

Single-Incision Laparoscopic Total Colectomy

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ABSTRACT

Background and Objectives: To present our experience with a single-incision laparoscopic total colectomy, along with a literature review of all published cases on single-incision laparoscopic total colectomy.

Methods: A total of 22 cases were published between 2010 and 2011, with our patient being case 23. These procedures were performed in the United States and United Kingdom. Surgical procedures included total colectomy with end ileostomy, proctocolectomy with ileorectal anastomosis, and total proctocolectomy with ileopouch-anal anastomosis. Intraoperative and postoperative data are analyzed.

Results: Twenty-two of the 23 cases were performed for benign cases including Crohns, ulcerative colitis, and familial adenomatous polyposis. One case was performed for adenocarcinoma of the cecum. The mean age was 35.3 years (range, 13 to 64), the mean body mass index was 20.1 (range, 19 to 25), mean operative time was 175.9 minutes (range, 139 to 216), mean blood loss was 95.3mL (range, 59 to 200), mean incision length was 2.61cm (range, 2 to 3). Average follow-up was 4.6 months with 2 reported complications.

Conclusions: Single-incision laparoscopic total colectomy is feasible and safe in the hands of an experienced surgeon. It has been performed for both benign and malignant cases. It is comparable to the conventional multi-port laparoscopic total colectomy.

Key Words: Single-incision, single-port, total colectomy, laparoscopic colectomy.

INTRODUCTION

Surgical procedures have continuously evolved over the years with the aim of minimizing invasive techniques,¹ reducing postsurgical complications, pain, recovery time, and overall, improving patients' satisfaction. Single-incision laparoscopic surgery has been used for cholecystectomy,² hysterectomy,³ nephrectomy,⁴ appendectomy,⁵ colectomy,⁶ and many abdominal surgeries. A growing number of surgeons are reporting the benefits of single-incision laparoscopic surgery for partial colectomies^{7,8}; consequently, the next step forward is performing total colectomies through single-incision laparoscopic surgery.⁹⁻¹⁴

We report our experience of single-incision laparoscopic total colectomy in a patient with ulcerative colitis, causing severe bleeding. This case led us to a world literature review of all the cases in which this procedure has been performed, hoping to gain further insight into the surgical technique and patient outcomes. Our analysis of this patient and the current literature is presented.

MATERIALS AND METHODS

A review of the patient's chart was performed along with a literature review using the Pubmed database. **Table 1** consists of a summary of the 23 cases of single-incision laparoscopic total colectomy that have been published to date, including our patient.

Our patient is a 38-year-old woman with a past medical history of ulcerative colitis and genetic hypercoagulability. She was admitted to the hospital with acute deep vein thrombosis (DVT) and was started on heparin anticoagulation. She subsequently had refractory bleeding secondary to anticoagulation that required prompt total colectomy. Colonoscopy showed severe colitis.

She was placed in the supine position, and a 3-cm midline incision through the umbilicus was made. A laparoendoscopic single-site quadport (Olympus, Center Valley, PA) was placed. Pneumoperitoneum was obtained, and a 5-mm laparoscopic EndoEYE camera with flexible tip (Olympus, Center Valley, PA) was inserted. The cecum was mobilized with a Harmonic scalpel (Ethicon, Bloom-

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Table 1.
Summary of Single-incision Laparoscopic Total Colectomy in the Literature

Reference	No. of Pts	Age (years)	BMI (kg/m ²)	Presenting Symptoms ^a	Colonoscopy ^a	Disease ^a	Indication ^a	Procedure ^a	OT ^a (mins)	BL ^a (mL)	IL ^a (cm)	Diet Intro (days)	LOS ^a (days)	Intra/Post-op Complications ^a
Current Article	1	38	19.7	Severe Bleeding	Severe Colitis	UC	Severe Bleeding	TC, EI	210	100	3	1	7	None
Bardakcioglu et al. ⁹	1	64	NS	Anemia	Large tumor in cecum sigmoid polyp	Adenocarcinoma of the cecum	Well-differentiated carcinoma	TC, IRA	NS	NS	3	1	4	None
Geisler et al. ¹⁰	1	13	7	NS	NS	FAP	Multiple polyps	TPC, IAA	172	100	2.5	1	4	None
Leblanc et al. ¹¹	4	45b	25b	Abdominal pain	Severe colitis, proctitis	UC (n=2)	Failure of medical management	TC, EI, IRA	212b	30b	2.75b	1b	4.5b	Post-op ileus on day 3
Cahill et al. ¹²	3	28b	24b	Weight loss Diarrhea Abdominal pain	Numerous polyps	Crohns (n=1) FAP (n=1) UC (n=2)	Failure of medical management	TC, EI	201b	200b	2b	NS	5b	SBO
Fichera et al. ¹³	10	28b	21.9b	Weight loss NS	NS	UC (n=10)	Failure of medical management	TC, EI, IAA	139b	100b	NS	3b	5.1b	NS
Ramos et al. ¹⁴	3	NS	NS	NS	NS	NS	NS	TC	216.3b	59.1b	2.8b	NS	5b	None

