

Case Analysis

Single Incision Laparoscopic Colectomy for Benign Colon Diseases

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Key Words

Colectomy;
Single incision laparoscopy

Purpose. The purpose of this study was to evaluate the treatment outcomes of single incision laparoscopic surgery (SILS) using a unique access for patients with benign colon diseases and to compare them with the short-term surgical outcomes among different procedures.

Methods. Medical records of patients receiving SILS using a self-made multiple-port system for the treatment of benign colon diseases between March 2010 and December 2011 were collected and reviewed. All operations were performed by a single surgeon. Demographic and clinical data of patients receiving different procedures were recorded and compared.

Results. Including 20 males and 18 females, 38 patients were collected for the study analyses. Among them, 11 patients received right-side colon resection, 18 received left-side colon resection, and 9 received total colectomy. No significant differences in gender, body mass index, tumor size, incision length or estimated blood loss among these groups of patients were found. However, significantly younger age, longer duration of operation and length of bowel resection were noted in the patients undergoing total colectomy. Curved instruments were used in 5 patients (27.8%) in the left-side colon resection group. There were no significant differences in the pain scores and average length of hospital stay among the three groups.

Conclusions. Simple self-made access device demonstrated a safe and economic option of SILS for colorectal diseases. The study indicates that SILC performed with our self-made access device provides relatively safe clinical outcome to the patients with benign colon diseases even with total colectomy.

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Laparoscopic surgery became a favorable surgical option for the surgeons since 1980s. A new way of opening a body cavity can be a revolution in surgery. With the advance of the technique, single incision laparoscopic surgery (SILS), natural orifice transluminal endoscopic surgery (NOTES),^{1,2} minilaparoscopy-assisted natural orifice surgery (MANOS),³

and other new techniques are the new paradigm in our way of operation in the 21st century.⁴ Some of them had moved from the research stage to the clinical arena to further decrease surgical invasiveness and improving cosmetic outcomes. SILS, a natural evolution of conventional laparoscopic surgery, offers the minimally invasive advantage of conventional multi-incision

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sion laparoscopic surgery and the cosmetic advantage of a single incision that it typically hidden in the umbilicus.

In colorectal diseases, conventional laparoscopic surgery was associated with fewer complications when compared to those of conventional surgery.^{5,6} For American Society of Anesthesiology class 3 and 4 patients, laparoscopic colectomy is associated with faster recovery and reduced costs as compared to open colectomy.⁷ Single-incision laparoscopic colectomy (SILC) has developed into a viable option for the treatment of benign and malignant colorectal diseases with the innovation of new access devices, instrumentation, and surgical techniques.⁸ SILS appears to be feasible and safe when performed by surgeons who are highly skilled in laparoscopy. Despite of technical difficulties, there may be potential benefits associated with SILS over conventional laparoscopic colectomy.^{9,10}

With SILS, a single incision is typically made at the umbilicus and access devices specially developed are used for the introduction of trocars and instruments.¹¹ In most cases, no other abdominal wounds are required and the umbilical incision, though larger than that of conventional laparoscopy, is minimally visible once healed. Recent reports have provided accumulating evidence of the feasibility and safety of SILS for gastrointestinal, colorectal and bariatric surgery.¹²⁻¹⁷ Despite of these encouraging reports, challenges remain with SILS. Most access devices which are commercially available are rigid with only one access point, it is possible that instrument crowding hampers dissection.¹¹ In addition, the instruments are parallel to each other so as to limit the performer's operation movement and to further increase the difficulties of tissue manipulation and dissection. To overcome these obstacles, curved instruments which are specially designed with relative high cost are used. Hence, we introduced a simple access device using a commercially available wound protector and surgical glove to improve the feasibility of SILS. The purpose of this report is to evaluate our experience of this surgical approach in the SILC for benign colon diseases among different procedures which included right/left-side colon resection and total colectomy.

Materials and Methods

After receiving the approval of the Institutional Review Board, the study was conducted to collect medical records retrospectively of the patients with benign colon diseases undergoing SILC using a self-made multiple-port system between March 2010 and December 2011 at our institution. Demographic, intraoperative, and postoperative data were collected and compared, which included age, gender, body mass index (BMI), measurable tumor size, incision length, length of bowel resection, estimated blood loss, use of curve instrument, duration of operation, drain placement, pain score and hospital stay.

