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Research Article

Single-Port Colonic Surgery: The Bermuda Experience

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ABSTRACT

Background: Single Incision Laparoscopic Surgery (SILS) is attractive because it uses 1 umbilical incision for preparation and extraction of the specimen. However, the procedure is technically demanding compared to conventional laparoscopy, and it is unclear if it is possible to adopt this procedure in an isolated community like Bermuda with a small hospital.

Methods: Since the introduction of SILS in Bermuda by an experienced SILS surgeon, 230 patients who underwent SILS colon procedures from 2012-2018 were reviewed. The data were analyzed according to intra- and postoperative events and outcomes. The results were compared to internationally published data.

Results: There was a low operative time of 127.8 (40-305) minutes. There were only 4 conversions to open surgery (1.7%). The overall complication rate was 11.7% (27 patients). There were 2 postoperative deaths (0.9%). These data are within the range of internationally published data.

Conclusion: Initiated and guided by an experienced SILS surgeon, the adoption of single-port colon surgery in Bermuda was successful, and the SILS procedure now belongs to the standard procedures for colonic operations in Bermuda.

Keywords: Single Incision Laparoscopic Surgery (SILS), Isolated community, Technically demanding, Experienced SILS surgeon, Colonic surgery

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INTRODUCTION

Laparoscopic colonic surgery is advantageous because it results in better cosmesis, less incisional pain and faster recovery (Schwenk W, *et al.*, 2005). Single Incision Laparoscopic Surgery (SILS) appears to be safe and effective when compared to multiport laparoscopy (Khayat A, *et al.*, 2015) but is technically challenging due to the resulting crowding of the laparoscopic instruments (Islam A, *et al.*, 2011). Doctors learning this type of surgery reportedly have a steep learning curve, and longer operative times can lead to increased surgeon fatigue (Ishida T, *et al.*, 2018).

Experts from an international multicenter registry, the European Consensus of Single-port Expertise in Colorectal Treatment (ECSPECT) have stated that "The feasibility and safety, conversion and complication profile demonstrated here provides guidance for patient selection" (Weiss H, *et al.*, 2017). The success of SILS in Europe has triggered debate about its application and transferability to other jurisdictions, including small island states, and from this has arisen recommendations for low-income countries, such as the training of local and regional healthcare providers and monitoring outcomes, which can be used for guidance in isolated communities seeking to offer SILS procedures (Grimes CE, *et al.*, 2013).

The aim of this study is to evaluate the feasibility and safety of performing SILS colonic procedures within the single-hospital healthcare system of Bermuda, an island in the Atlantic Ocean with an area of just 54 km^2 (21 sq. miles) and a population of 70,000, located over 1000 km (640 miles) from the nearest landmass.

METHODS

Patient selection

All patients receiving a SILS colon procedure in Bermuda were evaluated. Patients with benign and malignant indications were selected without preference for gender, age, body mass index or American Society of Anesthesiologists (ASA) classification. Previous abdominal surgery and tumor stage were not definite exclusion criteria. As there is only 1 hospital in Bermuda, the database of the single hospital (King Edward VII Memorial Hospital) includes all patients who had SILS procedures and thus the complete cohort of colonic procedures could easily be analyzed. Every patient in the study was given detailed information regarding the procedure and written consent provided. The hospital ethics committee approved the study.

Surgical technique

The technique has been presented in detail recently (Vestweber B, *et al.*, 2011; Vestweber B, *et al.*, 2013). In most cases, access was achieved through a single vertical umbilical incision of approximate length of 2.5 cm. This incision in some cases would be widened for specimen extraction. However, if a colostomy or ileostomy was planned or considered likely, the access incision was instead made at the intended stoma site, eliminating the need for a separate stoma incision. The procedures were performed or assisted by 2 experienced surgeons, one of whom had major experience in laparoscopic surgery and especially SILS at a German center prior to practicing in Bermuda.

