outcome between the two groups. The patient's status was determined based on follow-up examinations. Comparisons were tested using Fisher's exact test, Student's t test, and the Pearson χ^2 test, with Yates correction for conditional variables. Patient survival was calculated using the Kaplan–Meier method and the statistical significance of the differences between curves was tested using the log-rank test. A P value of <0.05 was considered to be significant. Statistical analyses were performed using the JMP 8.0 package (SAS Institute, Cary, NC, USA).

Results

Open group (OG)

Nine (50 %) patients (5 males and 4 females; mean age 68.0 ± 19.3 years; range 22–89 years) underwent open gastrectomy. Total gastrectomy was performed in five (55.6 %) patients and distal gastrectomy in four (44.4 %) patients. Splenectomy was performed at the same time in three cases, a partial resection of the transverse colon in two cases, and a partial resection of the liver (which had been invaded by the tumor) in one case. The operative time was 327.4 ± 62.7 min (distal gastrectomy 330.8 ± 73.6 min; total gastrectomy 324.8 ± 61.5 min). The estimated blood loss was 839.6 ± 750.5 g (distal gastrectomy 425.3 ± 185.1 g; total gastrectomy 1171.0 ± 889.9 g). The 30-day morbidity included one case of pneumonia and one case with leaking anastomosis that resulted in hospital death. The bowel function was resumed after 3.4 ± 1.4 days and food intake after 6.6 ± 3.2 days. The patients were discharged after 33.7 ± 22.6 days (range 14–78 days). The mean follow-up period was 19.4 ± 26.1 months (range 2.6–83 months). Five patients could not undergo postoperative chemotherapy because of a poor performance status, while four patients could; S-1 was used in two patients and infusional fluorouracil plus cisplatin was used in others. The mean time before the initiation of postoperative chemotherapy was 32.0 ± 17.1 days (range 14–49 days). Three patients were still alive at the last follow-up: two without recurrence, and one with recurrence. One patient died from another disease (non-cancer), and four patients died of cancer. The cause of cancer death was peritoneal dissemination in all patients. The 1- and 2-year survival rates after surgical resection excluding the case of hospital death were 50.0 and 33.3 %, respectively, and the median survival period was 5 months (with one patient still alive after 60 months).

Laparoscopic group (LG)

Nine (50 %) patients (7 males and 2 females; mean age 61.1 ± 15.3 years; range 38–82 years) underwent laparoscopic gastrectomy. Total gastrectomy was performed in four (44.4 %) patients and distal gastrectomy in five (55.6 %) patients. Splenectomy was performed at the same time in two patients. The operative time was 348.1 ± 115.1 min (distal gastrectomy 309.0 ± 64.6 min; total gastrectomy 397.0 ± 155.1 min). The estimated blood loss was 55.8 ± 96.0 g (distal gastrectomy 80.8 ± 127.2 g; total gastrectomy 24.5 ± 25.3 g). The 30-day mortality and morbidity included one case of postoperative paresis of the intestine without postoperative death. Bowel movement was resumed after 2.6 ± 1.9 days and food intake after 4.4 ± 2.7 days. The patients were discharged after 14.9 ± 10.2 days (range 8–39 days). The mean follow-up period was 20.5 ± 11.5 months (range 1.3–40.6 months). Two patients could not undergo postoperative chemotherapy because of a poor performance status, while seven patients could. All these patients received S-1. The mean time until the initiation of postoperative chemotherapy was 41.0 ± 8.1 days (range 28–51 days). Seven patients were still alive at the last follow-up: five without recurrence and two with recurrence. Two patients experienced recurrence and died. The site of recurrence was peritoneal dissemination in all patients. No port-site metastases were observed. The 1- and 2-year survival rates after surgical resection were 100 and 62.5 %, respectively.

Comparative results

The age, gender, depth of tumor invasion into the gastric wall, preoperative chemotherapy, the extent of gastrectomy, or the histological type of cancer, did not differ between the two groups. The number of involved nodes in the LG was much lower than that in the OG ($P = 0.062$; Table 1). The quality of surgery, including the duration and number of resected lymph nodes, did not differ between the groups; however, the estimated blood loss in the LG was less than that in the OG ($P = 0.009$). The resumption of food intake ($P = 0.038$) and the postoperative length of hospital stay ($P = 0.028$) in the LG were earlier/shorter than those in the OG. The postoperative morbidity rates were similar ($P = 0.47$; Table 2). There was no statistical difference in the 2-year survival rates between the groups excluding the case of hospital death ($P = 0.055$; Fig. 1).