Self-made multiple-port system

SILC were performed with a self-made multiple-port system. In brief, the system was constructed by connecting a commercial wound protector (ALEXIS® Wound Retractor System; Applied Medical, Rancho Santa Margarita, CA, USA) to a surgical glove. Trocars, e.g. 5-mm, 10-mm and 15-mm, were then introduced through little finger, thumb and middle finger of the glove, respectively (Fig. 1). The double-ring design of the wound protector allows the wound protector and surgical glove to be connected tightly and the glove to roll completely around the wound protector without air leak. The device allows a larger range of movement, good wound protection, and change of direction at any time. Besides, it is suitable for all body types.

The brief diagrammatic representations of the equipment in relation to the surgeon were shown in Fig. 2. Representative images of specimen removal and postoperative wounds are shown in Fig. 3.

Postoperative care

All patients received standard postoperative care and pain management. Visual analogue scale pain scores were recorded on the first postoperative day. Patients were asked to rate their pain on a scale of 1 (no pain) to 10 (worst pain imaginable). If drains were

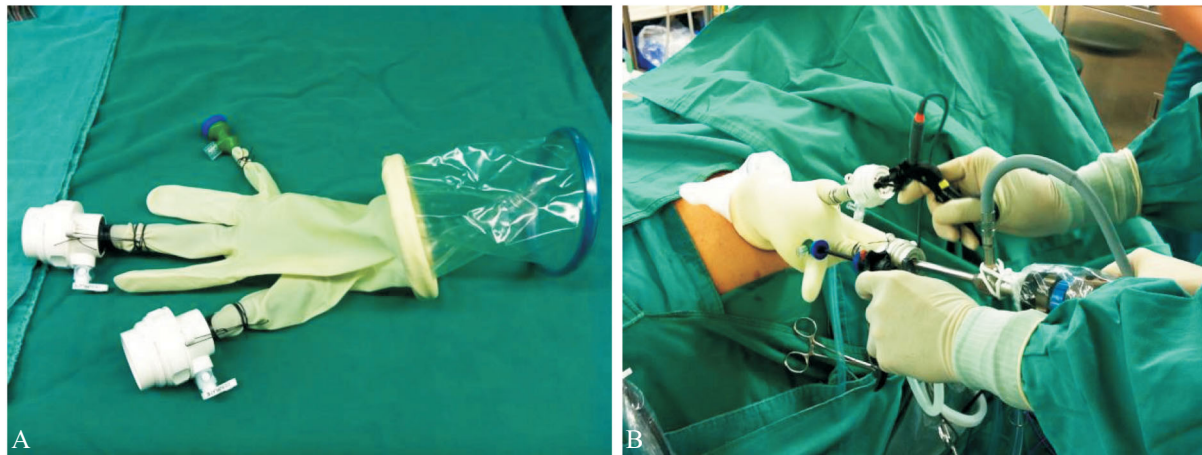


Fig. 1. Illustration of the self-made multiple-port system. A) A surgical glove is attached to a standard wound protector and trocars are introduced through the fingers of the gloves. B) Intraoperatively, the system allows greater freedom of movement of the instruments than conventional systems to do.

