>.99 ^c
Volume depletion	20			2 (10%)			1 (5%)	>.99 ^c
Portal vein thrombosis	20			1 (5%)			0 (0%)	>.99 ^c
Heparin-induced thrombocytopenia	20			1 (5%)			0 (0%)	>.99 ^c
Pneumonia	20			0 (0%)			1 (5%)	>.99 ^c
Anastomotic leak	20			0 (0%)			0 (0%)	>.99 ^c
Mortality	20			0 (0%)			0 (0%)	>.99 ^c
Readmission (<30 d)	20			7 (35%)			5 (20%)	.73 ^c

^aIPAA = ileal pouch anal anastomosis; IV, intravenous.

^bStudent *t* test, two tailed.

^cFisher exact test, two tailed.

ulcerative colitis that failed management with high-dose steroids and Infliximab, Janssen Medical, Titusville, NJ) or advanced chronic Crohn proctocolitis with a large pelvic abscess and BMI of 14 kg/m² and patients at the extremes of age (proctocolectomy in a 78-year-old woman) or with reoperation with dense adhesions at the time of surgery requiring conversion to an open procedure. This is similar to the multiport series, in which 4 patients had a length of stay >10 days: 2 cases that had ileocolic resections complicated by intra-abdominal abscesses, a fulminant colitis patient with severe malnutrition who underwent an abdominal colectomy, and a patient with proctocolectomy and ileal pouch anal anastomosis with comorbid hyperparathyroidism leading to hypercalcemic crisis.

Fourteen complications occurred in 8 SILS patients; 40% of all patients had ≥ 1 complication related to their operation, as compared with 35% of multiport patients having ≥ 1 complication. The most frequent complication was postoperative ileus, which was unexplained in 1 patient and was thought to be due to a perineal wound infection in 1 patient, an intra-abdominal abscess in 1 patient, and portal vein thrombosis in 1 patient. All cases of ileus resolved with time or treatment of the underlying problem. Wound infection at the SILS incision occurred in only 1 patient (5%); this occurred in 1 multiport patient as well. The SILS patient had chronic myelodysplastic syndrome and significantly depressed blood cell counts; this patient required further wound debridement and had an extremely prolonged healing time. Volume depletion occurred in 2 patients with ileostomies; in both cases this required readmission but resolved with volume resuscitation, oral rehydration, anti-motility agents, and time. There were no anastomotic leaks, and there were no deaths. Readmission in <30 days occurred in 7 SILS patients (33%) compared with 5 multiport patients (20%). In the SILS patients, one of these admissions was not directly related to the operation; 2 patients were admissions from outside emergency departments where subsequent workup showed no complications; 2 patients were readmitted for volume depletion; 1 patient was readmitted for a delayed perineal wound infection; and 1 patient was readmitted for a partial small bowel obstruction, which resolved with nonoperative management. In the multiport patients, 1 readmission was related to a Crohn exacerbation, whereas the remaining 4 patients were readmitted for complications from their surgical procedures: intra-abdominal abscess in 2, wound infection in 1, and perineal wound infection in 1. Overall complications and morbidity appeared similar between the groups, and there were no significant differences.