RESULTS

Patient characteristics

Baseline demographic characteristics of all 230 patients treated by single-port surgery are presented in *Table 1.*

The mean age was 64.1 ± 13.5 years with a range of 19-93 years. There were 120 females and 110 males. The average Body Mass Index (kg/m^2) was 28.1 ± 5.6 (overweight) with a range of 18.6-47.3. Patients in all 4 American Society of Anesthesiologists (ASA) classifications were included: ASA I 41 (17.8%), ASA II 83 (36.1%), ASA III 91 (39.6%), and ASA IV 15 (6.5%).

The operative procedures were classified into 5 categories:

- Subtotal colectomy n=4(1.7%)
- Low anterior resection n=13(5.7%)
- Ileocecal resection and right hemicolectomy n=85(37.0%)
- Sigmoidectomy, high anterior resection and left hemicolectomy n=120(52.2%)
- Transverse colectomy n=8(3.5%)

The diagnostic indications for surgery and anesthesia risk scores

Table 1: Baseline patient characteristics

Procedure	Subtotal colectomy	Low anterior resection	Ileocecal resection and right hemi colectomy	Sigmoidectomy, high anterior resection and left hemi colectomy	Transverse colectomy	All patients
Patients (n)	4	13	85	120*	8	230
Age (yr.)	48.0 ± 24.2 (19-73)	65.0 ± 9.6 (55-85)	67.6 ± 14.0 (19-93)	61.8 ± 12.4 (37-91)	69.9 ± 12.3 (50-87)	64.1 ± 13.5 (19-93)
Gender (M/F)	4/0	4/9	40/45	60/60	2/6	110/120
Body mass Index (kg/m²)	23.2 ± 4.0 (18.8-27.8)	27.2 ± 5.3 (19.7-39.6)	28.1 ± 6.2 (19.0-47.3)	28.4 ± 5.1 (18.6-41.9)	28.0 ± 6.2 (21-37.8)	28.1 ± 5.6 (18.6-47.3)
Note: Data are mean ± SD (range) unless otherwise stated. *103 Sigmoid resections, 6 high anterior resections, and 11 left hemi colectomies						

for each type of SILS procedure are shown in *Table 2*. The commonest diagnoses were diverticular disease (84 patients, 36.5%) and colon cancer (81 patients, 35.2%). The majority of operations were left colon procedures (sigmoid colectomy, high anterior resection, and left hemicolectomy).

Intraoperative outcomes

Table 3 presents the intraoperative outcomes of the study population. In this series, 4 (1.7%) procedures required conversion to an open procedure. No conversion to standard multiport laparoscopy was necessary. The reasons for conversion were post-inflammatory tissue changes and technical difficulties, including bleeding and adhesions. The mean operating time was 127.8 ± 43.8 minutes with a range of 48-305 minutes, depending on the type of procedure.

Postoperative outcomes

Table 4 shows the length of hospital stay and complication rates. The mean length of stay was 6.0 ± 4.3 days with a range of 1-33 days. Complications were defined using the Clavien-Dindo classification (Dindo D, *et al.*, 2004). The overall complication rate was 11.7% (27 patients), with left sided procedures accounting for 63% of all complications. There were 2 postoperative deaths (0.9%).