Discussion

The American Joint Committee on Cancer Staging system classifies positive peritoneal lavage cytology, which is considered to be a poor prognostic factor, as M1 disease [23]. Many patients are thought to have stage IV disease when positive lavage cytology is identified before surgical resection, and are offered systemic chemotherapy. Peritoneal

Table 1 Clinicopathological characteristics of the P−/cy+ patients ($n = 18$)

	OG	LG	p value
Number of Patients	9	9	
Age (years)	68.0 ± 19.3	61.1 ± 15.3	0.2
Gender			0.21
Male	5	7	
Female	4	2	
Preoperative chemotherapy			0.52
Present	1	2	
Absent	8	7	
Surgical resection			0.63
Total gastrectomy	5	4	
Distal gastrectomy	4	5	
Resection of other organ			0.14
Present	5	2	
Absent	4	7	
Histologic type			0.52
Differentiated	2	1	
Undifferentiated	7	8	
Depth of tumor invasion			0.25
T3	1	3	
T4	8	6	
Tumor size (cm)	11.9 ± 5.1	9.2 ± 3.3	0.13
Number of involved lymph nodes	30.3 ± 26.1	8.2 ± 7.2	0.062
N status			0.11
N0, 1	0	2	
N2, 3	9	7	
Stage			
IV	9	9	

OG open group, *LG* laparoscopic group

Table 2 Surgical results for the OG ($n = 9$) and LG ($n = 9$)

	OG	LG	p value
Operation time (min)	327.4 ± 62.7	348.1 ± 115.1	0.72
Blood loss (g)	839.6 ± 750.5	55.8 ± 96.0	0.009
Number of resected lymph nodes	52.4 ± 35.8	55.2 ± 28.0	0.88
Complication rate	22.2 ($n = 2$)	11.1 ($n = 1$)	0.47
Recovery of bowel function (POD)	3.4 ± 1.4	2.6 ± 1.9	0.37
Resumption of food intake (POD)	6.6 ± 3.2	4.4 ± 2.7	0.038
Postoperative length of stay (POD)	33.7 ± 22.6	14.9 ± 10.2	0.028
Induction rate of postoperative chemotherapy within 8 weeks	44.4 ($n = 4$)	77.8 ($n = 7$)	0.14
Recurrence rate	55.6 ($n = 5$)	44.4 ($n = 4$)	0.50
Recurrence site			
Peritoneum	3	4	
Peritoneum and lymph nodes	2	0	
Mean follow-up periods (months)	19.4 ± 26.1	20.5 ± 11.5	0.92
Mean survival time (months)	13.1	Not evaluable	

OG open group, *LG* laparoscopic group, *POD* postoperative day

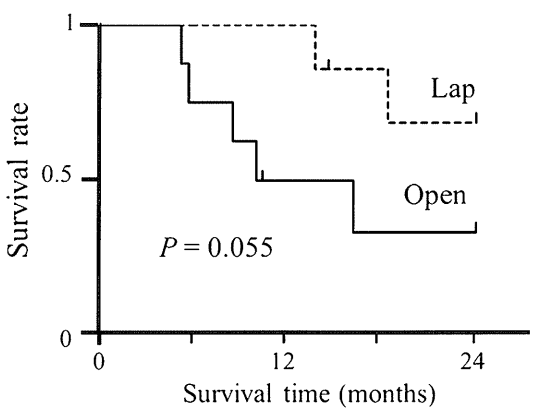

Fig. 1 Overall survival rate of P−/Cy+ patients that underwent laparoscopic gastrectomy (Lap $n = 9$) or open gastrectomy (Open $n = 8$)

carcinomatosis is associated with a very high likelihood of positive cytology, with a reported incidence of 59–69 % [2, 6], but the floating cancer cells in the peritoneal cavity do not always survive and then become implanted. Furthermore, chemotherapy may destroy peritoneal free cancer cells in P−/cy+ patients, but not the primary lesion [9, 23]. Therefore, many surgeons have tried to gain prognostic benefit for P−/cy+ patients using surgical procedures [9, 24]. P−/cy+ patients that undergo gastrectomy require other adjuvant therapies that are specifically focused on peritoneal free cancer cells [24, 25]. However, radical gastrectomy for P−/cy+ patients may be detrimental and thus may have problems associated with the ability to undergo postoperative chemotherapy and the prognosis.

Several authors have reported that laparoscopic radical gastrectomy, which was first performed for gastric cancer by Kitano et al. [15] in 1992, provides important postoperative advantages. Goh et al. [16] published the early results of 118 laparoscopy-assisted distal gastrectomies performed for benign and neoplastic disease by 16 surgeons in 12 countries: 10 of the surgeons reported that laparoscopic distal gastrectomy was superior to open distal gastrectomy regarding such factors as faster recovery, reduced pain, and improved cosmesis. Adachi et al. [26] reported the results of a clinical study comparing laparoscopic and open distal gastrectomy, and showed the