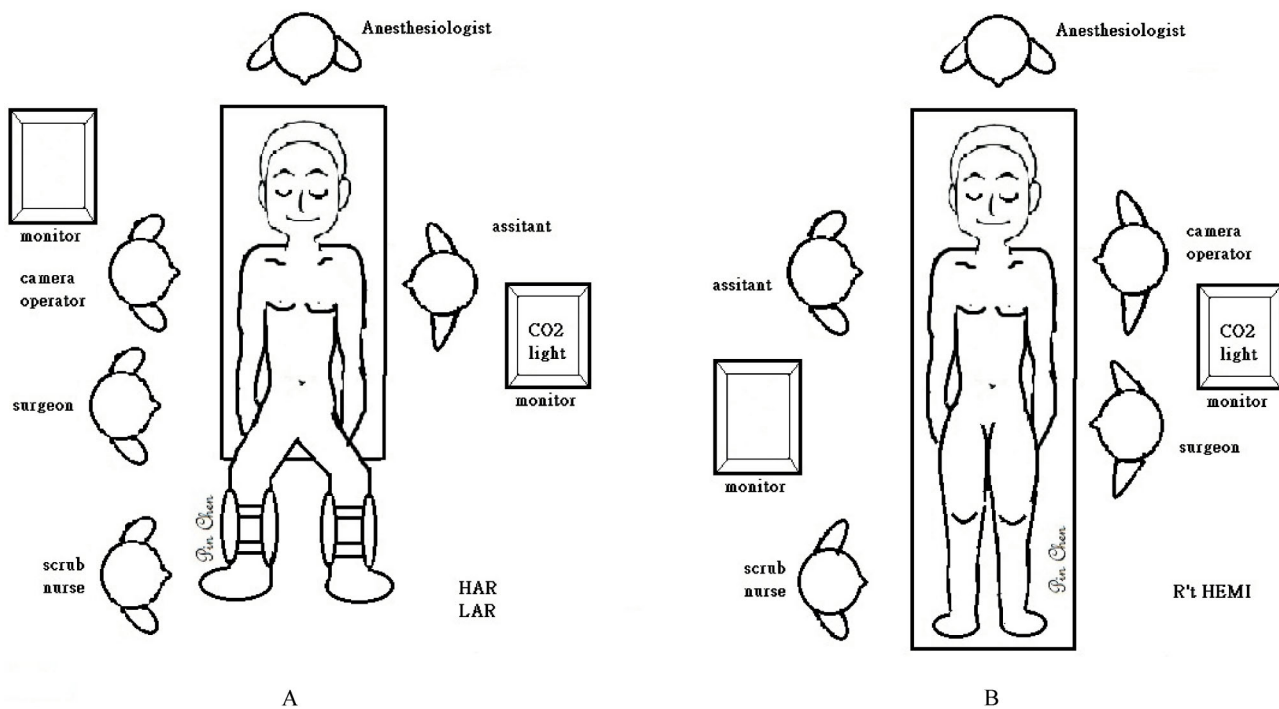


Fig. 2. The brief diagrammatic representations of the equipment in relation to the surgeon. A) For left-side colon resections, including high/ low anterior resection and total colectomy. B) For right-side colon resections.

placed, they were removed when the drainage amount was < 50 ml per day. Patients were kept fasting until the passage of flatus, and then sips of water were allowed. If tolerated, diet was advanced to clear liquids followed by a soft diet. Patients were discharged when tolerating a general diet, typically on postoperative day 5-7, and followed-up in the outpatient clinic.

Statistical analysis

Continuous data were presented a mean ± standard deviation (SD), and categorical data by number (n) and percentage (%). Comparability of demographic data and clinical outcomes among these groups was tested using the chi-square test for cate-



Fig. 3. Representative images of specimen removal through the wound protector in the single incision laparoscopy.

gorical variables and the one-way ANOVA (analysis of variance) and post-hoc analysis with Scheffe's method for the continuous variables. All statistic assessments were evaluated at the 0.05 level of significance. Statistic analyses were performed using SPSS 15.0 statistical software (SPSS Inc, Chicago, IL, USA).

Results

Including 20 males and 18 females, 38 patients were collected for the study analyses. All patients underwent surgery for the treatment of benign diseases, which included 6 cases of diverticulosis, 25 cases of benign colon tumor, 4 cases of familial adenomatous polyposis and 3 cases of colonic inertia. Among them, 11 patients received right-side colon resection, 18 received left-side colon resection, and 9 received total colectomy. Of the 18 patients in the left-side colon resection group, 15 patients received high anterior resection, 2 patients received low anterior resection and 1 patient received left hemicolectomy. All operations were performed by a single surgeon.

Demographic data of the patients receiving different procedures were presented in Table 1. In the right-side colon resection group, there were 7 males (63.6%) and 4 females (36.4%) with a mean age of

52.7 ± 16.6 years (range, 32-69 years). In the left-side colon resection group, there were 9 males (50.0%) and 9 females (50.0%) with a mean age of 60.2 ± 11.7 years (range, 33-76 years). In the total colectomy group, there were 4 males (44.4%) and 5 females (55.6%) with a mean age of 36.3 ± 17.9 years (range, 19-61 years). No significant differences in gender, BMI, or measurable tumor size were noticed among these groups. However, patients were significantly younger in the total colectomy group.

Surgical data and clinical outcomes among these groups are presented in Table 2. All operations were performed successfully without any intraoperative complications or need to convert to laparotomy. There were no significant differences among these groups with respect to the incision length and blood loss. However, significant longer duration of operation and length of bowel resection were noted in the total colectomy group.

