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Original Article

Single-incision laparoscopic versus laparoscopy-assisted subtotal gastrectomy for peptic ulcers: a retrospective comparative study

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Abstract: Background/Aims: The application of single-incision laparoscopic surgery (SILS) for peptic ulcer remains controversial. The aim of this study was to compare clinical outcomes and postoperative parameters of transumbilical single-incision laparoscopic subtotal gastrectomy (SILSG) versus laparoscopy-assisted subtotal gastrectomy (LASG) for benign peptic ulcer. Methods: Data from 31 patients who underwent laparoscopic subtotal gastrectomy for benign peptic ulcers between January 2008 and May 2014 at Shengjing Hospital was collected retrospectively. Among them, 13 underwent SILSG and 18 underwent LASG. Demographic, intraoperative, and postoperative data were analyzed and compared between the two groups. Results: The mean operation time was significantly longer in the SILSG group than in the LASG group (285.8±45.5 vs. 224.7±49.1 min, respectively; P=0.001). However, the postoperative hospital stay was significantly shorter (7.9±0.9 vs. 9.3±2.0 days, respectively; P=0.029), and the mean total PSAS score was significantly lower (3.9±0.9 vs. 4.9±1.1, respectively; P=0.013) in the SILSG group than in the LASG group. There were no significant differences between the two groups with respect to other variables. Conclusion: Compared to LASG, SILSG is a technically feasible procedure with better cosmesis and equivalent curability. Prospective randomized trials with long-term follow-up are needed to evaluate definitive clinical and aesthetic advantages of this technique.

Keywords: Single-incision laparoscopic surgery, subtotal gastrectomy, peptic ulcer, complication

Introduction

Studies that continue to show benefits of laparoscopic surgery herald a trend toward less invasive procedures and surgery free from scars. Single-incision laparoscopic surgery (SILS) is an example of this technique and has gained wide acceptance among laparoscopic surgeons. It is a relatively new procedure that has been applied in various types of surgery, including appendectomy, cholecystectomy, colectomy, and nephrectomy [1-4]. Despite current controversy, studies have demonstrated prominent results that suggest that SILS may improve cosmesis and enhance advantages seen with traditional laparoscopic surgery.

To date, single-incision laparoscopic subtotal gastrectomy has only been described in a limited number of case reports and small case series [5, 6]. These procedures were technically successful, suggesting that the surgical approach is feasible. However, the exact feasibility and safety of this technique have not yet been elucidated, because most of these studies are case reports designed to introduce a new technique into practice. To the best of our knowledge, no comparison to laparoscopy-assisted subtotal gastrectomy has been made in the literature.

This study aims to evaluate the safety and feasibility of transumbilical single-incision laparoscopic subtotal gastrectomy (SILSG) with total intracorporeal gastrointestinal reconstruction for benign peptic ulcers. Additionally, the outcomes were analyzed retrospectively and compared with those of laparoscopy-assisted subtotal gastrectomy (LASG) to assess the potential benefits of SILSG.

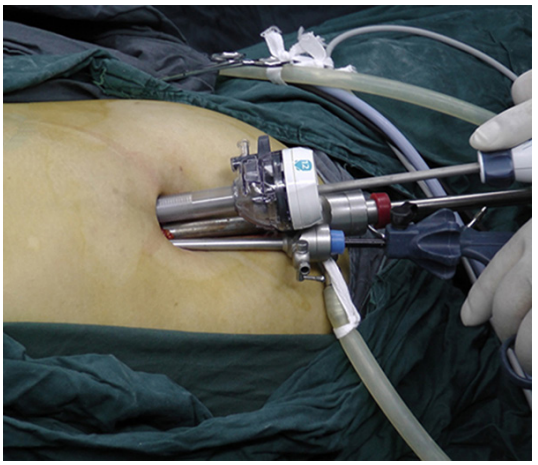

Figure 1. The transumbilical trocar arrangement.