superiority of the former in terms of surgical trauma, rapid recovery of gastrointestinal function, and a shorter postoperative hospital stay. Kitano et al. [15] showed that laparoscopic assisted distal gastrectomy resulted in an earlier recovery, less pain, and reduced impairment of pulmonary function (forced vital capacity and forced expiratory volume in 1 s) in comparison to open gastrectomy. Husher et al. [19, 20] reported the benefits of laparoscopic gastrectomy to include reduced blood loss, shorter time to resumption of oral intake, and earlier discharge from the hospital. However, laparoscopic gastrectomy has failed to gain universal acceptance as an alternative to the open approach for a number of reasons, including the issue of oncological curability in terms of lymph nodal dissection, particularly D2 lymphadenectomy. Adequate training in laparoscopic techniques and procedures is mandatory prior to performing a laparoscopic gastrectomy with D2 lymphadenectomy. Huscher et al. [20] reported laparoscopic radical gastrectomy with D2 lymphadenectomy to be a valid alternative to open surgery with similar oncological effectiveness. Hao et al. [13] reported laparoscopic techniques in gastric cancer surgery did not increase the detection rate of free cancer cells in the peritoneal cavity in comparison to conventional open techniques. Radical resection was performed in both groups of patients in the current study. The connective tissue around the stomach rather than gastric wall was gently grasped or the stomach was lifted to obtain a good surgical view in the laparoscopic procedures in the current series. In addition, the manipulation of the tumor was avoided to prevent tumor seeding and port-site recurrence during laparoscopic maneuvers as in open gastrectomy. The mean number of resected lymph nodes was similar in both groups; therefore, the oncologically correct resection of the gastric cancer and lymphadenectomy were considered to be well-preserved after laparoscopic gastrectomy. The LG showed important surgical advantages, such as less intraoperative blood loss, a faster resumption of oral intake, and an earlier discharge from the hospital. There were no disadvantages in terms of operation time, complications, and recovery of bowel function. These results support the feasibility and safety of laparoscopic gastrectomy with D2 lymphadenectomy for P−/cy+ patients as an alternative to standard open gastric resection. However, laparoscopic radical gastrectomy for P−/cy+ patients is difficult and requires advanced techniques to prevent tumor seeding, and therefore, highly experienced surgeons should perform the procedures for P−/cy+ patients after they have obtained adequate experience of laparoscopic surgery for not only early but also advanced gastric cancer.

No significant difference was observed between the two groups in terms of patient characteristics, depth of tumor invasion, histological type, tumor size, and the extent of gastrectomy; however, differences in the requirement for resection of other organs (e.g., transverse colon) and the number of metastatic lymph nodes (which did not affect the stage of these groups) may have contributed to the poor prognosis in the OG. There was no difference in the 2-year overall survival rates between the two groups, although the postoperative follow-up period was probably very short and macroscopic examination by laparoscopy was limited. Nonetheless, laparoscopic radical gastrectomy did not prove to be detrimental to P−/cy+ patients in comparison to open surgery in terms of the postoperative morbidity. Miyashiro et al. [7] reported that patients with a small number of cancer cells with peritoneal lavage cytology gained prognostic benefits after a radical resection without preoperative chemotherapy, but the surgical results were not satisfactory. Multimodal therapy, in addition to surgery, is used to extend the overall survival for P−/cy+ patients [8]. Pre and postoperative chemotherapy prolong the median survival time of P−/cy+ patients and are therefore considered to be appropriate [3]. In fact, the differences in postoperative chemotherapy, especially S-1, may have affected the better prognosis in the LG [12].

Lorenzen et al. [9] reported that neoadjuvant chemotherapy (NAC) for patients with positive cytology improved the prognosis for patients that became cytologically negative after NAC; although NAC may be a risky strategy, because 25 % of the patients showed a worsening of their disease. Shimizu et al. [27] suggested that staging laparoscopy with washing should be performed as a separate procedure, and those patients with positive cytology should undergo resection after preoperative chemotherapy. However, Mezhir et al. [24] reported persistently positive cytology at repeated staging laparoscopy with washing after preoperative chemotherapy in 43 % of P−/cy+ patients. Furthermore, not all patients with positive peritoneal cytology are able to undergo pre or postoperative chemotherapy. Radical gastrectomy may be appropriate for those patients require immediate palliative resection for bleeding or stenosis, but are unable to undergo NAC for positive peritoneal cytology. However, seven patients in the current series could not undergo postoperative chemotherapy within 8 weeks, due to a poor performance status which was probably affected by the surgical invasiveness. Therefore, laparoscopic gastrectomy, which has the advantages of a faster recovery and less-invasiveness, may positively contribute to subsequent multimodal therapy, and especially to the early induction of postoperative chemotherapy, in P−/cy+ patients. The patients without non-curative factors except for free cancer cells may thus become appropriate subjects for laparoscopic radical gastrectomy and obtain benefits from these procedures.

This is the first study comparing the short-time results of laparoscopic and open gastrectomy for P−/cy+ patients. Although this study has significant limitations due to the

small sample sizes and the limited duration of follow-up, the results suggest that laparoscopic radical gastrectomy is a safe and less invasive procedure for P−/cy+ patients. Laparoscopic gastrectomy is feasible for P−/cy+ patients and is important for the early induction of postoperative chemotherapy. However, laparoscopic gastrectomy for P−/cy+ patients should only be performed by surgeons with adequate training and substantial experience with laparoscopic gastrectomy for T1-3 gastric cancer.

Conflict of interest No authors have any conflicts of interest to declare.

