Original Article

Single-incision laparoscopic distal gastrectomy for early gastric cancer

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Introduction

Laparoscopic gastrectomy for early gastric cancer has been widely adopted as an alternative treatment option and has been reported to be beneficial for patients, with better early postoperative outcomes and also with compatible long-term oncologic outcomes to open gastrectomy (1,2).

In the meanwhile, efforts are underway to reduce the minimal invasiveness of laparoscopy. Natural orifice transluminal endoscopic surgery (NOTES) and single incision laparoscopic surgery (SILS) is the representative of this effort. While NOTES is still on the research area because of the limitation of equipment and difficulty of closure of incised lumen, there have been explosive reports on single ports surgery in the various clinical surgical fields (3).

Single-incision laparoscopic surgery (SILS) has been introduced to reduce the abdomen wall incision and trauma and the embryonic scar of the umbilicus is easily accessed to the peritoneum without any visible scar. SILS procedures decrease postoperative pain and hospital stay and lead to faster postoperative recovery than conventional laparoscopy apart from better cosmetic aspects (4). Although long-term data are still lacking to prove the outcome SILS, the reported data of oncologic patients undergoing SILS provide the technical feasibility of a single port surgery (5).

However, the feasibility of single-incision laparoscopic distal gastrectomy (SIDG) for early gastric cancer comparing with laparoscopic distal gastrectomy (LDG) has not been demonstrated in the field of gastrectomy.

There have been only 3 reports describing this procedure for patients with early gastric cancer (EGC) (6-8). Furthermore, all of these reports use 1 or 2 additional assistant ports in SIDG (*Table 1*). The technical difficulty of this operation could be showed by a long operation time comparing with conventional LDG, although the number of retrieved lymph node was not less.

Herein, we present briefly our clinical experience of SIDG in Seoul National University Bundang Hospital.

Methods

Study design and data collection

Prospectively maintained database from patients who underwent laparoscopic distal gastrectomy (LDG) due to gastric cancer were reviewed. From October 2010 to January 2013, 30 consecutive patients underwent SIDG for early gastric cancer at Seoul National University Bundang Hospital in Korea. A 2 mm assistant port was used in the initial 10 cases of SIDG. Last 20 cases of SIDG were done without any assistant port (Pure SIDG).

All 30 operations except initial 7 cases of SIDG were done by a single surgeon who had experience of 100 cases of LDG before starting the single port surgery and more than 50 cases of conventional open gastrectomy. In this study, we included patients with a preoperative diagnosis of stage I (7^{th} edition AJCC), in whom no lymph node (LN) enlargement.

Surgical technique

Pure single-incision distal gastrectomy with D1+beta lymph node dissection

The patient was placed in a lithotomy position with reverse Trendelenburg. The operator and a scopist were positioned

Table 1 Summary of previous literatures on SIDG

Year	Authors	Patients	Operation methods	Surgical outcomes	Characteristics
July 2011	Omori *et al*.	7	2.5 cm incision Two 2 mm assistant ports	Operation time: 344 min EBL 25 mL The retrieved numbers of LN: 67 No serious morbidity	First report on SIDG No pure SIDG
Mar 2012	D.J. Park *et al*.	2	2.5 cm incision One 2 mm assistant port	Operation time: 275 min EBL 85 mL The retrieved numbers of LN: 32 No complications	Case report One assistant port
May 2012	Omori *et al*.	20	2.5 cm incision Two 2 mm assistant ports	No postoperative complications including leakage and stricture	Technical report on intracorporeal Billroth I anastomosis