Materials and methods

Patient selection and data collection

Between January 2008 and May 2014, a total of 33 patients underwent laparoscopic subtotal gastrectomy for benign peptic ulcers in the Department of General Surgery of Shengjing Hospital, Shenyang, China. Two patients were excluded from this study: one patient underwent emergent surgery, and one patient was lost to follow-up after discharge. As a result, 31 patients were included in the current study. These patients either had a previous history of upper gastrointestinal tract bleeding or developed stenosis. They all received proper medical treatment before surgery, but the ulcers failed to heal. The patients were divided into two groups (SILSG group or LASG group) according to the procedures attempted. The decision to perform the procedure as SILSG or LASG was made according to patient and surgeon discretion. The patients who were more concerned about cosmetic results were assigned to the SILSG group. All the patients were fully informed about the characteristics of the SILSG procedure and other surgical options. As a result, thirteen patients underwent SILSG; procedures of these patients were performed by a single surgeon. This was the operating surgeon's initial experience with SILSG. The rest of the procedures of patients who underwent LASG were performed by another surgeon from the same surgical group during the same study period. Both surgeons had performed more than 50 laparoscopic gastrectomies before the study period. Informed consent was obtained from all patients.

Patient characteristics and intraoperative and postoperative data were analyzed retrospectively and compared between the two groups. All the diagnoses were confirmed by preoperative endoscopy and postoperative pathologic examination. Ulcer size was determined according to the final pathology report from each surgical specimen. Operation time was defined as the interval between initial skin incision and closure of all trocar sites. Blood loss was defined as the amount of blood collected from the abdomen by suction throughout surgery. Conversion was defined as a failure to perform the procedure as preoperatively scheduled. Postoperative analgesia consisted of intravenous administration of the COX-2 inhibitor Parecoxib Na, 40 mg on the day of operation and 20 mg on the first postoperative day. Subjective pain was evaluated on postoperative day 1 by a 10-cm visual analog scale (VAS) score, which ranged from 0 (no pain) to 10 (extremely severe pain). Postoperative hospital stay was defined as the number of days in the hospital between first postoperative day and the day of discharge. The complications were categorized according to the Clavien-Dindo classification [7], which grades complications on the basis of the intervention required to correct them. All patients had a follow up visit at 3 months after discharge and were asked to fill out the Patient Scar Assessment Scale (PSAS) questionnaire as adopted by Draaijers et al. [8]. The PSAS consists of five questions that are rated on a scale from 1 (best response) to 10 (worst response). The questions address different aspects of the scar, including color, stiffness, thickness, irregularity, and overall impression. The mean total PSAS score represents the patients' overall satisfaction with the cosmetic results. This study was approved by the Institutional Review Board of Shengjing Hospital of China Medical University.

Surgical procedure

Transumbilical single-incision laparoscopic subtotal gastrectomy: Under general anesthesia, patients were placed supine with legs apart; the monitor was above the left shoulder of the patient. The operating surgeon stood between the patient's two legs, while the camera holder stood on the right side of the patient.

Table 1. Characteristics of patients who underwent SILSG and LASG

	SILSG Group (n=13)	LASG Group (n=18)	*P* value
Gender [n (%)]			0.403
Male	8 (62)	13 (72)	
Female	5 (38)	5 (28)	
Diagnosis [n (%)]			0.552
Gastric ulcer	10 (77)	13 (72)	
Duodenal ulcer	3 (23)	5 (28)	
Age (years)			
Mean ± SD	60.3±8.9	54.5±11.5	0.139
Median (range)	61 (42-73)	55 (28-70)	
BMI (kg/m^2)			
Mean ± SD	21.7±3.1	21.9±1.9	0.818
Median (range)	20.9 (17.0-26.8)	21.6 (19.0-25.4)	
Ulcer size (cm)			
Mean ± SD	1.6±0.9	1.6±0.7	0.856
Median (range)	1.5 (0.5-3.5)	1.7 (0.3-3.0)	

A carbon dioxide pneumoperitoneum was created using the closed method with a veress needle. A 3-cm vertical transumbilical incision was made for trocar access. Conventional trocars, including a 5-mm and a 10-mm standard trocar and an unbladed trocar, were used (Xcel B12LT; Ethicon Endo-Surgery, Inc., US). All three trocars were introduced through the same incision at different fascial sites. A 30° 10-mm rigid laparoscope (Stryker Endoscopy, US) was used for visualization (**Figure 1**).