^aBL=blood loss, EI=end ileostomy, FAP=familial adenomatous polyposis, IAA=ileopouch-anal anastomosis, IAA=incision length, IRA=ileoanal anastomosis, LOS=length of stay, NS=not specified, OT=operative time, Ref=reference, SBO=small bowel obstruction, TC=total colectomy, TPC=total proctocolectomy, UC=ulcerative colitis

^bmean data of series.

field CT), the mesentery of the colon was dissected right along the colon through the hepatic flexure to the mid transverse colon, and the sigmoid colon was taken down. A plane was made underneath the mesentery of the sigmoid rectal junction and was cut using a 450-mm straight nonroticulating stapler. The left colon was mobilized all the way from the sigmoid up to the splenic flexure and across to the mid transverse colon. The terminal ileum was transected with a stapler prior to mobilization. The colon was removed through this single-port device with the port left in place as a wound protector. The specimen was easily accommodated through the single-port device. The abdomen was copiously irrigated. A 12-mm port was placed in the right lower quadrant at the last stages of the operation where the ileostomy would eventually be brought out. The end of the terminal ileum was brought up to the edge of the fascia of the right lower quadrant port site. Both ports were removed and the umbilical port fascia and skin were closed. The ileostomy was created in a Brooke fashion using interrupted sutures through the full thickness of the stoma, then through the skin.

The operative time was 210 minutes with approximately 100mL of blood loss. No additional abdominal access was used. Liquid diet was introduced on postoperative day 1. No intra- or postoperative complications were noted. She was ambulant on postoperative day 2 and was bridged with coumadin prior to discharge on postoperative day 7. She resumed part-time work the next day.

RESULTS

A literature search using the Pubmed database indicated 6 reports of 22 cases,⁹⁻¹⁴ with this current article being the 23rd case, in which single-incision laparoscopic total colectomy was performed. Details of the published case series and case reports are summarized in **Table 1**. Twenty of these procedures were performed in the United States and 2 in the United Kingdom.

The surgical procedure was performed in patients at a mean age of 35.3 years (range, 13 to 64) with a mean body mass index (BMI) of 20.1 (range, 19 to 25). It has been successfully performed in males and females with a male to female ratio 13:10.

Nine of the 23 cases reported presenting symptoms. Our patient presented with severe bleeding from heparin anticoagulation due to deep vein thrombosis (DVT), 3 patients presented with abdominal pain, 3 with bloody diarrhea, 1 with diarrhea and anal incontinence, and 1 had familial adenomatous polyposis.

Colonoscopy results showed severe colitis with proctitis in 4 patients, a large number of polyps, and an adenocarcinoma of the cecum with a large sigmoid polyp in 1 patient each.

Twenty of the 23 patients had a preoperative diagnosis. Fifteen patients (65%) had ulcerative colitis, which was either resistant to medical therapy or caused severe bloody diarrhea; 2 patients (8%) had familial adenomatous polyposis; 2 (8%) had refractory Crohn's disease; 1 (4%) had adenocarcinoma of the cecum and synchronous cancer of the sigmoid colon.

A total colectomy with end ileostomy was performed in 19 patients; total colectomy with ileorectal anastomosis and proctocolectomy with ileorectal anastomosis were performed in 1 patient each, total proctocolectomy with ileo-pouch-anal anastomosis was performed in 2 patients.

The mean operative time was 175.9 minutes (range, 139 to 216). The mean blood loss was 95.3mL (range, 59 to 200). Mean incision length was 2.61cm (range, 2 to 3). Mean postoperative length of hospital stay was 4.56 days (range, 4 to 7).

Solid diet was introduced on postoperative day 1 in 4 patients and postoperative day 3 in 10 patients. Two patients were started on a liquid diet on postoperative day 1, and another patient was started on a soft diet on postoperative day 2.

