

Single-incision laparoscopic surgery for stricturing and penetrating Crohn's disease

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Abstract

Purpose Single-incision laparoscopic surgery (SILS) is a promising new technique that is potentially applicable to Crohn's disease (CD). However, there is no consensus on the application of SILS for penetrating CD due to its complex pathology.

Methods We investigated the feasibility of SILS in 24 CD patients (12 with stricturing and 12 with penetrating CD) and compared the results between the two groups.

Results There were 17 males and seven females [median age at the time of surgery, 41 (range 20–61) years old] included in the study. Sixteen patients underwent primary surgery, while eight received repeat surgery. Twenty patients had small bowel CD and four patients had ileocolonic CD. The indication for surgery was a fistula/abscess in 12 patients, stenosis in 10 and other indications in two cases. The total length of the operation and blood loss was 171 min (113–221 min) and 230 mL (30–400 mL) in the penetrating CD cases, and 149 min (111–186 min) and 90 mL (20–400 mL) in the stricturing CD cases. There were no significant differences in the length of the operation between the two groups, but the blood loss was significantly greater in the cases of penetrating CD. Conversion to open surgery was required in one patient with penetrating CD. Postoperative complications developed in one patient with stricturing CD.

Conclusion SILS could be performed safely not only in patients with stricturing CD, but also in those with penetrating CD.

Keywords Single-incision laparoscopic surgery · Stricturing Crohn's disease · Penetrating Crohn's disease

Introduction

With the recent development of surgical devices and innovations in surgical techniques, laparoscopic surgery is now being increasingly applied in the field of colorectal surgery. Single-incision laparoscopic surgery (SILS) involving a single umbilical incision is a new laparoscopic procedure which has received attention because of its potential to reduce abdominal wall trauma, decrease postoperative pain and improve the cosmetic results of appendectomy, cholecystectomy and colectomy for early colorectal cancer [1, 2].

Studies have indicated that laparoscopic surgery for ileocecal stenosis due to small bowel or ileocolonic Crohn's disease (CD) is a feasible, safe and highly effective procedure that might allow a shorter postoperative hospital stay than open surgery, although these studies were conducted in well-selected patients [3–6]. On the other hand, laparoscopic surgery for penetrating CD has not been widely accepted, possibly because there have been few reports supporting its safety and feasibility [7]. The procedures used in conventional laparoscopic surgery for stricturing CD were reported to be feasible by SILS [8, 9]; however, there have been few studies on the feasibility of SILS for all types of CD including the penetrating phenotype.

Therefore, in the present study, we investigated the feasibility of SILS for all types of CD, including the penetrating phenotype of this disease.

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Methods

Patients

Single-incision laparoscopic surgery was initiated for early colorectal cancer at our institution in May 2009 [10] and was introduced for the treatment of CD in August 2009. The indications for SILS followed those of conventional laparoscopic surgery for CD that had been applied until August 2009. The candidates for SILS were all patients with stricturing or penetrating CD undergoing primary or repeat operations. Patients were excluded if they needed an extensive surgical procedure with multiple organ resections based on the preoperative diagnosis or if they required extensive colectomy, which was usually performed using a hand-assisted laparoscopic technique [11]. The subjects were 24 consecutive patients who met the above inclusion criteria and underwent SILS at our institution.

Surgical technique

Through a small incision in the umbilicus, a camera port and two manipulation ports were inserted to perform intra-abdominal procedures using the glove technique or a device designed specifically for SILS (EZ Access System™, Hakko Medical, Nagano, Japan) (Fig. 1). The diseased intestine was dissected and mobilized laparoscopically in the peritoneal cavity. We performed procedures for the intestine, including surveillance for bowel lesions, resection, anastomosis and strictureplasty, outside the body. An information drain was inserted through a site other than the small incision in the umbilicus. The insertion of one additional port at the planned drain insertion site was permitted, as required based on the intraoperative findings. Conversion to open surgery was defined as an unplanned abdominal

incision to perform the dissection and mobilization of the diseased intestine. In two patients who underwent ileostomy closure, an end ileostomy had been constructed for anastomotic leakage in the previous operation. We used the ileostomy site for access to the peritoneal cavity, and mobilized the right colon laparoscopically for re-anastomosis.

Assessments

Data including the patient characteristics [age, gender, body mass index (BMI), the American Society of Anesthesiologists (ASA) physical status, primary/repeat surgery, age at diagnosis, disease duration, lesion location and surgical indications], surgical procedure, length of the operation, blood loss, conversion to open surgery and perioperative complications were extracted from the prospectively collected Surgical Database of Patients with CD, and these were retrospectively analyzed for the comparison between the patients with stricturing CD and those with penetrating CD.