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Surgical Technique

Feasibility and safety of intracorporeal esophagojejunostomy after laparoscopic total gastrectomy: Inverted T-shaped anastomosis using linear staplers

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Background. *Although laparoscopic distal gastrectomy has been widely accepted in clinical practice, laparoscopic total gastrectomy (LTG) is not yet familiar because of the difficulty in esophagojejunostomy. The purpose of this study was to evaluate perioperative and short-term outcomes of our procedure of intracorporeal gastrojejunostomy using linear staplers after LTG.*

Methods. *Of 98 consecutive patients who underwent LTG for gastric cancer in our department between August 2002 and December 2010, 94 patients underwent esophagojejunostomy with a linear stapling device. After October 2007, we modified the esophagojejunostomy; ie, the most recent 57 patients underwent transection of the esophagus in the ventrodorsal direction and insertion of a linear stapler from the anterior wall of the Roux limb to the posterior wall so as to make an inverted T-shaped anastomosis. We evaluated the results in these 57 patients (recent group) and compared them with the results in the earlier 37 patients (early group).*

Results. *The mean operative time in the recent group was 368 to 94.6 min, and the mean estimated blood loss was 57 to 33 g; both were comparable with those in the early group. Neither open conversion nor intraoperative complications were encountered. Two patients experienced anastomotic leakage in the earlier group, but anastomotic leakage did not occur in the recent group. No mortality was encountered.*

Conclusion. *We herein report our procedure of intracorporeal gastrojejunostomy using linear staplers after LTG. Our procedure of esophagojejunostomy using linear staplers is safe and feasible and has acceptable morbidity. (Surgery 2013;153:732-8.)*

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LAPAROSCOPIC DISTAL GASTRECTOMY for early gastric carcinoma has gained wide acceptance because of its minimal invasiveness.[1-3] However, laparoscopic total gastrectomy (LTG) is not yet familiar because of the difficulty in esophagojejunostomy. When performing open total gastrectomy, esophagojejunostomy with a circular stapling device is generally accepted as a substitute for hand-sutured anastomosis. However, there are 2 disadvantages in this technique: first, purse-string suturing is necessary; and second, it can be difficult to introduce the anvil of the circular stapler into the esophagus. These problems are more serious in laparoscopic surgery than in open surgery. The transorally placed anvil technique using the OrVil (Covidien, Mansfield, MA) system was developed to solve these difficulties. However, some problems remain, such as possible risk for esophageal injury during transoral application of the anvil head and abdominal infection because of a contaminated OrVil tube. The circular stapler was

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not developed for intracorporeal anastomosis, so another technique such as the globe method is required for intracorporeal anastomosis under maintenance of pneumoperitoneum.[4] Walther et al[5] and Matsui et al[6] reported esophagojejunostomy with linear stapling devices in open surgery. Uyama et al[7] discussed the availability of a linear stapling technique for laparoscopic esophagogastric anastomosis after proximal gastrectomy. Recently, Inaba et al[8] reported a large series of patients who underwent esophagojejunostomy using linear staplers and named this technique the overlap method, which achieved satisfactory outcomes.

Although we successfully performed esophagojejunostomy using linear staplers in 37 patients, we still encountered technically demanding steps, such as hand-sewn closure of entry holes. In our recent series, esophagojejunostomy was performed with some modifications. This procedure makes it easy to close the entry hole of the stapler by hand sewing and thus prevent distortion of the Roux limb.

We herein report the short-term outcome of LTG using Roux-en-Y reconstruction with comparative data of our earlier and recent methods.

METHODS

Patients. A total of 98 consecutive patients underwent LTG for gastric cancer between August 2002 and December 2010 in our department of Kyushu University Hospital. The preoperative clinical assessments, including the clinical classification of tumor depth and nodal involvement, were performed by upper gastrointestinal radiography, esophagogastroduodenoscopy, endoscopic ultrasonography, abdominal ultrasonography, and computed tomography. LTG was indicated only for early gastric cancer until January 2008. The indication for LTG was then expanded to all advanced cases, even those with positive peritoneal cytology, after January 2008.

For esophagojejunostomy after LTG, circular staplers were used through a 5 cm minilaparotomy in the upper abdominal wall in the first 4 patients. We then performed totally intracorporeal esophagojejunostomy using linear staplers in the next 37 patients (early group). After 2007, we performed esophagojejunostomy using linear staplers with some modifications, as described below, in the most recent 57 patients (recent group). We herein compare the 2 linear stapling procedures before and after the technical modifications.

Surgical procedures. Our LTG procedure was performed as follows in the early group. Under general anesthesia, the patient was placed in the supine position with legs slightly apart. The operator and first assistant stood on the patient's right and left sides, respectively, and the laparoscope operator stood between the legs of the patient. First, a trocar 10 mm in diameter was inserted near the umbilicus by the open laparoscopy method. Under pneumoperitoneum, 12 mm trocars were inserted into the bilateral abdomen and 5 mm trocars were placed into the bilateral upper abdomen. After dissection of the lymph nodes, the duodenal bulb was divided using a linear stapler inserted through the right lower trocar. The esophagus was also divided in the horizontal direction using a linear stapler on the oral side of the esophagogastric junction. Before reconstruction, the whole stomach with regional lymph