There were minor variations in the types of intraoperative instruments used (**Table 2**). A SILS port (Covidien, Mansfield, MA) was used in 10 patients, and a GelPOINT/Olympus quadport (Applied Medical, Rancho Santa Margarita, CA and Olympus, Center Valley, PA) were used in 13 patients. Twenty cases reported energy devices: LigaSure (Covidien, Mansfield, MA) was used in 9 patients, ENSEAL (Ethicon, San Angelo, TX) was used in 10 patients, and HARMONIC scalpel (Ethicon, San Angelo, TX) was used in 1 patient. A 5-mm laparoscopic camera (Karl Storz, Tuttlingen Germany) was used in 10 patients; a 12-mm laparoscopic camera was used in 10 patients; a 5-mm laparoscopic EndoEYE camera with flexible tip (Olympus, Olympus, Center Valley, PA) was used in 2 patients; and a 5-mm laparoscopic camera with a flexible steering tip was used in 1 patient. A 12-mm roticulating linear stapler (Covidien Autosuture, Mansfield, MA) was used in 17 patients. An ENDOPATH (Ethicon, San Angelo, TX) was used in 3 patients. A 450-mm EndoGIA stapler (Ethicon Endosurgery, San Angelo, TX) was used in 2 patients, a 4.5-mm EndoGIA and EEA 25-mm stapler (Covidien, Mansfield, MA) was used in 1 patient. In 22 pa-

Table 2.
Summary of Intraoperative Instruments

Reference	Type of port	Energy Device	Use of Staplers	Type of Camera	Grasper
Current Article	LESS Quadport single port (Olympus, USA)	HARMONIC® Scalpel (Ethicon, USA)	450mm EndoGIA straight non-roticulating stapler	5mm Laparoscopic EndoEYE camera with flexible tip (Olympus, Center Valley California, USA)	5mm straight grasper
Barakciglu et al. ⁹	SILS™ (Covidien) Connecticut, USA	LigaSure™ (Covidien) Connecticut, USA	12mm roticulated linear stapler (Covidien Autosuture) Norwalk Connecticut, USA	5mm Laparoscopic camera with 30-degree lens (Karl Storz) Tuttlingen, Germany	5mm straight(Karl Storz) Tuttlingen Germany
Geisler et al. ¹⁰	GePOINT (Applied Medical) California, USA	LigaSure Atlas (Covidien) Colorado, USA	450mm EndoGIA stapler and 29mm Proximate ILS circular staple (Ethicon Endo-surgery) Cincinnati Ohio, USA	5mm Laparoscopic EndoEYE camera with flexible tip (Olympus) Center Valley California, USA	RealHand flexible laparoscopic grasper (Novare Surgical) California, USA
Leblanc et al. ¹¹	SILS™ (Covidien) Massachusetts, USA	LigaSure (Covidien Valleylab) Colorado, USA	12mm roticulated stapler EndoGIA (Covidien Autosuture) North Haven Connecticut, USA	5mm Laparoscopic camera with 30-degree lens (Karl Storz) Tuttlingen, Germany	5mm straight grasper
Cahill et al. ¹²	5mm, 10mm, 12mm trocars placed through a single incision	LigaSure™-V (Covidien) Connecticut, USA	Linear articulated stapler and circular stapler	10mm laparoscopic camera with 30-degree lens (Karl Storz)	5mm straight grasper
Fichera et al. ¹³	GePOINT (Applied Medical) California, USA	ENSEAL (Ethicon Endo-Surgery) Cincinnati, USA	12mm roticulated stapler EndoGIA (Covidien Autosuture) North Haven Connecticut, USA	12mm laparoscopic camera with 30-degree lens (Karl Storz)	5mm straight grasper
Ramos et al. ¹⁴	SILS™ (Covidien)/ GePOINT (Applied Medical)	NS	Echelon™ ENDOPATH (Ethicon, USA)	5mm straight laparoscope with right angle light cord	5mm straight grasper

tients, a 5-mm straight grasper was used, and a RealHand flexible laparoscopic bowel grasper (Novare Surgical, Cupertino, CA) was used in 1 patient.

Follow-up was reported in 4 patients (range, 2 to 7 months). On an average follow-up of 4.6 months, the following complications were reported: one patient developed postoperative ileus on day 3 that resolved spontaneously. Another patient developed severe abdominal pain on postoperative day 4 due to peritoneal free fluid and had to undergo another laparoscopy. The same patient developed small bowel obstruction 4 months later.