Statistical analysis

All statistical analyses were performed using the JMP version 11.0 software program (SAS Institute, Cary, NC, USA). The protocol for this study was approved by the institutional review board of Osaka University Graduate School of Medicine.

Results

Patient characteristics

The subjects were 17 males and seven females. The median (range) age at surgery was 41 (20–61) years old, and the

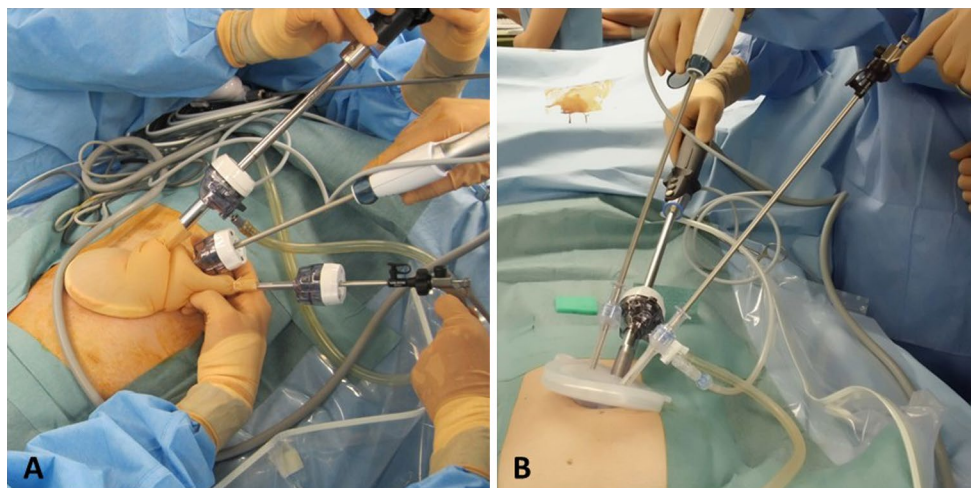


Fig. 1 The surgical technique. The transumbilical approach (**a** the glove technique, **b** using the EZ access system™)

median BMI was 18.1 (15.2–23.3). Sixteen patients underwent primary surgery and eight underwent a repeat operation. The ASA physical status was 1 in seven patients and 2 in 17 patients. The median (range) age at the time of the diagnosis of CD was 29 (14–44) years old, and the median (range) disease duration was 9.5 (0–30) years. The location of the CD lesions was the small bowel in 20 patients and the ileocolon in four patients. Twelve patients had stricturing CD and 12 had penetrating CD. Among the patients with penetrating CD, three had an ileo-ileal fistula, three had a retroperitoneal fistula, three had an entero-cutaneous fistula, two had an enterovesical fistula and one had an entero-ovarian (right) fistula. There were no significant differences in the age, gender, BMI, ASA physical status, the number of patients who underwent a primary or repeat operation, the age at the time of the diagnosis of CD, disease duration or the location of lesions between the patients with stricturing and penetrating CD (Table 1).

Feasibility

The surgical procedures were ileocecal resection (ileocelectomy) in 15 patients, ileal resection in 15, stricturoplasty in five and ileostomy closure in two (including

several overlapping cases). The median (range) length of the operation was 154 (111–221) min, and the median (range) blood loss was 127.5 (20–650) mL. The respective median (range) lengths of the operation and blood loss were 149 (111–186) min and 171 (113–221) min and 90 (20–400) mL and 230 (30–400) mL in those with stricturing and penetrating CD. There were no significant differences in the length of the operation between the two groups, but the blood loss was significantly greater in the patients with penetrating CD than in those with stricturing CD. Conversion to open surgery was required in one patient (8.3 %) with penetrating CD who had an ileo-cutaneous fistula (Table 2).

Safety

The postoperative complications encountered were anastomotic leakage and intraperitoneal hematoma, both of which developed in one patient (8.3 %) with stricturing CD on the fourth postoperative day and necessitated an emergency operation. The findings during the emergency operation revealed that the intraperitoneal hematoma was secondary to the anastomotic leakage, and no intraoperative injury

Table 1 The patient characteristics

	All cases (<i>n</i> = 24)	Stricturing (<i>n</i> = 12)	Penetrating (<i>n</i> = 12)
Age at operation (years)	41 (20–61)	41 (20–44)	40.5 (20–61)
Gender			
Male	17	8	9
Female	7	4	3
BMI (kg/m ²)	18.1 (15.2–23.3)	17.9 (16.0–23.2)	18.1 (15.2–23.3)
ASA physical status			
ASA1	7	3	4
ASA2	17	9	8
Operation			
Primary	16	6	10
Repeat	8	6	2
Age at diagnosis (years)	29 (14–44)	28.5 (14–39)	29 (16–44)
Duration of disease (years)	9.5 (0–30)	10 (0–17)	5.5 (0–30)
Location			
Small bowel	20	12	8
Ileocolon	4	0	4
Surgical indications			
Fistula/abscess	12	–	12
Stenosis	10	10	–
Ileostomy closure	2	2	–
Penetrated site			
Enteric	3	–	3
Retroperitoneum	3	–	3
Cutaneous	3	–	3
Vesicle	2	–	2
Ovary	1	–	1