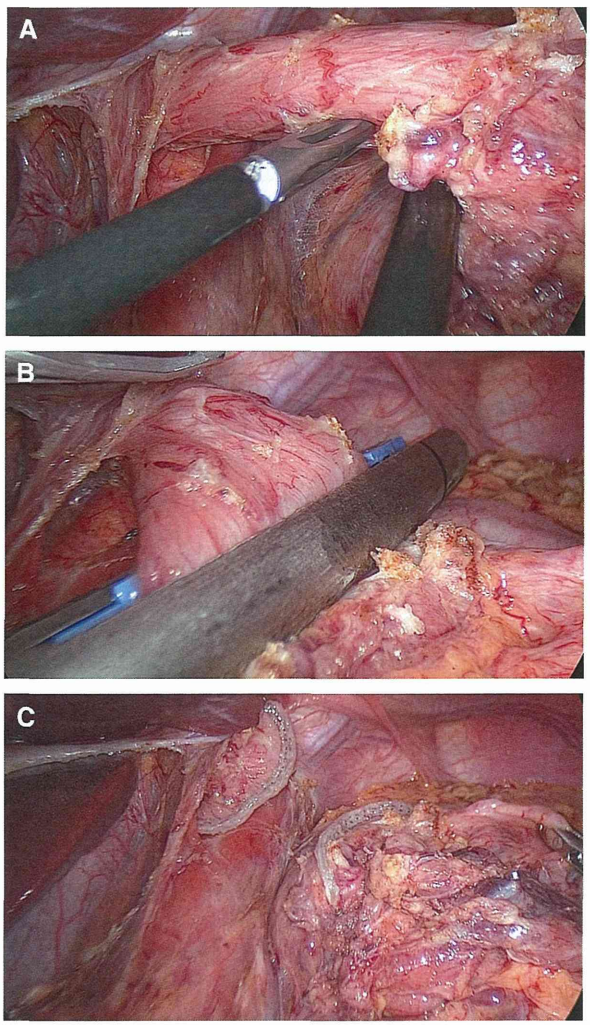

Fig 1. The esophagus is divided with a linear stapler (*A*). The esophagus is rotated clockwise 90 degrees from the usual position (*B*). The esophagus is divided with a linear stapler above the esophagogastric junction (*C*). The esophagus is divided in the ventrodorsal direction.

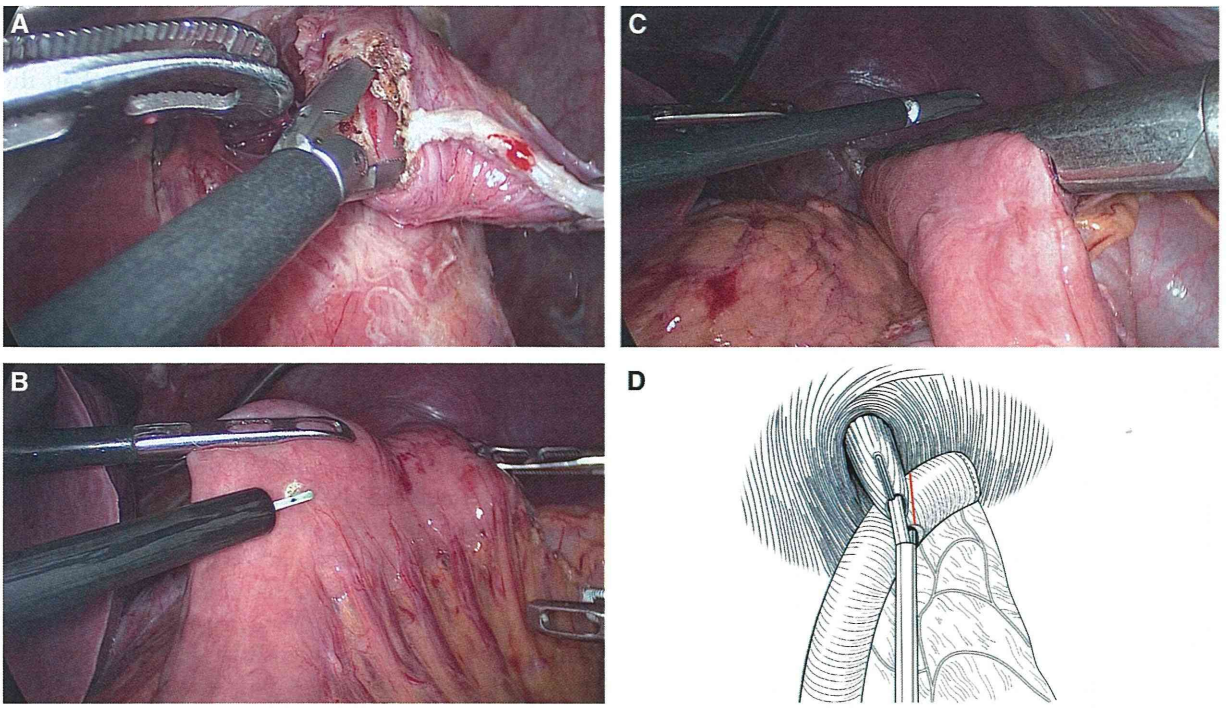

Fig 2. A small hole is made at the dorsal portion of the esophageal stump (*A*). A small hole is made 5 cm from the stump of the Roux limb (*B*). One jaw of a 45 mm stapler is inserted through the anterior wall of the Roux limb (*C*). The staple line is placed in the direction of the posterior wall of the Roux limb (*D*) (*red line*).