Pathological examination was reported in 2 patients. In one patient, the report showed adenocarcinoma of the cecum with 17 negative lymph nodes (T3N0M0) and villous adenoma with no residual adenocarcinoma on the sigmoid colon. In another patient, pathological examination showed active mucosal ulcerative colitis with no evidence of dysplasia or malignancy.

DISCUSSION

This report summarizes the current world literature on single-incision laparoscopic total colectomies. Over the past few years, there has been widespread acceptance of multi-port laparoscopic colectomies as an alternative to the traditional open abdominal surgery due to proven advantages of reduced intraoperative and postoperative complications. The added advantage of improved cosmesis makes single-incision laparoscopic total colectomy a viable alternative to the conventional multi-port laparoscopic colectomy.

This report highlights the fact that single-incision laparoscopic total colectomies have been performed in emergent/nonemergent cases and benign/malignant cases. The majority of patients had a form of inflammatory bowel disease refractory to medical therapy.

The procedure has been performed in both males and females with an average BMI of 21.2, which is not surprising because surgeons probably selectively handpicked patients for this procedure. However, studies have shown that laparoscopic colectomies are safe and feasible in patients with higher BMI, with no significant difference in recovery of intestinal function and length of stay compared to patients with normal BMI.^{15,16}

Various surgical techniques were used by different surgeons during the procedure. At the start of the procedure, most of the patients were placed in either lithotomy positions or Trendelenburg positions. Minor variations were

made during the course of the operation, as patients were tilted either to the right or the left to provide proper visualization. Surgeons were positioned on the left when mobilizing and dissecting the right colon, on the right when operating on the left colon and between the patient's legs when mobilizing and dissecting the transverse colon. Dissection and mobilization were performed in a medial-to-lateral fashion, starting with the right colon, advancing through hepatic flexure, splenic flexures, left colon, and ending with the sigmoid. However, there is also a reported case in which this procedure progressed from distal to proximal colon.

Various intraoperative instruments have been used in performing single-incision laparoscopic total colectomy. The choice of instruments may be influenced by the personal preferences of surgeons, but the majority of cases were performed using flexible-tip cameras and straight instrumentation. In our experience, laparoscopic triangulation can be easily achieved with the flexible-tip camera and straight instruments/energy devices. **Table 2** summarizes the intraoperative instruments, including energy devices and staplers that have been successfully used for these cases.

Detailed pathological reports were not available for most patients, but based on the available reports, this procedure is feasible in benign and malignant cases with excision of up to 17 lymph nodes.⁹

Postoperative pain scores were not recorded for any cases, but a study comparing single-port and multi-port laparoscopic hysterectomy showed that fewer pain medications were used in patients who underwent single-port laparoscopic surgery.¹⁷ Improved cosmetic outcome is another potential benefit of single-incision laparoscopic surgery. A recent study comparing the conventional and single-incision laparoscopic cholecystectomy showed a clear benefit in individual-perceived postoperative appearance in the single-incision laparoscopic surgery group.¹⁸ The length of hospital stay is consistent with published data on conventional laparoscopic total colectomy; however, the estimated blood loss is significantly lower in single-incision laparoscopic surgery.¹⁹ It should be noted that there are 2 more cases, one in the United States and the other in Brazil, that are not included in this analysis because they have not been published in peer-reviewed journals.

Based on our experience in other advanced single-port cases and after reviewing this world literature on single-port total colectomies, we believe that there are distinct advantages to this procedure that seem to go beyond just the cosmetic benefits. Early ambulation, less pain, and

fewer wound complications have led to faster recovery in this series. This definitely makes the case for attempting single-port total colectomies. Instrumentation for single-port surgery is advancing at an amazing pace. The challenges of triangulation, exposure, as well as instrument collision are getting better every day. Although very few surgeons in this series used curved instruments, the flexible 5-mm camera in our opinion is the key to exposure and avoiding collisions. Patient selection remains the key to any successful single-port surgery. Choosing nonobese patients with inflammatory pathology (with one exception of adenocarcinoma) has allowed the surgeons in this series to maneuver the colon better and resect the mesentery just inferior to the colonic wall with an energy device. The colonic extraction is also easier through the single port with less mesenteric load in the specimen. Larger case series will definitely set the road map for the single-port total colectomy cases in the future.

CONCLUSION

Based on our analysis on the reported cases worldwide, we find this procedure feasible and very comparable with multi-port laparoscopic colectomies in terms of length of hospital stay, operative time, and complications rates.²⁰ Prospective larger volume studies are needed to further analyze and validate similar trends in single-incision laparoscopic total colectomy in terms of pain and cosmesis.

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