Table 2 The feasibility and safety of single-incision laparoscopic surgery

	All cases (<i>n</i> = 24)	Strictureing (<i>n</i> = 12)	Penetrating (<i>n</i> = 12)
Surgical procedure			
Ileocecal resection/ileocollectomy	15	7	8
Ileal resection	15	9	4
Strictureplasty	5	4	1
Ileostomy closure	2	2	0
Length of operation (min)	154 (111–221)	149 (111–186)	171 (113–221)
Blood loss (ml)*	127.5 (20–650)	90 (20–400)	230 (30–650)
Laparotomy incision (cm)	4.0 (3.5–9.5)	4.0 (3.5–6.0)	4.5 (4.0–9.5)
Conversion to conventional laparoscopic surgery	0 (0 %)	0 (0 %)	0 (0 %)
Conversion to open surgery	1 (4.2 %)	0 (0 %)	1 (8.3 %)
Complications	1 (4.2 %)	1 (8.3 %)	0 (0 %)
Anastomotic leakage	1 (4.2 %)	1 (8.3 %)	0 (0 %)
Intraperitoneal hematoma	1 (4.2 %)	1 (8.3 %)	0 (0 %)

* $p < 0.05$

or other complication due to the initial surgery was noted. None of our patients developed a surgical site infection (SSI) at the umbilical incision (Table 2).

Discussion

The present study demonstrated that SILS is feasible and safe in patients with penetrating CD, as well as those with stricturing CD. In recent years, studies on colorectal cancer surgery have demonstrated the non-inferiority of laparoscopic surgery compared with conventional open surgery in terms of the short-term minimal invasiveness and long-term oncological outcomes [12]. Therefore, laparoscopic surgery is currently regarded as a standard procedure for both advanced and early colorectal cancer [13]. The safety and feasibility of laparoscopic surgery for CD have been reported based on several controlled studies comparing it with open surgery and on meta-analyses that included randomized controlled trials. In terms of the feasibility of laparoscopic surgery for CD, many of these studies reported that the length of the operation was relatively longer compared to that of open surgery, and the reported differences ranged from reductions of 23 min to prolongation of up to 80 min. Most of these studies found that the blood loss during laparoscopic surgery did not differ from that during open surgery. In addition, the conversion rate to open surgery was reported to be approximately 10 % (0–29 %), and the incidence of postoperative complications was approximately 15 % (0–28 %), suggesting that there was little or no difference in these parameters compared with open surgery [4–6, 14].

However, it should be noted that the patients in the laparoscopic surgery groups may have been subject to selection

bias, because most of the studies included in the meta-analyses were not randomized controlled trials. Studies focusing on long-term outcomes showed that laparoscopic surgery is associated with a lower incidence of postoperative relapse and repeat surgery [5, 15]. Some investigations have found that laparoscopic surgery is feasible for both penetrating CD and repeat surgery [16–18]. However, these results have not been validated. At present, laparoscopic surgery is a standard procedure for colorectal cancer, while there is considerable variation in the indications for laparoscopic surgery as a treatment for CD among surgeons and institutions because of the complex pathology of CD. Moreover, delayed conversion to open surgery was reportedly associated with an increased incidence of postoperative complications [19] and a potential risk for CD recurrence [20].

Taking the past results together, it is clear that it is difficult to establish standardized indications for laparoscopic surgery for CD. However, in well-selected patients, the length of hospital stay after laparoscopic surgery was reported to be significantly shorter, by approximately 2.5 (0.3–6) days, than that after open surgery. Thus, laparoscopic surgery would offer major benefits to patients if it can be completed safely.