nodes was taken out through a minimally enlarged umbilical incision (3–4 cm) to check the lesion. Roux-en-Y reconstruction was performed with an isoperistaltic 40 cm Roux limb created 30 cm from the duodenojejunal junction. The Roux limb was ascended through the retrocolic or antecolic route. Esophagojejunal anastomosis was performed using a blue cartridge linear stapler. We opened small incisions at the left edge of the esophageal stump and antimesenteric side 5 cm from the stump of the Roux limb. A linear stapler was then inserted parallel with the esophagus and Roux limb. After the linear stapler was fired, the common entry incision was closed by hand sewing to avoid possible stenosis of the anastomotic site. We then routinely performed an anastomotic leak test by infusion of 50 mL of 50-fold diluted indigo carmine. Side-to-side jejunojejunostomy was performed 40 cm distal to the esophagojejunostomy using a white cartridge linear stapler. Next, when the antecolic route was used, we closed the Petersen and the jejunojejunostomy mesenteric defects with continuous sutures. In addition to these 2 defects, the retrocolic tunnel mesenteric defect was also closed with 3 or 4 interrupted sutures when the retrocolic route was used.

After October 2007, we modified the esophagojejunostomy procedure. First, the esophagus was rotated clockwise 90 degrees from the usual position to divide the esophagus in the ventrodorsal direction (Fig 1). Second, small incisions were made at the dorsal edge of the esophageal stump and anterior wall of the jejunum 5 cm from the stump of the Roux limb (Fig 2, *A* and *B*). One jaw of a 45 mm endostapler was inserted through the anterior wall of the Roux limb; a staple line was placed in the direction of the posterior wall of the Roux limb. The linear stapler was then lifted up to the anastomotic site beside the lower esophagus to check for low tension of the mesentery, necessary and sufficient lower esophageal exposure, and soundness of the jejunal wall to avoid inadvertent perforation of the posterior wall of the jejunal loop by the jaw of the linear stapler during firing. Finally, another jaw was inserted into the esophageal incision (Fig 2, *C* and *D*). After firing the linear stapler, the common entry hole was closed by hand sewing (Fig 3, *A*, *B*, and *C*). The shape of the esophagojejunostomy was then a stick shape or inverted T shape, as seen in circular stapler anastomosis commonly performed in open surgery.

Statistical analysis. The perioperative clinical data were obtained from patients' records. All values were expressed as mean ± SD. Statistical analysis was carried out using the unpaired chi-square test for categorized variables, the Student *t* test, and the

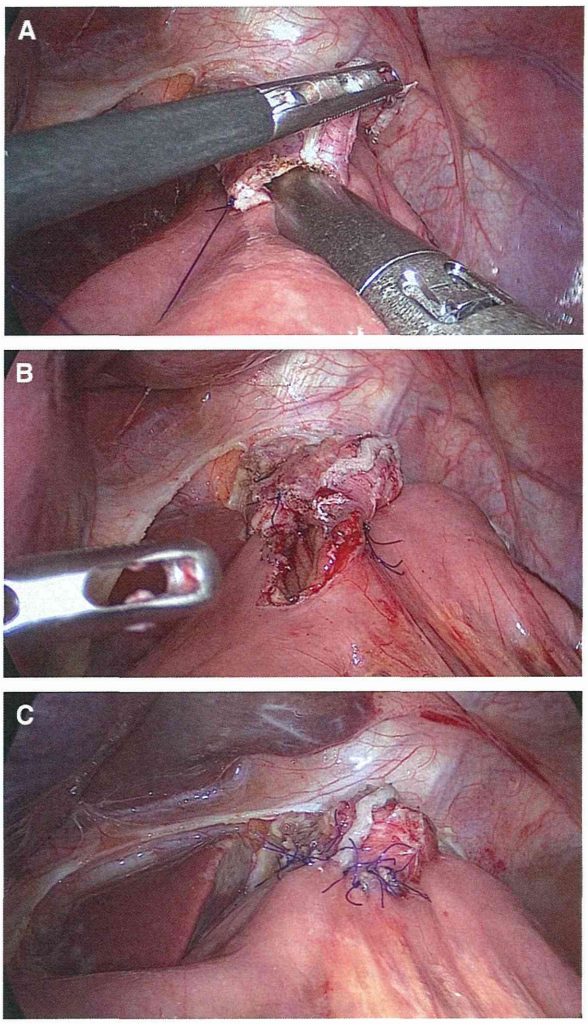

Fig 3. The linear stapler is fired (*A*). The common stab incision opens upward (*B*). The common stab incision is closed by hand sewing (*C*). The inverted T-shaped esophagojejunostomy is completed.