Table 2: Diagnoses and ASA scores by SILS procedure type

Procedure	Subtotal colectomy	Low anterior resection	Ileocecal resection and right hemi colectomy	Sigmoidectomy, high anterior resection and left hemi colectomy	Transverse colectomy	All patients
Patients (n)	4	13	85	120*	8	230
Diagnosis (n)	Polyposis coli (2) Slow transit (1) Diverticular dis. (1)	Rectal ca. (11) TVA (2)	Colonic ca. (48) Colonic polyp (27) Diverticular dis. (3) Crohn's dis. (2) Appendiceal ca. (2) Appendix mucocele (1) Cecal volvulus (1) UIC (1)	Diverticular dis. (80) Colon ca. (28) Colon polyp (10) Endometriosis (1) Pneumatosis int. (1)	Colon ca. (5) Colon polyp (2) Crohn's dis. (1)	Diverticular dis. (84) Colon ca. (81) Colon polyp (39) Rectal ca. (11) Crohn's dis. (3) TVA (2) Polyposis coli (2) Appendiceal ca. (2) Appendix mucocele (1) Cecal volvulus (1) Endometriosis (1) Slow transit (1) Pneumatosis int. (1) UIC (1)
Histology (n)						
Benign	2	2	10	82	1	97
Low-grade neo	1	0	15	7	1	24
High-grade neo	0	0	9	0	1	10
Malignant	1	11	51	31	5	99
ASA score (n)						
1	1	1	9	29	1	41
2	2	4	25	51	1	83
3	1	7	44	33	6	91
4	0	1	7	7	0	15
Note: ASA: American Society of Anesthesiologists, ca: Carcinoma, dis: Disease, int: Intestinalis, neo: Neoplasia, TVA: Tubulovillous Adenoma, UIC: Ulcerative Ischemic Colitis. *103 Sigmoid resections, 6 high anterior resections, and 11 left hemi colectomies.						

Table 3: Intraoperative outcomes of 230 single incision laparoscopic colon resections, with standard, straight, nonarticulating instruments

Procedure	Subtotal colectomy	Low anterior resection	Ileocecal resection and right hemi colectomy	Sigmoidectomy, high anterior resection and left hemi colectomy	Transverse colectomy	All patients
Patients (n)	4	13	85	120*	8	230
Operating time (min)	162.3 ± 35.4 (136-212)	159 ± 62.1 (84-305)	104.6 ± 28.5 (48-175)	138.0 ± 42.5 (65-261)	153.4 ± 59.6 (87-279)	127.8 ± 43.8 (48-305)
Specimen length postfixation (cm)	85 ± 33.2 (50-130)	17.7 ± 3.9 (12-26.3)	20.6 ± 7.8 (8-40.5)	18.3 ± 6.7 (5.6-55)	14.6 ± 7.8 (6-29)	20.1 ± 11.8 (5.6-130)
Conversion to open procedure (n, %)	0	0	2	1	1	4 (1.7%)
Note: Data are mean ± SD (range) unless otherwise stated. *103 Sigmoid resections, 6 high anterior resections, and 11 left hemi colectomies						

Table 4: Length of stay and Clavien-Dindo classification of surgical complications (contracted form) following 230 single-incision laparoscopic colon resections, using standard, straight, nonarticulating instruments

Procedure	Subtotal colectomy	Low anterior resection	Ileocecal resection and right hemi colectomy	Sigmoidectomy, high anterior resection and left hemi colectomy	Transverse colectomy	All patients
Patients (n)	4	13	85	120*	8	230
Length of hospital stay (days)	9.5 ± 3.0 (7-13)	6.2 ± 4.2 (3-19)	6.1 ± 4.9 (1-33)	5.8 ± 4.1 (3-24)	5.6 ± 2.3 (3-10)	6.0 ± 4.3 (1-33)
Clavien-Dindo surgical complication Grade (n)						
I	0	0	0	1	0	1
II	0	0	6	8	1	15
III a/b	2	0	0	7	0	9
IV a/b	0	0	0	0	0	0
V	0	0	1	1	0	2
Note: Data are mean ± SD (range) unless otherwise stated. *103 Sigmoid resections, 6 high anterior resections, and 11 left hemi mcolectomies						

DISCUSSION

After the single port variation of laparoscopic surgery was introduced to colon surgery, surgeons all over the world started to use this technique. However, because of the steep learning curve of SILS surgery, even for experienced standard port laparoscopic surgeons, there has been some concern for increased complications resulting from surgeons who were less experienced in laparoscopic surgery trying to adapt this technique (Makino T, *et al.*, 2012).

It has been deemed safe for colonic surgery and rules for further development have been established (Ahmed I, *et al.*, 2012; Vestweber B, *et al.*, 2011; Weiss H, *et al.*, 2017). Whether this type of surgical procedure is transferable to small isolated places like Bermuda is an important thought to consider.