SIDG, single-incision laparoscopic distal gastrectomy; EBL, estimated blood loss

between the patient's legs. A longitudinal 2.5-cm long transumbilical skin incision was made. A commercial 4-holes single port (Glove port; Nelis, Bucheon-si, Gyeonggi-do, Korea) was then placed in the umbilical incision, and the abdominal cavity was insufflated with carbon dioxide at a pressure of 13 mmHg. There was no additional assistant trocar. A 10-mm flexible high-definition scope (Endoeye flexible HD camera system; Olympus Medical Systems Corp., Tokyo, Japan) and a Harmonic Scalpel (Ethicon Endo-Surgery Inc., Cincinnati, OH) were used to visualize every corner of the operative field and facilitate dissection. We used the conventional laparoscopic grasper when operating in the greater curvature side and the curved instruments for single port surgery (Olympus Medical Systems Corp.) when operating in the lesser curvature side, including the suprapancreatic LND. Modified combined suture retraction of the falciform ligament and the left lobe of the liver was performed using 2-0 prolene on a straight needle and 5-mm hemoclips (6). Partial omentectomy was initiated distally approximately 3 to 4 cm away from the gastroepiploic arcade, which included the LN 4 d. To prevent omental infarction, the left gastroepiploic vessels were ligated distal to the omental branch. Then, the omentum was dissected and taken down from the mesocolon to the head of the pancreas and duodenum. The right gastroepiploic arcade was approached in a retrograde fashion. We first dissected the space between the duodenum and the basin including the right gastroepiploic vessels and LN station 6 and then detached these from the duodenum and distal stomach. Thus, we could easily dissect and divide the right gastroepiploic area without any significant bleeding. After dissecting LN 6, the right gastric artery and the proper hepatic artery were adequately exposed to dissect LNs 5 and 12a, and the operator exchanged the grasper for the prototype curved instruments. The right gastric artery was then divided at its origin. The duodenum was divided 2 cm distal to the pylorus using a laparoscopic linear stapler (Echelon 60 mm -3.5 and 4.5; Ethicon). LNs 8a and 9, located on the right side of the left gastric artery, were dissected along each artery. The left gastric vein and artery were exposed, individually clipped, and divided to allow dissection of LN 11p. However, we do not expose the portal vein and splenic vein for D2 lymph node dissection. LNs 1, including the vagus nerve, were dissected and the lesser curvature side was cleared up for transecting the stomach. After the transecting the stomach by linear staplers, the specimen was removed in a plastic bag from the single umbilical incision without any extension.

Uncut Roux-en Y Gastro-jejunostomy

For intracorporeal anastomosis, we used laparoscopic flexible linear stapler (Echelon flex 60-3.5 and 4.5; Ethicon Endo-Surgery Inc., Cincinnati, OH). To make an antiperistaltic gastro-jejunostomy, 2 small holes were made on the greater curvature side of the stomach and the jejunum 20 cm distal from Treitz ligament. After the formation of gastro-jejunostomy (G-Jstomy), we checked bleeding in the stapler line and lumen and the common opening was closed with a linear stapler. Next, side-to-side jejuno-jejunostomy (J-Jstomy), 25 cm below the G-Jstomy was performed in an intracorporeal fashion using 2 linear staplers. Finally, a linear stapler with no knife was applied

Table 2 Patient demographics and clinical characteristics

	SIDG (n=30)
Age	56.2±12.8
Sex (male:female)	23:7
BMI (kg/m^2)	23.4±3.7
Comorbidity	33.3% (n=10)
Previous abdominal operation history	16.7% (n=5)
ASA	
1	15
2	15

Table 3 Operative data

	SIDG (n=30)
Operation time (min)	175.5±46.6
Type of surgery	SIDG:pure SIDG =10:20
Laparoscopy or open conversion, n (%)	0
Lymph node dissection (D1+beta:D2)	28:2
Resectability (%)	
R0	100%
Other organ resected, n (%)	1 (3.3%)
Estimated blood loss (mL)	49.3±40.9
Reconstruction	BI:R-Y =10:20

in the afferent loop between the G-Jstomy and J-Jstomy in order to prevent bile reflux. The abdominal cavity was checked, 1 Jackson-Pratt (J-P) drainage tubes was placed through the umbilical wound around the subhepatic area, and the incision was closed.