Mann-Whitney U test for continuous variables. Patient survival was calculated using the Kaplan-Meier method, and the statistical significance of the differences among curves was tested using the log-rank test. A P value of $<.05$ was considered significant. Statistical analysis was performed using the JMP 8.0 program (SAS Institute, Cary, NC).

RESULTS

Clinical characteristics. Characteristics of patients in the early and recent groups are shown in Table I. The male-to-female ratio and mean age of the recent group were comparable to those of the early group. The mean tumor sizes of the recent and early groups were 5.8 ± 3.9 cm and 4.4 ± 2.5 cm, respectively. The tumor sizes in the recent group were significantly larger than those in the early group ($P = .036$). The ratio of advanced carcinoma to early carcinoma in the recent group was 28:29, which was significantly higher than the 3:34 ratio in the early group ($P < .0001$). Clinical stages were classified according to the TNM Classification of Malignant Tumors.

Perioperative findings. Table II presents a summary of perioperative data. The mean operative time in the recent group was 368 ± 94.6 min, and the mean estimated blood loss was 57 ± 33 g; both were comparable to those in the early group. Neither open conversion nor intraoperative complications were encountered in this series. Of 57 patients, 17 underwent procedures combined with splenectomy for D2 nodal dissection, 1 underwent splenectomy and pancreatic tail resection, and 6 underwent total remnant gastrectomy subsequent to distal or proximal gastrectomy. Of 57 patients, 7 underwent laparoscopic cholecystectomy for cholelithiasis. The mean operative time and mean estimated blood loss included those of laparoscopic cholecystectomy but excluded those of laparoscopic colectomy. The number of harvested lymph nodes in the recent group was 47 ± 18.8, which was comparable to 53.4 ± 21.0 in the early group ($P = .13$), whereas the number of metastatic lymph nodes in the recent group tended to be larger than that in the early group ($P = .064$).

Postoperative course. The postoperative course is summarized in Table III. There were 4 intra-abdominal morbidities in 4 patients in the recent group: 1 pancreatic fistula (1.8%) in a patient who underwent splenectomy and pancreatic tail resection; 1 leakage of the duodenal stump (1.8%); 1 internal hernia of the Roux limb through the transverse mesocolon defect, resulting in jejunal obstruction (1.8%); and 1 postoperative stasis (1.8%). On the other hand, there were 3 intra-abdominal morbidities in the early group; 2 anastomotic leakages of the esophagojejunostomy (5.4%); and 1 postoperative stasis (2.7%). Of the 2 anastomotic leakages, 1 resulted in thoracic empyema. We defined stasis as impairment of normal passage of intestinal contents after surgery, resulting in a prolonged hospital stay. There was 1 case of postoperative stasis in each group (1.8% in the recent group and 2.7% in the early group), neither of which was due to mechanical obstruction at the esophagojejunostomy but instead were due to impaired intestinal motility. There was neither anastomotic stenosis nor bleeding in either group.

The mean time to resumption of water intake was significantly shorter in the recent group than in the early group (2.6 ± 0.8 vs 3.5 ± 1.6 days, respectively). The postoperative hospital stay was

Table I. Clinicopathologic characteristics of the patients

	Recent group	*Early group*	P
Number of patients	57	37	
Age (y)	66.2 ± 12.5	65.8 ± 9.9	.771
Male/female	40/17	24/13	.651
Body mass index (kg/m^2)	22.0 ± 3.4	21.1 ± 2.0	.257
Tumor size (cm)	5.8 ± 3.9	4.4 ± 2.5	.036
Clinical depth of invasion			
Mucosa/submucosa/muscularis propria/subserosa/serosa	8/21/10/12/6	12/22/3/0/0	
Clinical			
Early/advanced	29/28	34/3	<.0001
Clinical nodal involvement			
N0/N1/N2	42/14/1	36/1/0	
Clinical stage			
IA/IB/IIA/IIB/IIIA/IIIB	27/8/11/7/3/1	34/2/1/0/0/0	

Table II. Perioperative findings in the patients

	Recent group	*Early group*	P
Operative time (min)	368.0 ± 94.6	341.4 ± 75.7	.086
Blood loss (g)	80.4 ± 115.0	70.2 ± 77.3	.483
Intra- or postoperative transfusion	None	None	
Operative procedure			
LTG	33/57	33/37	.0012
LTG + Sp	17/57	1/37	.0009
LTG + Sp, pancreatic tail	1/57	0/37	.418
LTRG	6/57	3/37	.697
Synchronous operation			
Laparoscopic cholecystectomy	7	4	
Laparoscopic colectomy	0	2 (rectum, T-colon)	
Harvested lymph nodes	47.0 ± 18.8	53.4 ± 21.0	.130
Metastatic lymph nodes	2.5 ± 6.0	0.67 ± 1.4	.064

LTRG, Laparoscopic total remnant gastrectomy; *pancreatic tail*, resection of pancreatic tail; *Sp*, splenectomy.

also significantly shorter in the recent group than in the early group (14.2 ± 12.1 vs 16.7 ± 9.5 days, respectively).

