Laparoscopic Gastrectomy for Patients with a History of Upper Abdominal Surgery: Results of a Matched-pair Analysis

Shigeru Tsunoda, Hiroshi Okabe, Kazutaka Obama, Eiji Tanaka, Masatoshi Akagami, Yousuke Kinjo, Yoshiharu Sakai

Department of Surgery, Graduate School of Medicine, Kyoto University

54 Kawahara-cho, Shogoin, Sakyo-ku, Kyoto 606-8507, Japan

Telephone: +81-75-366-7595

FAX: +81-75-366-7642

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Corresponding Author: Hiroshi Okabe MD, PHD

Department of Surgery, Graduate School of Medicine, Kyoto University

54 Kawahara-cho, Shogoin, Sakyo-ku, Kyoto, 606-8507, Japan

E-mail address: hokabe@kuhp.kyoto-u.ac.jp

Telephone: +81-75-366-7595

FAX: +81-75-366-7642

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Abstract

Purpose

The safety and feasibility of laparoscopic gastrectomy (LG) for patients who have undergone previous upper abdominal surgery (PUAS) remain unclear. A matched-pair analysis was conducted to compare the short-term outcomes of LG between patients with gastric cancer who had undergone PUAS and those who had not.

Methods

A matched-pair analysis was performed to compare the short-term outcomes of LG between 22 patients who had undergone PUAS and 66 who had not (control group). To compare the outcome to that of open gastrectomy (OG) following PUAS, a total of 143 consecutive OG patients treated during the same study period were also reviewed.

Results

Cholecystectomy was the most common type of PUAS, followed by gastrectomy. There were no significant differences between the groups in terms of the length of the operation, blood loss, the number of retrieved lymph nodes or the rate of conversion to open surgery. The postoperative morbidity in the PUAS group (3/22, 13.6%) was comparable to that of the control group (7/66, 10.6%, p=0.6981). There was no mortality within 30 days in either group. When compared to OG following PUAS (n=23), LG was performed with significantly less blood loss with an equivalent postoperative outcome.

Conclusions

LG following PUAS is considered to be a safe and feasible surgical modality. PUAS should therefore not be regarded as a contraindication for LG.

Key words: Laparoscopic gastrectomy, previous surgery, gastric cancer

Introduction

Gastric cancer is one of the most common malignancies in the world, and it is especially common in East Asia [1]. Despite considerable progress in chemotherapy and radiotherapy, gastrectomy combined with adequate lymph node dissection remains the gold standard for resectable gastric cancer in East Asia [2], as well as in some Western countries [3]. The development of improved techniques for general laparoscopic surgery, coupled with refinements in instrumentation, has made laparoscopic gastrectomy (LG) an important treatment option in some specialized centers [4]. Recently, a prospective, moderate-sized randomized trial of LG for early gastric cancer reported the non-inferiority of LG to open gastrectomy (OG) [5]. Large retrospective studies have also shown acceptable oncologic outcomes [6-8].

As the popularity of laparoscopic surgery increases, many patients who have undergone previous upper abdominal surgery (PUAS) are considered candidates for LG. PUAS may be associated with difficulty in initial trocar placement and obtaining adequate exposure of the operating field. PUAS might also increase the risk of injuring organs adherent to the abdominal wall during trocar insertion, as well as adhesiolysis. The feasibility of LG in such patients thus remains unclear. A Japanese prospective phase II trial of LG for early gastric cancer (JCOG 0703) has recently reported the safety of LG in terms of the incidence of anastomotic leakage or pancreatic fistula formation [4]. However, the protocol of that trial excluded patients who had a history of open surgery. It is important to assess the feasibility of LG in such patients, although their relatively small (albeit increasing) number would preclude adequate-sized prospective clinical trials. We therefore conducted a matched-pair analysis to compare the short-term outcomes of LG between patients with gastric cancer who had undergone PUAS and those who had not. This study design was selected to minimize the effects of potential confounders, such as age, clinical TNM stage, surgical procedure and body mass index (BMI), while maintaining a reasonable sample size.