Most studies on laparoscopic surgery for CD were conducted from 1990 to the early 2000s, and the inclusion criteria were variable. In addition, the recent advent and extended application of new medical therapies, such as biological agents, has provided early control of inflammation, thereby making the lesions, which would previously have extended to surround the diseased intestine due to uncontrolled inflammation, relatively limited [21, 22]. For example, in times before the advent of the newer medical therapies there had been no effective treatment options

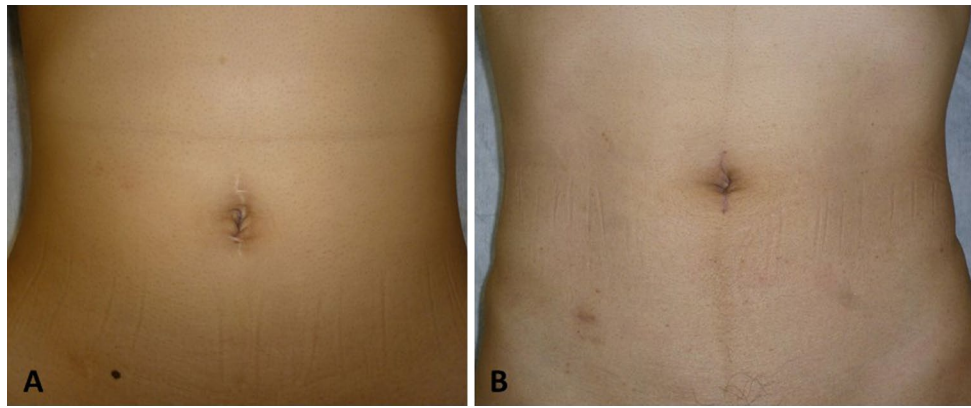


Fig. 2 The postoperative scar after transumbilical single-incision laparoscopic surgery. Only a tiny postoperative scar was noted at the umbilical region. Representative cases are shown in **a** a 20-year-old

female with stricturing Crohn's disease and **b** a 61-year-old male with penetrating Crohn's disease

other than total parenteral nutrition for bowel rest, some patients with insufficient control of inflammation would have needed subacute surgery. However, such patients may experience sufficient control of inflammation by biological agents to prevent the development of a complex fistula or may even achieve temporary fistula closure. Further advances in these medical therapies may influence the feasibility of laparoscopic surgery for CD and change the indications.

In 2009, SILS, which was anticipated to become a new laparoscopic procedure in the field of colorectal surgery, was introduced for the treatment of CD at our institution. The indications for SILS followed those for the conventional laparoscopic surgery applied for the disease. In total, 24 consecutive patients were included in the present study. SILS for CD through a small umbilical incision has advantages over conventional laparoscopic surgery in terms of providing a safe approach into the peritoneal cavity, even in patients with adhesions, and allowing detailed surveillance for small bowel lesions before mobilizing the intestine. A short (2.5–3 cm) incision at the umbilicus was initially used as in colorectal cancer surgery. However, based on the experiences with several of our earliest cases, we determined the median length of the incision necessary for safe extraction of the thickened diseased intestine with CD involvement from the peritoneal cavity to be 4 cm (3.5 cm at a minimum). This incision length insured reliable bowel lesion surveillance and was found to be useful for resecting small bowel lesions. Thus, a 3.5–5 cm incision has since been used in individual patients with reference to the findings of preoperative imaging studies, such as computed tomography (Fig. 2).

This median length of 4.0 cm is relatively long compared to that used in routine SILS for cholecystectomy or early colorectal cancer, and the scar partially extends

beyond the umbilicus. However, 4 cm is shorter than the incisions reported in our studies of conventional laparoscopic surgery for CD [23]. SILS within only an intra-umbilical scar might be more technically difficult than conventional laparoscopic surgery because of the interference among the ports. However, SILS through a 3.5–5 cm skin incision, taking the extraction of the CD specimen into consideration, appears to be applicable in required procedures, similar to conventional laparoscopic surgery. None of the patients in our series required conversion to conventional laparoscopic surgery. One patient with an enterocutaneous fistula required conversion to open surgery. The conversion to open surgery was performed because it was intraoperatively judged to be difficult to complete the procedures even if it has been converted to conventional laparoscopic surgery. None of the patients in our series developed an SSI. This might be attributable to the fact that the skin incisions were small and limited to the umbilicus. Studies in further case series will be necessary to evaluate whether SILS is truly associated with these advantages.

However, the application of SILS still requires careful consideration based on the accumulation of experience with CD patients, and topics for consideration include the length of the small incision and the decision whether conversion to open surgery is necessary. Thus, at present, it is reasonable that laparoscopic surgery for CD, including SILS, should be indicated only for limited ileocecal stricturing lesions in a non-specialized setting, as recommended in the guidelines [24]. However, SILS is a potentially feasible procedure that appears to provide a short-term, minimally invasive benefit even in patients with penetrating CD if it is performed at an institution with sufficient experience, where the necessity of conversion to open surgery can be appropriately determined.

Conclusion

Single-incision laparoscopic surgery could be performed safely not only in patients with stricturing CD, but also in those with penetrating CD.

Conflict of interest The authors have no conflicts of interest to declare.

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