One of our surgeons Boris Vestweber relocated from a German center for colonic surgery (Klinikum Leverkusen) to Bermuda in 2012. The data from 224 SILS-colon procedures from this center were published in 2012 (Vestweber B, *et al.*, 2013). In Bermuda, SILS procedures started that same year and a total of 230 operations have been done. Although there are some significant differences in patient demographics and disease distribution between the German and Bermudian experiences, some useful insight can still be gained from a comparison.

While the two groups were evenly matched in size and male/female distribution, they had some distinct differences (*Table 5*). A larger portion of Bermudian patients underwent right-sided procedures (37% *vs.* 13%). Compared to the German cohort, the Bermudian patients were nearly a decade older, a bit heavier, had much higher ASA risk scores, and were much more likely to have a malignant diagnosis (42.6% *vs.* 16.1%). Despite these negative factors, the Bermudian cohort had on average a 23% shorter operating time, a 73% lower conversion to open rate, and a 40% shorter mean hospital stay, with an equivalent complication rate.

Table 5: Data comparison between a single German center for colonic surgery (Klinikum Leverkusen) and Bermudian

Variables	German cohort (n=224)	Bermuda cohort (n=230)
Age (yr)	56.5 ± 14.9	64.1 ± 13.5
Gender (M/F)	107/117	110/120
Body Mass Index (kg/m^2)	26.5 ± 4.7	28.1 ± 5.6
Right sided procedures	30	85
Left sided procedures	150	120
Benign pathology	188	131
Malignant pathology	36	99
ASA score		
1	44	41
2	157	83
3	23	91
4	0	15
Operating time (mins)	166.4 ± 73.9	127.8 ± 43.8
Conversion to open	14 (6.3%)	4 (1.7%)
Length of hospital stay (days)	9.9 ± 7.5	6.0 ± 4.3
Complication rate	11.2% (25/224)	11.7% (27/230)
Note: Data are mean ± SD (range) unless otherwise stated		

The pre-operative and postoperative complications were reported according to the Clavien-Dindo classification (Dindo D, *et al.*, 2004). There was a similar Clavien-Dindo severity distribution between the two groups with grade I-II representing 7% of Bermudian and 6.25% of German complications. There were two deaths in the Bermuda cohort; one was a patient who had an emergency SILS resection for segmental intestinal infarction and progressed to complete intestinal infarction, and the other had an emergency SILS resection for intestinal bleeding while on an anticoagulant and later developed an anastomotic leak. There were no deaths in the German cohort.

The morbidity and mortality rates for SILS colon procedures in Bermuda also compares favorably to other internationally published data.

The European ECSPECT-registry (Weiss H, *et al.,* 2017) includes 1769 patients observed complications in 224 patients (12.7%) and an overall mortality of 8 (0.5%) patients.

A meta-analysis from Spain included 1119 SILS-colonic procedures reporting 199 (17.8%) complications (Luján JA, *et al.,* 2015).

A South Korean trial (Kang BM, *et al.*, 2018) of 99 SILS-procedures reported a complication rate of 10.8%. In another Korean group of 59 patients undergoing SILS-procedures for colon cancer, complications were seen in 11 (18.6%) patients, with only 1 (1.7%) having a severe problem (Clavien-Dindo IV) (Oh JR, *et al.*, 2018).

An analysis of 256 patients undergoing right hemicolectomy for cancer showed an overall 30-day morbidity rate of 21.4% with no mortality. The authors concluded that compared to multiport procedures, single-port surgeries for right sided colon cancer may offer some advantages like lower operative morbidity, shorter hospital stay, and better cosmesis (Chouillard E, *et al.*, 2016).

CONCLUSION

Single-port colon surgery is a technically demanding procedure. Published data show that in experienced hands it can produce results as good as conventional multiport colon surgery. The adoption of SILS-procedures should be guided by an experienced Single-Port surgeon.