Curved instruments were used in 5 patients in the left-side colon resection group. 4 patients received McBurney incision wound and one of them received protective loop ileostomy created over McBurney incision wound due to multiple underlying diseases. One patient, operated for sigmoid colon villotubular adenoma, received an extra-port (5 mm) over left lower quadrant of abdomen additional to umbilical incision wound due to difficult anatomy.

Postoperatively, no obvious surgery related complications were noted for all patients. There were no significant differences in the pain scores and length of hospital stay among the three groups.

Table 1. Patient demographic data

	Right-side colon resection	Left-side colon resection	Total colectomy	<i>p</i>
Age (years)	52.7 ± 16.6	60.2 ± 11.7	36.3 ± 17.9	< .001*
Gender, n (%)				.662
Male	7 (63.6)	9 (50.0)	4 (44.4)	
Female	4 (36.4)	9 (50.0)	5 (55.6)	
BMI	24.3 ± 3.3	24.8 ± 3.9	23.5 ± 3.4	.665
Tumor size (cm)	2.0 ± 1.0	2.3 ± 1.4	0.8 ± 0.3	.335

* Statistically significant.

Table 2. Surgical data and clinical outcomes

	Right-side colon resection	Left-side colon resection	Total colectomy	<i>p</i>
Incision length (cm)	3.2 ± 0.3	3.3 ± 0.6	3.0 ± 0.4	.291
Length of bowel resection (cm)	28.3 ± 12.2	19.9 ± 6.0	88.2 ± 10.1	< .001*
Blood loss (mL)	35.7 ± 24.8	27.9 ± 20.6	24.2 ± 12.3	.430
Curved instrument, n (%)	0	5 (27.8)	0	
Duration of operation (min)	150.0 ± 38.1	163.4 ± 36.3	211.7 ± 76.7	.021*
Drain, n (%)	3 (27.3)	4 (22.2)	3 (33.3)	.823
Pain score	2.6 ± 0.9	2.7 ± 1.0	3.1 ± 1.3	.535
Hospital stay (days)	7.4 ± 4.52	5.9 ± 1.1	7.8 ± 2.2	.180

* Statistically significant.

Discussion

To better perform SILC, a multiple-port system was created and used. We therefore propose the term SIMPLE (Single Incision Multiple Port Laparoscopic colectomy) for it. Commercially available access systems offer immovable trocar sites. Instrument crowding is common when using access devices with immovable trocar sites, especially when colectomy requires large areas of dissection. Curved instruments may then be needed and consequently increase total cost of the procedure. When SIMPLE was used, demonstrating a 15 mm trocar was used in the middle finger of the glove, a 10-12 mm trocar was used in the thumb and a 5 mm trocar was used in the little finger, the range of movement was large enough to overcome instrument crowding. With greater range of movement, SIMPLE encounters less instrument crowding and offers economic advantage over conventional commercially available devices. Uematsu et al.¹⁸ also reported performing SILC with a novel device; however, that device requires an additional component and there is less freedom of movement of the instruments. Interestingly, Uematsu et al.¹⁹ have also reported another unique way, extracorporeal magnetic retraction, to overcome problems with instrument crowding. In addition, SIMPLE is suitable for all body types (fat or thin) because the wound protector can be rolled for all kinds of body sizes of patients.

Curved instruments were mainly required in left-side colon resection group due to the close proximity of working instruments with limited triangulation in the pelvic cavity. With the use of the 30-degree camera and familiarity of anatomic landmark, we

gradually overcome the difficulties. As the accumulation of our clinical experience, we have found the best result and least technical difficulty with straight instruments. However, development of a standardized technique and additional experience is needed for more consistent success. In this report, curved instruments were only required in 27.8% of the SILC cases and most of them were early cases, indicating an economic advantage over conventional procedures. In addition, most commercially available access devices are designed for laparoscopic cholecystectomies and appendectomies which require a smaller wound of around 2.5 cm, which contributes to instrument crowding. The wound size required for our device is typically 3-4 cm, which helps address the issue of crowding. Lastly, any type of trocar can be used with our device.