Following a routine exploration of the abdomen, the diaphragmatic surface of the left lateral hepatic lobe was sprayed with tissue glue (cyanoacrylate glue, CA glue) and attached to the diaphragm. The glue suspended the liver in order to achieve a better and clear view of the lesser curvature. The gastrocolic ligament was dissected using a harmonic scalpel toward the lower pole of the spleen. Division then continued to the right side of gastrocolic ligament until the duodenal ampulla, and the right gastroepiploic vessels were divided between the clips. The adhesions to the posterior gastric walls were severed. The gastrohepatic ligament was opened, and the right gastric vessels divided and double clipped at this root. The left gastric artery and vein were then exposed and severed from the root. For intracorporeal gastrojejunostomy, the duodenum was transected 2 cm distal to the pyloric ring using an endoscopic stapler (Echelon 60 3.5 mm, Ethicon Endo-Surgery, USA). A proximal loop of the jejunum was located and brought upside across the transverse colon in a postcolonic way. Then the posterior wall of the stomach and the anti-mesenteric side of the jejunum were aligned together using endoscopic stapler. The common incision was closed by running suture with a 3/0 absorbable suture. The stomach was transected at least 1 cm distal to the lesion by endoscopic staplers.

The specimen was then transported outside from the peritoneal cavity using a specimen bag. A single soft drainage tube was placed beside the duodenal stump and came to outside through the umbilical incision. The umbilical incision was suture closed in 2 layers, and the operation was thus completed.

Standard laparoscopy-assisted subtotal gastrectomy: Five trocars were used for the LASG procedure. After the stomach was mobilized laparoscopically, a small 4-cm open upper midline abdominal incision was created, and gastrointestinal reconstruction was completed.

Statistical analysis

The results of patients who underwent SILSG and LASG were compared. Continuous data is presented as the mean ± standard deviation, median, and range. Categorical variables are expressed as numbers and percentages for the group from which they were derived. The unpaired-sample Student t test and Mann-Whitney U test were used for comparison of continuous variables. The Chi-square test was used for comparison of categorical variables. Results were considered statistically significant for $P<0.05$. All statistical analyses were performed using SPSS 18.0 for Windows (SPSS Inc, Chicago, IL).

Results

Patient characteristics are listed in **Table 1**. There were no significant differences between the two groups with respect to age, gender, body mass index (BMI), ulcer type, and size. **Table 2** shows the operative findings, postoperative course, and morbidity after these oper-

Table 2. Operative outcomes between SILSG and LASG

	SILSG Group (n=13)	LASG Group (n=18)	*P* value
Operation time (min)			
Mean ± SD	285.8±45.5	224.7±49.1	0.001
Median (range)	280 (230-360)	225 (130-330)	
Blood loss (mL)			
Mean ± SD	176.9±69.6	144.4±101.3	0.327
Median (range)	200 (50-300)	125 (50-500)	
Conversion, n (%)			0.671
Standard LASG	1 (7.7)	0	
Open SG	0	1 (5.6)	
First flatus time (days)			
Mean ± SD	3.8±1.4	4.5±1.0	0.093
Median (range)	4 (1-6)	4 (3-7)	
VAS pain score			
Mean ± SD	4.8±1.5	5.2±1.4	0.384
Median (range)	5 (2-7)	5 (3-8)	
Mean total PSAS score (3 months after operation)			
Mean ± SD	3.9±0.9	4.9±1.1	0.013
Median (range)	3.6 (2.7-5.8)	4.7 (3.4-6.9)	
Postoperative hospital stay (days)			
Mean ± SD	7.9±0.9	9.3±2.0	0.029
Median (range)	8 (7-10)	10 (7-12)	
Postoperative complications, n (%)	1 (6.7)	2 (9.1)	0.624
Average follow-up period (months)			
Mean ± SD	8.8±3.8	10.7±5.3	0.288
Median (range)	8 (5-18)	9 (6-25)	

ations. Due to bleeding from the right gastric artery, one case was converted to LASG in the SILSG group. One patient in the LASG group was switched to open subtotal gastrectomy because of extensive intraperitoneal adhesion. The mean operation time was significantly longer in the SILSG group than in the LASG group (285.8±45.5 vs. 224.7±49.1 min, respectively; P=0.001). However, the postoperative hospital stay was significantly shorter (7.9±0.9 vs. 9.3± 2.0 days, respectively; P=0.029), and the mean total PSAS score was significantly lower (3.9± 0.9 vs. 4.9±1.1, respectively; P=0.013) in the SILSG group than in the LASG group.