DISCUSSION

This study shows the feasibility of a single-incision laparoscopic approach in IBD, but it also shows that there appears to be little, if any, benefit compared with multiport laparoscopy in the inflammatory bowel population. The conversion rate of 10% is in line with other SILS series, which trend in the 4% to 9% range^{12,13}; less than that in some laparoscopic inflammatory bowel series¹⁴; and not different from the conversion rate in the multiport cohort. No cases were converted to multiport laparoscopy, which may suggest that if a case can be accomplished with multiport laparoscopy, it can be accomplished with single-incision laparoscopy. Both SILS conversions and the multiport conversion occurred early and were conversions meant to facilitate operations that could not be completed with minimally invasive techniques. Conversion from a SILS approach to an open approach does not leave additional stab incisions, a benefit over conversion from multiport laparoscopy, making SILS an excellent technique for initial exploration. All SILS cases were completed with standard commercially available equipment; angled instruments and intracorporeal retractors were unnecessary, as shown in prior series.¹⁵ For visualization, the flexible-tip laparoscope was found to be of great benefit in total abdominal colectomy and proctocolectomy. Angled laparoscopes were sufficient for right-sided colonic resections but were inadequate for more advanced procedures. We found that both access devices, the SILS port and the GelPoint, were roughly equivalent. The SILS port has the advantage of easier instrument insertion and a lower profile, whereas the GelPoint was more effective in high BMI cases and has the advantage of incorporating a wound protector. In this series the SILS port was favored in low BMI cases and the GelPoint in high BMI cases. Patients with a wide range of BMIs and IBDs were treated in this series, again showing the utility of the single-incision approach.

Criticism toward SILS has been multifaceted and includes concerns regarding the operative time, potential for increased complications, and lack of patient benefit. In this series the operative times were long but comparable with those of standard multiport laparoscopy. Right-sided resections took an average of 2 hours, and proctocolectomies took an average of 5.5 hours; both of these were not significantly different from the multiport cases. There was a trend toward a longer procedure length in the abdominal colectomy group, and the lack of a significant difference may represent a type II error given the low numbers in the series. Overall, these procedure lengths are

similar to those in other single-site and multiport laparoscopy reports in the literature. In comparison with early laparoscopic series, these operative times are somewhat shorter.¹⁶ It can be expected for the operative time to improve with surgeon experience, as well as with improved technology. At least 1 complication occurred in 40% of patients compared with 35% of multiport patients; however, none of the SILS complications appeared to be attributable to the single-incision technique. The overall complication profile was markedly similar between the two groups. Positively, only 1 patient (5%) had a wound infection at the abdominal incision site, a rate lower than that for open colonic surgery at our institution and others.¹⁷ Two SILS patients had perineal wound infections, a well-known complication of proctectomy; this was seen in 1 multiport patient. Both SILS intra-abdominal abscesses occurred in patients with severe ulcerative colitis, one of whom had a total abdominal colectomy for fulminant colitis. There were no instances of visceral organ injury due to poor visualization or difficult dissection ergonomics.

Our length of stay for the SILS patients is higher than that in many SILS series but is similar to that in IBD-specific laparoscopic series⁹ and the same as that in the multiport patients. This is partially due to IBD and the nature of this patient population at a tertiary referral center. Our series also shows an increased need for pain medications in this population as compared with other series of laparoscopic colectomy in the non-IBD population.¹⁸ This may limit the utility of single-incision surgery in this population because the purported benefits of less pain and shorter hospital stay may be difficult to realize. Alternatively, this may argue for the use of an accelerated recovery pathway.¹⁹ However, it is difficult to know whether the use of SILS in IBD would enhance the efficacy of such a strategy, and this comparative series argues that SILS outcomes are no different than multiport outcomes. Additional criticism toward this series, in particular, lies in its retrospective nature. Selection bias may play a role in any retrospective study because difficult cases may have been started with multiport laparoscopy or performed by an open approach. Alternatively, the wide range of BMI values (14–35 kg/m²) and inclusion of patients with severe disease (fulminant colitis, recurrent ileocolic disease, and pelvic abscess) show the possibilities of a single-incision approach.

Overall, the SILS technique adds to the technical complexity of the case, but in this series, it did so without significantly increasing the operative time or morbidity. There appear to be no significant benefits to the SILS approach

compared with the standard multiport approach, with the exception of cosmesis. This may be increasingly true in the IBD population because pain medicine requirements and length of stay remain higher than those in the non-IBD population, and this knowledge may be useful in designing future randomized trials. Further studies comparing multiport laparoscopy with single-incision surgery are needed to help elucidate the role of single-incision surgery in the IBD population.

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