Including 23 cases of total colectomies, Geisler et al.²⁰ reported a study of 102 consecutive cases of SILC, which resulted an average operating time of 99 min, mean length of incision of 3.7 cm, and average estimated blood loss of 140 ml. Another report, also by Geisler et al.,²¹ demonstrated 5 patients receiving single-port laparoscopic total proctocolectomy with ileal pouch-anal anastomosis. Diagnoses included ulcerative colitis (n = 4) and familial adenomatous polyposis (n = 1). These cases reported a median age of 43 years, a median body mass index was 20.7 kg/m², a median operative time of 153 min and a median estimated blood loss of 100 ml. Baig et al.²² reported similarly 8 cases of total colectomies in 35 consecutive SILC with a mean age of 58 years and BMI of 23.9 kg/m². Besides, they concluded the Glove port technique facilitates procedural frequency and famil-

ilarity and proves economically favorable. Leblanc et al.²³ and van den Boezem et al.²⁴ also demonstrated their experience in SILS for total colectomy as a safe and feasible procedure. The results of our analysis confirmed prior reports in the literature of the safety and feasibility of SILC.

The short-term surgical results were also compared among different colon resection procedures for benign colon diseases in this study, which showed that single incision laparoscopic total colectomy was a safe procedure as well when compared to single-side colon resection with respect to the incision length, blood loss, incidence of postoperative stress ulcers, pain scores and length of hospital stay. There are 9 patients in the total colectomy group which included 4 cases of familial adenomatous polyposis, 3 cases of colonic inertia, 1 case of diverticulosis and 1 case of multiple colon polyps. We believe that the significant younger age of the patients in the total colectomy group is due to relative younger age distribution of the patients in familial adenomatous polyposis and colonic inertia. Furthermore, it is truly that there are significant longer duration of operation and length of bowel resection were found in the total colectomy group when compared to other colon resection procedures. However, our clinical outcome of the single incision laparoscopic total colectomy was consistent with other studies.²⁰⁻²⁴ Because of relative small size of the benign lesions, the incision wound need less extension while retrieving the specimen, which makes the wound smaller and achieves better cosmetic outcome than that of malignant lesions. Besides of cosmetic appearance,²⁵ the preservation of abdominal wall and limited incisional access are attractive in those patients with relative younger age undergoing total colectomy for familial adenomatous polyposis and colonic inertia, which awaits further investigation to strongly support our conclusion.

Conclusions

In conclusion, the results of this report provide further evidence of the feasibility of SILS for the treatment of benign colorectal diseases. Our simple

self-made access device, termed SIMPLE (Single Incision Multiple Port Laparoscopic colEctomy), demonstrated a safe and economic option of SILS for colorectal diseases. The study indicates that SILC performed with our self-made access device provides relatively safe clinical outcome to the patients with benign colon diseases even with total colectomy.

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病例分析

單一切口腹腔鏡大腸切除手術治療 良性大腸疾病

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目的 以一種自製簡單的裝置來進行單一切口多端孔腹腔鏡大腸切除手術並比較不同手術方式治療良性大腸疾病之短期結果。

方法 回溯性的收集自 2010 三月至 2011 十二月，於本院因良性大腸疾病接受以一種自製簡單的裝置來進行的單一切口腹腔鏡大腸切除手術之病例。全部的手術皆由同一位外科醫師執行，收集記錄其臨床資料並進行統計分析比較。

結果 總共 38 例病患，共計有男性 20 位及女性 18 位，其中包括 11 例右側大腸切除手術（平均年齡為 52.7 ± 16.6 歲）、18 例左側大腸切除手術（平均年齡為 60.2 ± 11.7 歲）及 9 例全大腸切除手術（平均年齡為 36.3 ± 17.9 歲）。各組在性別、身體質量指數、病灶大小、傷口長度及手術中失血量方面並無統計學上的顯著差異，然而在接受全大腸切除手術的這一組病患其手術時間較久、大腸切除的長度較長且年齡有較輕的趨勢。在接受左側大腸切除手術的這一組病患中，有 5 位病患（27.8%）於手術中使用了可彎曲的腹腔鏡器械。在術後疼痛指數及住院天數方面各組比較並無統計學上的顯著差異。

結論 我們提出之簡易自製的裝置，為臨床上進行單一切口腹腔鏡大腸切除手術提供了一項安全且經濟的方法。本篇研究的結果顯示，以此簡易自製的裝置進行單一切口腹腔鏡全大腸切除手術來治療良性大腸疾病，其臨床治療結果相對安全。

關鍵詞 大腸切除手術、單一切口腹腔鏡手術。