Methods

Between August 2005 and December 2010, a total of 281 consecutive patients who underwent LG for histologically proven adenocarcinoma of the stomach were reviewed from a prospective database, and clinical data were extracted for the analyses. From this cohort, a matched-pair analysis was conducted for all 22 patients who had undergone a PUAS (LG-PUAS). Each patient in the PUAS group was matched to three corresponding patients (control) from the remaining 259 patients with no history of upper abdominal surgery. The LG-PUAS group and control group were matched for age,

clinical stage, BMI and type of gastrectomy. Five types of gastrectomy (distal gastrectomy, pylorus-preserving gastrectomy, total gastrectomy, proximal gastrectomy and completion gastrectomy for remnant gastric cancer) were performed. To simplify the analysis, patients who had undergone pylorus-preserving gastrectomy were combined with those who had undergone distal gastrectomy, and the patients who had undergone proximal gastrectomy or completion gastrectomy were combined with those who had undergone total gastrectomy on the basis of the area of the operation (i.e., whether the esophagus was divided or not). No patient in this cohort had undergone wedge resection with either minimal or no lymphadenectomy. To compare the outcomes to those of OG for patients with a history of PUAS (OG-PUAS), a total of 143 consecutive patients treated by OG during the same period was also reviewed.

The clinical stage was classified according to the TNM classification [9]. Upper abdominal surgery was defined as any open abdominal operation in which the upper edge of the incision was located as high as the midpoint between the xiphoid process and umbilicus or higher. Upper abdominal surgery included laparoscopic procedures that involved any intra-abdominal organ higher than the umbilicus (i.e., esophagus, stomach, duodenum, hepato-biliary-pancreatic system, spleen, small bowel, ascending to descending colon, kidney and adrenal gland). Appendectomy was not included as an upper abdominal surgery.

Before April 2009, LG was performed in patients with T3(SS)N0 or earlier disease. Subsequently, the indication range of LG was extended to patients with more advanced diseases. As for PUAS, our indications for LG were gradually extended in accordance with the characteristics of individual patients. At present, patients who have undergone PUAS two or more times and those who have undergone major procedures, such as liver transplantation and coronary bypass grafting using the gastroepiploic artery, proceed to OG. All procedures were performed by board certified surgeons from the Japan Surgical Society and were controlled by surgeons accredited by the Endoscopic Surgical Skill Qualification System from the Japan Society for Endoscopic Surgery [10] or equivalent surgeons. Our surgical procedure for LG has been described previously [11]. Briefly, the patient is placed in a modified lithotomy position in a reverse Trendelenburg fashion. The first port is inserted transumbilically by the open method. This can be done relatively easily even in patients who have had previous laparotomy, because the previous midline incisions usually did not involve the umbilicus, keeping the underlying region free from adhesion. Then, the abdominal cavity is examined to find adequate space for working ports. If there is not enough space for safe port insertion, the transumbilical incision can be elongated to permit specimen extraction, and adhesiolysis is performed under direct

vision. Once a camera port and one or two working ports are inserted, adhesiolysis can be performed after the creation of a pneumoperitoneum, which elevates the abdominal wall to provide a better dissection plane on laparoscopy. After a carbon dioxide pneumoperitoneum was created at 8 mm Hg, four operating ports and a Nathanson liver retractor (Cook Japan, Tokyo, Japan) were placed. Lymph node dissection was carried out using ultrasonically activated coagulating shears (SonoSurg®; Olympus, Tokyo, Japan), and the stomach was resected using an endoscopic linear stapler. Intracorporeal reconstruction was then carried out by either the Billroth-I [12] or Roux-en-Y method [13]. Radical lymphadenectomy, which was defined as D2 or D1+ lymph node dissection, was performed in both groups [11,14]. The extent of lymphadenectomy was in accordance with the Japanese Gastric Cancer Treatment Guidelines 2010 (ver. 3) [15] and the Japanese Classification of Gastric Carcinoma (3rd English edition) [16]. Postoperative complications, such as pneumonia, pleural effusion, atelectasis, cardiac events (myocardial infarction, heart failure and arrhythmias), anastomotic leakage, anastomotic stenosis, small bowel obstruction, diarrhea and wound infection, were defined as grade 2 or higher adverse events according to the National Cancer Institute Common Terminology Criteria for Adverse Events (NCI-CTCAE), version 4.0, that occurred within 30 days after the operation.