Results

Patient demographics and clinical characteristics

The demographics of patients are described in *Table 2*. There were 23 males and 7 females in the SIDG group. The mean age of both groups was 56.2±12.8.

Operative data

All the surgeries, involving D1+beta or D2 lymphadenectomy without any laparoscopic or open conversion, were performed by a single surgeon and done in R0 status. The surgical parameters of the both group are shown in *Table 3*.

Table 4 Postoperative outcomes

	SIDG (n=30)
Postoperative hospital stays (days)	5.8±2.5
Time to first flatus	3.1±0.8
Time to first diet	3.6±1.0
Numbers of additional usage of parenteral analagesics	0.77±1.00
J-P drainage	
POD#1	105.6±90.5
POD#2	109.9±109.2
POD#3	13.8±149.3
Early complications	10.0% (n=3)
Late complications	0
Re-operation	0

The mean operation time was calculated from the start of the incision to the closure of the wound and was 175.5±46.6 in the SIDG group. The estimated blood loss was 49.3±40.9 in the SIDG group. There were initial 10 cases of SIDG with one 2 mm assistant port and 20 cases of pure SIDG without any assistant port in the SIDG group. No serious intraoperative events or complications were observed.

Postoperative outcomes

The postoperative outcomes were described in *Table 4*.

The overall early complication occurred in 3 patients (10.0%) in the SIDG group. The early complications included 1 case each of wound seroma, delayed gastric emptying and anastomotic stenosis. The wound complication was improved by conservative management. The delayed gastric emptying was improved by fasting for 5 days. A major complication, defined by a grade higher than Clavien-Dindo IIIa, was observed in 1 patient (3.3%), which was treated by temporary stent insertion.

Pathologic findings

The pathologic findings of this study are shown in *Table 5*. All the patients were diagnosed with EGC during the preoperative examinations. The number of retrieved lymph nodes was 46.9±12.2.

Operation time and learning curve

Figure 1 shows that the time taken for an operation

Table 5 Pathologic findings

	SIDG (n=30)
Size (cm)	2.49±1.88
Proximal resection margin (cm)	5.28±2.62
Distal resection margin (cm)	5.76±3.16
T-stage	
T1a	11
T1b	14
T2	3
T3	1
T4a	1
N-stage	
N0	24
N1	3
N2	1
N3a	2
Numbers of retrieved LN	46.9±12.2

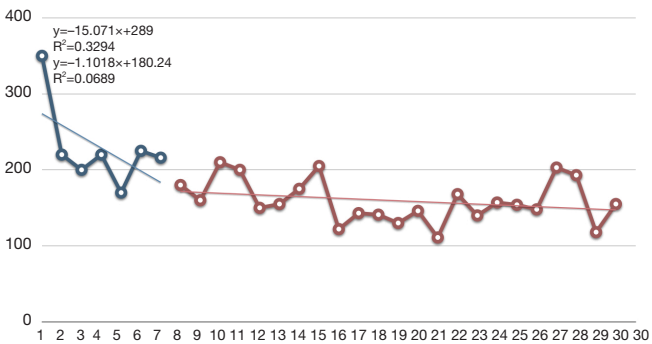

Figure 1 Operation time

gradually decreased in the SIDG group. To examine the learning process of SIDG, SIDG cases were divided into 3 groups based on the serial number of surgery (0-10, 11-20 and 21-30, respectively). The operation time in the 11-20 and 21-30 cases groups were significantly shorter than in the 0-10 cases group (P=0.007).

Conclusions

In this study, we evaluated the surgical outcomes of SIDG in 30 patients with EGC, which shows excellent postoperative outcomes. This procedure was found to have acceptable oncologic outcome, surgical time, and complications rates.

Thus, we conclude that SIDG is a likely acceptable treatment for EGC; furthermore, it is a feasible, safe, and useful method for reducing postoperative pain and facilitating cosmesis.

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