DISCUSSION

Laparoscopic surgery for various diseases has been widely accepted because it is less invasive, even for malignant diseases. In the gastrointestinal field, laparoscopic surgery has been a standard surgical option for early gastric cancer, especially in Japan[9,10] and Korea.[11] The number of laparoscopy-assisted distal gastrectomy procedures has been increasing every year. However, LTG is not yet familiar because of the difficulty of esophagojejunostomy.

There are 2 methods of mechanical esophagojejunostomy in LTG: circular stapling and linear stapling. The merit of the former is the accumulated experience in open total gastrectomy for most surgeons. The circular stapling method has been discussed in many previous reports.[12,13] We also successfully performed esophagojejunostomy using a circular stapler through a minilaparotomy in the first 4 patients in our series. However, some intraoperative problems can arise in making a proper purse-string suture at the esophageal stump and inserting an anvil into the esophageal lumen through a minilaparotomy. Moreover, it was difficult to apply the stapling device appropriately under a limited laparoscopic view, especially in obese patients.

To avoid these problems, we adopted a linear stapling device for esophagojejunostomy following Uyama's method.[7] Briefly, we divided the esophagus in the horizontal direction using a linear stapler and opened small incisions at the right edge of the esophageal stump and antimesenteric side 5 cm from the stump of the Roux limb. A linear stapler was then inserted parallel to the esophagus and

Table III. Postoperative courses of the patients

	Recent group	*Early group*	P
Morbidity			
Anastomotic leakage	0 case	2 cases	.0598
Anastomotic stenosis	0 case	0 case	1.0000
Anastomotic bleeding	0 case	0 case	1.0000
Pancreatic leakage	1 case	0 case	.2962
Leakage of duodenal stump	1 case	0 case	.2962
Ileus due to internal hernia	1 case	0 case	.2962
Stasis	1 case	1case	.8143
Atelectasis	2 cases	0 case	.1382
Pulmonary edema	0 case	2 cases	.0598
Pneumonia	1 case	1 case	.8143
Complete AV block	0 case	1 case	.1850
Delirium	3 cases	0 case	.0685
Mortality	None	None	
Water intake (day)	2.6 ± 0.8	3.5 ± 1.6	.0006
Oral intake (day)	4.9 ± 4.7	5.5 ± 2.5	.4560
Postoperative hospital stay (days)	14.2 ± 12.1	16.7 ± 9.5	.088
Pathologic depth of invasion			
Mucosa/submucosa/muscularis propria/subserosa/serosa	13/11/9/16/8	18/16/1/2/0	
Early/advanced	24/33	34/3	<.0001
Pathologic nodal involvement			
N0/N1/N2/N3a/N3b	35/11/3/5/3	28/5/4/0/0	
Final stage			
IA/IB/IIA/IIB/IIIA/IIIB/IIIC/IV	23/7/5/10/3/3/2/4	27/4/4/2/0/0/0	

Roux limb. After firing the linear stapler, the common entry incision was closed by hand sewing. Even with this method, possible problems remain, such as distortion of the Roux limb or mesenterium and slipping of the esophagojejunal anastomotic site into the lower mediastinum. Indeed, we experienced 2 anastomotic leakages in the early group, 1 of which resulted in thoracic empyema. In that case, the esophagojejunal anastomotic site had slipped into the mediastinum. When complications occur at the esophagojejunal anastomotic site in the mediastinum, severe morbidity may result.

To conquer these problems and ensure comfortable performance of Roux-en-Y reconstruction, we modified a previous esophagojejunostomy using the linear stapling device. There are 2 major points of our modifications: division of the esophagus in the ventrodorsal direction and insertion of the linear stapler from the anterior wall of the Roux limb to the posterior wall. With these procedures, the common entry incision, after the endostapler was fired, opened upward, and we thus obtained a good operative view for easy closure by hand sewing. The esophagojejunostomy then took a stick or inverted-T shape, avoiding the slipping of the esophagojejunal anastomotic site into the lower mediastinum. No special technique was required to perform this procedure. The modified linear stapling method was successfully performed in the most recent 57 patients. Esophageal invasion of the tumor was identified in 4 of 57 cases, and the esophageal extension in each case was ≤10 mm in length. This procedure was thus applicable to all cases in this series. If the tumor invades up to the thoracic esophagus, another technique may be required.

The ratio of advanced carcinoma to early carcinoma in the recent group was significantly higher than that in the early group. Therefore, splenectomy for D2 nodal dissection was more commonly performed in the recent group. Even in this situation, intra-abdominal morbidities did not increase in number compared with those in the early group after we adopted some modifications. In particular, esophagojejunal anastomotic leakage was not encountered in the recent group. The morbidity ratio in this series was comparable to that in previous reports.[8] The possibility of the influence of a learning effect, technical advancement of surgeons, or surgeons' comfort with increasing experience cannot be excluded; however, the devices and standardization of surgical procedures such as ours might be important for the favorable results represented by the absence

of esophagojejunal anastomotic leakage, by early oral intake, and by short hospital stays.

We believe that this method is feasible and reliable and will help to make LTG more familiar for surgeons; however, further follow-up is necessary to confirm long-term outcomes.

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