The statistical analysis was performed using the JMP 9 software program (SAS institute, Cary, NC, USA). The chi-square test was used to compare categorical datasets, and the unpaired t-test was used to compare the age and BMI of patients. Nonparametric datasets for variables such as the intraoperative blood loss, length of the operation, postoperative hospital stay and number of retrieved lymph nodes were compared using the Wilcoxon signed-rank test. P values < 0.05 were considered to indicate statistical significance.

Results

Patient characteristics

The demographic characteristics of the 22 patients who had undergone PUAS (LG-PUAS) are shown in Table 1. All 22 patients had undergone PUAS one time. The clinical characteristics of the LG-PUAS group (n=22) and the control group (n=66) are shown in Table 2. The two groups were well matched, and there were no statistically significant differences between the groups in terms of the age, sex, BMI, clinical TNM stage, type of gastrectomy or the extent of lymphadenectomy.

Surgical outcomes

The short-term surgical outcomes are shown in Table 3. The intraoperative factors were similar between the two groups. There was one open conversion in each group. One patient (4.5%) in the LG-PUAS group who had previously received a laparoscopic right hemicolectomy was converted to open surgery because of a spleen laceration during laparoscopic total gastrectomy, which was considered to be unrelated to the previous surgery, while bleeding from the splenic vein caused open conversion during laparoscopic distal gastrectomy in a patient in the control group. There were no cases that needed true additional port insertion that required an additional incision. However, one case following open right hemicolectomy (case #22) required 12 mm port insertion in advance of the insertion of the subxiphoid Nathanson retractor. In that case, after the adhesiolysis of the abdominal wall was finished, the subxiphoid port was changed to a Nathanson retractor. There were no differences between the groups in the proportion of patients who were intraoperatively converted to open surgery (4.5% vs 1.5%, P = 0.4088), the intraoperative blood loss (60 g vs 90 g, P = 0.5119), the length of the operation (322 min vs 316 min, P = 0.6299) or the number of retrieved lymph nodes (42 vs 40, P = 0.3855). The postoperative morbidity (13.6% vs 10.6%, P = 0.6981) and mortality (0% vs 0%) were also similar. The postoperative complications (≥Grade 2) are summarized in Table 3. Small bowel obstruction did not occur in this study cohort, and PUAS was not associated with any specific complication. The median postoperative hospital stay was also similar in both groups (13.5 days vs 13.0 days, P = 0.8088).

Comparison to OG

During the same study period, 23 OG for patients with a history of PUAS (OG-PUAS) were performed. Of these 23 patients, 22 patients had undergone PUAS one time and one patient had undergone PUAS twice (distal gastrectomy and cholecystectomy). The demographic characteristics of the 23 patients are summarized in Table 4. Due to the extension of our indications for LG, 21 (91%) out of 23 OG-PUAS procedures were performed before April 2009, when LG was indicated for more advanced disease. Thus, significantly more cases of advanced disease were treated by open surgery in the earlier period. When compared to OG-PUAS, LG-PUAS was associated with significantly less blood loss and an equivalent postoperative outcome (Table 4).

Discussion

To our knowledge, this is the first comparative study to assess the feasibility of LG in patients who had undergone PUAS. Since only one case series investigating the feasibility of laparoscopy-assisted gastrectomy after open upper abdominal surgery has been reported [17], we believe that our results provide new evidence supporting the safety of LG in patients who have undergone PUAS.

In the early laparoscopic era [18], previous abdominal surgery was considered to be a contraindication for laparoscopic surgery, but it is no longer regarded to be an “absolute contraindication”. In fact, laparoscopic colorectal surgery, which is more widely performed throughout the world than LG, has been reported to be a safe and oncologically reliable procedure, despite a slightly higher [19,20] or similar [21] conversion rate in patients who have undergone PUAS. Our results demonstrate that LG is non-inferior to open surgery in terms of both safety and adequate lymph node retrieval in patients who have undergone PUAS. The number of harvested lymph nodes (42 in the PUAS group) was considerably higher than that reported previously (32.8 in patients who underwent open upper abdominal surgery in an earlier study) [17]. Our findings suggest that LG can be performed without any drawback, even in patients who have undergone PUAS.