No rescue analgesics were given in addition to the scheduled COX-2 inhibitor. There were no significant differences between the two groups with respect to other variables.

As for postoperative complications, there was 1 case of anastomotic bleeding in the SILSG group as well as 1 case of delayed gastric emptying and 1 case of stump leakage in the LASG group. The hemorrhage was self-limited and managed conservatively with blood transfusion, hemostatics, and intravenous proton pump inhibitor therapy (Clavien-Dindo classification grade II). The patient with delayed gastric emptying was cured with conservative therapy (Clavien-Dindo classification grade II). The stump leakage was minor and corrected by surgical intervention (Clavien-Dindo classification grade IIIb). No incisional hernia or recurrence of the disease has been noted in any case during the follow-up period.

Discussion

As experience with SILS, particularly in cholecystectomy and appendectomy, has substantially increased, some surgeons are interested in using the technique for more challenging procedures. In 2011, Lee et al. reported on their experience with single-port laparoscopic repair for 13 patients with perforated duodenal ulcers

[9]. One year later, Nonaka et al. performed the first single-incision laparoscopic-assisted subtotal gastrectomy with intracorporeal reconstruction for benign gastric ulcer. A 2-mm miniloop retractor was inserted through an extra incision in the right subcostal space to create the operative field [10]. As experience continues to accumulate, SILS subtotal gastrectomy with lymphadenectomy was also performed for patients with early gastric cancer [11, 12]. Despite the above successful experience, the application of SILS to such cases remains questionable because of the technical difficulty of adequate lymph node dissection and total intracorporeal gastrointestinal reconstruction. Scant data on the safety and feasibility of SILS subtotal gastrectomy is available.

The present retrospective study compared demographic, intraoperative, and postoperative data of patients who underwent SILSG and LASG. Though the number of study patients is small, the advantages of SILSG over LASG has been proven in this retrospective comparative study; it demonstrated that patients undergoing SILSG have a shorter postoperative hospital stay and better cosmetic result with equivalent curability.

Besides cosmesis, SILS is theoretically associated with reduced pain due to minimization of abdominal trauma. However, previous published studies have shown conflicting results in terms of postoperative pain with SILS when compared with conventional laparoscopic surgeries [13-15]. In the present study, no difference in the postoperative VAS pain score was observed between the two groups. This was beyond our expectation. Our previous experience showed that SILS cholecystectomy or appendectomy was associated with less postoperative pain when compared with conventional surgeries (unpublished data). The difference in VAS pain scores lessens with more complicated procedures, however. This trend might be explained by a relatively larger incision used for trocar access, a greater tension exerted on the tissue by surgical instruments, and an increased absorption of CO_2 attributable to longer operation time. Thus, the difference in pain score after SILS and conventional laparoscopic surgery may vary between procedures and should be interpreted with caution.

As for postoperative complications, some surgeons have begun to suspect that SILS may increase the risk of umbilical hernia since a more sizable umbilical incision is required. A prospective randomized comparative study by Marks et al. suggested that single-incision laparoscopic cholecystectomy is associated with improved cosmesis scores at the cost of significantly higher hernia rates [16]. However, some studies revealed that the hernia rate after SILS is acceptably low in the hands of experienced laparoscopic surgeons [17-19]. Taking the problem into consideration, special attention was given to the process of incisional closure, and none of our patients in the SILSG group developed incisional hernia. Though we did not restrict BMI in the selection criteria, the patients in both groups had a relatively low body mass index due to a long history of peptic ulcers; this may be another reason for the low incisional hernia rate.

This study has several limitations. First, the retrospective design may lead to an unintended selection bias of ulcers particularly suited for SILSG. A prospective randomized trial could more conclusively demonstrate any compatibility or superiority of the less invasive technique. Second, the conclusion of this comparative study is based on the outcomes provided by different surgeons, which does not allow for an exact evaluation. Finally, this study examined the results of experienced laparoscopic surgeons, and the outcomes may not be representative of those obtained by the general surgical population. Nevertheless, the study does demonstrate that the procedure can be safely performed by experienced laparoscopic surgeons.

Conclusion

The results of the present study suggest that SILSG is a technically feasible procedure with better cosmesis and equivalent curability compared to LASG. Prospective randomized trials with long-term follow-up are needed to evaluate definitive clinical and aesthetic advantages of this technique.

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Disclosure of conflict of interest

None.

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