The data from the Bermudian experience suggest that under the guidance of an experienced single-port surgeon, the SILS colon procedure can be safely implemented in a small single-hospital community like Bermuda.

DECLARATIONS

Ethics approval

King Edward VII Memorial Hospital ethics committee approved the study.

Consent to participate

Every patient in the study was given detailed information regarding the procedure and written consent provided.

REFERENCES

1. Schwenk W, Haase O, Neudecker JJ, Müller JM. Short term benefits for laparoscopic colorectal resection. Cochrane Database Syst Rev. 2005; 2.
2. Khayat A, Maggiori L, Vicaut E, Ferron M, Panis Y. Does single port improve results of laparoscopic colorectal surgery? A propensity score adjustment analysis. Surg Endosc. 2015; 29(11): 3216-3223.
3. Islam A, Castellvi AO, Tesfay ST, Castellvi AD, Wright AS, Scott DJ. Early surgeon impressions and technical difficulty associated with laparoendoscopic single-site surgery: A Society of American Gastrointestinal and Endoscopic Surgeons Learning Center study. Surg Endosc. 2011; 25(8): 2597-2603.
4. Ishida T, Shigeta K, Okabayashi K, Tsuruta M, Hasegawa H, Kitagawa Y. Reduced-port surgery for rectal cancer. Mini-invasive Surgery. 2018; 2: 31.
5. Weiss H, Zorron R, Vestweber KH, Vestweber B, Boni L, Brunner W, *et al.* ECSPECT prospective multicentre registry for single-port laparoscopic colorectal procedures. Br J Surg. 2017; 104(1): 128-137.
6. Grimes CE, Maraka J, Kingsnorth AN, Darko R, Samkange CA, Lane RH. Guidelines for surgeons on establishing projects in low-income countries. World J Surg. 2013; 37(6): 1203-1207.
7. Vestweber B, Straub E, Kaldowski B, Paul C, Vestweber KH. Evaluation of current devices in single-incision laparoscopic colorectal surgery. World J Surg. 2011; 35(11): 2578.
8. Vestweber B, Galetin T, Lammerting K, Paul C, Giehl J, Straub E, *et al.* Single-incision laparoscopic surgery: Outcomes from 224 colonic resections performed at a single center using SILS™. Surg Endosc. 2013; 27(2): 434-442.
9. Dindo D, de martines N, Clavien PA. Classification of surgical complications: A new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg. 2004; 240(2): 205.
10. Makino T, Milsom JW, Lee SW. Feasibility and safety of single-incision laparoscopic colectomy: A systematic review. Ann Surg. 2012; 255(4): 667-676.
11. Ahmed I, Ciancio F, Ferrara V, Jorgensen LN, Mann O, Morales-Conde S, *et al.* Current status of single-incision laparoscopic surgery: European experts' views. Surg Laparoscop Endosc Percutan Tech. 2012; 22(3): 194-199.
12. Luján JA, Soriano MT, Abrisqueta J, Perez D, Parrilla P. Single-port colectomy *vs*. multi-port laparoscopic colectomy: Systematic review and meta-analysis of more than 2800 procedures. Cir Espan. 2015; 93(5): 307-319.
13. Kang BM, Kim HJ, Kye BH, Lee SC, Lee KY, Park Sj, *et al.* Multicenter, randomized single-port versus multiport laparoscopic surgery (SIMPLE) trial in colon cancer: An interim analysis. Surg Endosc. 2018; 32(3): 1540-1549.
14. Oh JR, Park SC, Park SS, Sohn B, Oh HM, Kim B, *et al.* Clinical outcomes of reduced-port laparoscopic surgery for patients with sigmoid colon cancer: Surgery with 1 surgeon and 1 camera operator. Ann Coloproctol. 2018; 34(6): 292.
15. Chouillard E, Alsabah S, Daher R, Younan A, Greco VJ, Chahine E, *et al.* Single-incision laparoscopy could be better than standard laparoscopy in right colectomy for cancer. J Laparoendosc Adv Surg Tech A. 2016; 26(5): 371-378.