Technically, the hardest part of LG after PUAS was insertion of the first three trocars. However, transumbilical insertion of the first trocar by the open method is relatively easy, because the previous midline incisions usually do not involve the umbilicus. Then, the abdominal cavity can be examined to find adequate space for working ports. If there is not enough space for safe port insertion, the transumbilical incision can be elongated to permit specimen extraction, and adhesiolysis is performed under direct vision. Once a camera port and one or two working ports are inserted, adhesiolysis can be performed after the creation of a pneumoperitoneum, which elevates the abdominal wall to provide a better dissection plane on laparoscopy.

Laparoscopic PUAS may cause less adhesion compared to open PUAS, and the initial placement of the trocars is sometimes easier in the laparoscopic PUAS group than in the open PUAS group. However, the difficulty of LG after PUAS also depends on the degree of the adhesions in the previously targeted area. Therefore, both laparoscopic and open PUAS were included in this analysis. Indeed, previous gastrectomy usually causes considerable adhesion around the previous anastomosis and suture line at the lesser curvature, but the difficulty of adhesiolysis depends not on the type of PUAS, but on degree of adhesion in individual cases. In our study, laparoscopic proximal

gastrectomy after distal pancreatectomy (case #8) took more time with more intraoperative blood loss than the average operation time and intraoperative blood loss of the four cases of laparoscopic completion gastrectomy (data not shown). Hence, completion gastrectomy was also included in this analysis.

Our study had several important limitations. First, it was retrospective, and we cannot rule out potential selection bias in the matched-pair analysis. Our indications for LG were gradually extended during the study period in parallel to the refinement of our laparoscopic technique. Therefore, in the early part of the study, relatively "straightforward" cases underwent LG, whereas more "complicated" cases were included in the latter part. Thus, "not-yet-improved" LG in the earlier period might have offset the potential drawbacks in more challenging cases in the later period. However, our results regarding the postoperative morbidity, length of the operation and lymph node yield were not at all inferior to those of previous studies [5,17], especially considering that 50% of the patients underwent total gastrectomy. With regard to the oncological feasibility, long-term outcomes are not yet available. However, given that the number of retrieved lymph nodes is a surrogate marker of oncological surgical quality [22], LG appears to be an oncologically feasible procedure after PUAS. In the patients who had undergone PUAS, we did not have access to information on the specific indications for LG. Whether LG is indicated in individual patients should be based on the results of physical examinations, clinical history, findings at previous operation(s) and the capabilities of the surgeons.

In conclusion, the safety and feasibility of LG in patients who had previously undergone PUAS were similar to those in patients without a history of upper abdominal surgery. Therefore, PUAS should not be regarded as a contraindication for LG.

Conflict of interest statement

None of the authors have any biomedical financial interest or potential conflicts of interest to declare.

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Table 1. Demographics of patients who had undergone previous upper abdominal surgery

Case	Age	Sex	Previous upper abdominal surgery (PUAS)	BMI	cStage	Type of LG	Lymphadenectomy
1	56	M	cholecystectomy	22.0	IA	DG	D2
2	69	M	laparoscopic cholecystectomy	29.4	IA	DG	D1+
3	80	M	laparoscopic right hemicolectomy	20.5	IA	TG	D1+
4	68	M	PPG	20.7	IA	CG	D2
5	74	F	laparoscopic gastrojejunostomy	17.7	IIIA	DG	D2
6	65	F	partial gastrectomy	20.2	IA	PPG	D1+
7	77	M	laparoscopic right hemicolectomy	19.0	IA	TG	D1+
8	63	F	distal pancreatectomy	18.3	IA	PG	D1+
9	74	M	DG (Billroth-II)	18.4	IA	CG	D1+
10	82	F	transabdominal left nephrectomy	24.0	IB	TG	D1+
11	59	F	laparoscopic cholecystectomy	20.4	IA	DG	D1+
12	54	M	DG (Billroth-II) + cholecystectomy	17.2	IA	CG	D1+
13	74	F	ileocecal resection	21.3	IA	DG	D2
14	67	M	cholecystectomy	25.4	IA	PG	D1+
15	77	M	partial hepatectomy (segment 8) + cholecystectomy	23.6	IB	TG	D1+
16	50	M	laparoscopic gastrojejunostomy	25.9	IIB	DG	D2
17	64	F	radical hysterectomy + para-aortic node dissection	18.6	IA	DG	D1+
18	58	M	DG (Billroth-II)	18.9	IB	CG	D1+
19	72	M	laparoscopic cholecystectomy	25.3	IA	DG	D1+
20	72	M	cholecystectomy	23.0	IA	DG	D1+
21	73	M	aortofemoral bypass	24.6	IA	PG	D1+
22	72	M	right hemicolecomy	20.0	IA	DG	D1+

Abbreviations; DG: Distal gastrectomy, TG: Total gastrectomy, PG: Proximal gastrectomy, PPG: Pylorus-preserving gastrectomy, CG: Completion gastrectomy

Table2. Patient characteristics and data on operation.

Variables		PUAS (n=22)	Control (n=66)	P value
Age	mean	68.2 (50-82)	67.2 (50-89)	NS (0.6652)
Sex	(M:F)	15:7	41:25	NS (0.6088)
BMI	mean (kg/m2)	21.6	21.6	NS (0.9974)
cStage	I / II / III / IV	20 / 1 / 1 / 0	63 / 2 / 1/ 0	NS (0.6657)
Type of LG	TG (TG/PG/CG)	11 (4/3/4)	33 (31/2/0)	NS (>0.9999)
	DG (DG/PPG)	11 (10/1)	33 (32/1)	
Lymphadenectomy	D1+ / D2	17 / 5	52 / 14	NS (0.8811)

Table 3. Perioperative outcomes

		PUAS (n=22)	Control (n=66)	P value
Open conversion		1 (4.5%)	1 (1.5%)	P=0.4088
Postoperative complications (≥CTCAE Grade 2)		3 (13.6%)	7 (10.6%)	P=0.6981
	Peripancreatic abscess	1	2	
	Intra-abdominal abscess	1	1	
	Pneumonia	1		
	Delayed gastric emptying		2	
	Ileum perforation		1	
	Angina pectoris		1	
Mortality within 30 days		0 (0%)	0 (0%)	NA
Blood loss (g)	(median)	60 (0 – 900)	90 (0 – 3600)	P=0.5119
Length of operation (min)	(median)	322 (200 - 476)	316 (204 - 472)	P=0.6299
Hospital stay (days)	(median)	13.5 (8 – 35)	13.0 (8 – 85)	P=0.8088
Lymph node yield	(median)	42 (6 – 85)	40 (11 – 89)	P=0.3855

Table 4. Comparison to open gastrectomy

Variables		LG-PUAS (n=22)	OG-PUAS (n=23)	P value
Age	mean	68.2 (50-82)	69.5 (48-87)	0.6502
Sex	(M:F)	15:7	16:7	0.9202
BMI	mean (kg/m2)	21.6	21.8	0.8433
cStage	I / II / III / IV	20 / 1 / 1 / 0	13 / 5/ 5/ 0	0.0334
Type of LG	TG (TG/PG/CG)	11 (4/3/4)	14 (9/0/5)	0.4632
	DG (DG/PPG)	11 (10/1)	9 (9/0)	
Lymphadenectomy	D1+ / D2	17 / 5	10 / 13	0.0207
Postoperative complications (≥CTCAE Grade 2)		3 (13.6%)	3 (10.6%)	0.9534
	Peripancreatic abscess	1	1	
	Intra-abdominal abscess	1	1	
	Pneumonia	1		
	Anastomotic stricture		2	
Mortality < 30 days		0 (0%)	0 (0%)	NA
Blood loss (g)	median	60 (0 – 900)	590 (190 – 1530)	<0.0001
Operative time (min)	median	322 (200 - 476)	275(194 - 536)	0.1369
Hospital stay (days)	median	13.5 (8 – 35)	15.0 (11 – 78)	0.1005
Lymph node yield	median	42 (6 – 85)	27 (2 – 87)	0.1397