

Short- and Long-term Outcomes After Laparoscopic Versus Open Total Gastrectomy for Advanced Gastric Cancer

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Abstract

Background/Aim: Total gastrectomy is the cornerstone treatment for gastric cancer, particularly in patients with proximal or large tumors. For early-stage gastric cancer, laparoscopic total gastrectomy (LTG) has demonstrated comparable short- and long-term outcomes to those of open total gastrectomy (OTG), while reports on advanced gastric cancer (AGC) are limited. We aimed to compare the short- and long-term outcomes of patients with AGC who underwent LTG or OTG. **Patients and Methods:** This study included consecutive patients with AGC who underwent LTG or OTG with lymph node dissection at our institution from January 2002 to June 2024. Propensity score matching was conducted at a 1:1 ratio to reduce bias.

Results: A total of 158 patients were enrolled (LTG: 39; OTG: 119). Of these, 64 were paired by propensity score matching. The clinical tumor invasion depth was balanced, but the pathological depth was significantly deeper in the LTG group. The number of patients with lymph node metastasis did not differ. The median operative time was longer for LTG (512.5 min) than for OTG (267 min), whereas LTG resulted in significantly less blood loss (125 g vs. 411 g). Postoperative morbidity ($\geq$ Clavien–Dindo grade 3) was comparable (LTG: 12.5%, OTG: 9.4%). The LTG group had a significantly shorter median hospital stay (11 days vs. 17 days). There were no significant differences in overall or recurrence-free survival between the groups.

Conclusion: LTG is a feasible and safe approach for AGC, offering comparable short- and long-term outcomes to OTG.

Keywords: Laparoscopy, open surgery, total gastrectomy, gastric cancer, advanced cancer.

Introduction

Gastric cancer remains a significant global health problem and is the fifth leading cause of cancer morbidity and

related mortality worldwide. Despite the development of various new drugs to treat gastric cancer, surgical curative resection remains the mainstay of treatment. Open distal gastrectomy (ODG) is the standard of care for patients with



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gastric cancer worldwide (1). However, since the first case of laparoscopic distal gastrectomy (LDG) was reported in 1994 (2), and with continuous improvements made in laparoscopic hemostatic devices and surgical techniques, it has become widely used worldwide. In a large population-based study, researchers reported shorter hospital stays after laparoscopic gastrectomy, comparable or decreased postoperative complications, and comparable lymph node dissection (3-5). Furthermore, the results of various randomized controlled trials (RCTs) [JCOG0912 (6, 7), KLASS01 (8, 9)] have shown comparable short-term and long-term results of LDG and ODG for early-stage gastric cancer, and LDG has become a standard surgical procedure. Furthermore, the results of RCTs on the short-term and long-term outcomes of LDG and ODG for advanced gastric cancer (AGC) have been reported in Japan (10, 11), Korea (12, 13), and China (14, 15), and LDG has also become a standard surgical procedure for AGC.

Total gastrectomy is the cornerstone of curative treatment, particularly in cases involving proximal or large tumors. Laparoscopic total gastrectomy (LTG) is not as popular as LDG because of the difficulty of esophagojejunostomy and lymph node dissection around the splenic hilum. In fact, the prevalence of LTG is lower than that of LDG in Japan, and according to a survey conducted in 2021 by the Japanese Society of Endoscopic Surgery, the percentage of LDG (including robotic surgery) in distal gastrectomy exceeded 50% at 72.8% (7,997/10,990), whereas that of LTG was only 44.3% (1,643/3,707). RCTs in patients with early-stage gastric cancer have shown that the short- and long-term results of LTG are comparable to those of open total gastrectomy (OTG) (16-18), whereas reports conducted in patients with AGC are limited. In this study, we focused on AGC and compared the short- and long-term results of LTG with those of OTG with the aim of examining the feasibility of laparoscopic surgery.

Patients and Methods

Patients. In this study, we included consecutive patients who underwent LTG or OTG with lymphadenectomy for

primary gastric cancer at our institution from January 2002 to June 2024. We retrospectively analyzed the clinical data. The inclusion criteria were as follows: 1) gastric adenocarcinoma and 2) clinical T2-4a, N-/+, and M0. The exclusion criteria were as follows: 1) remnant gastric cancer, 2) Siewert type I or II esophagogastric junction cancer, 3) emergency gastrectomy, and 4) the presence of other active malignant diseases. This study was conducted in accordance with the principles embodied in the 1975 Declaration of Helsinki and was approved by the University of Yamanashi Ethics Committee (approval number: 2029). Informed consent from patients was not needed since this study was a retrospective study.

Surgical procedure. Total gastrectomy with standard lymph node resection was performed according to the Japanese guidelines for gastric cancer treatment (19, 20). Combined splenectomy was indicated for all AGCs until 2017. Since 2018, it has been performed only for lesions involving the greater curvature of the upper region. Liver, pancreas, and transverse colon combined resection was performed in cases in which intraoperative findings revealed macroscopic invasion. A total of five trocars were used in LTG surgery. All patients underwent Roux-en-Y reconstruction. All surgeries were performed by a chief surgeon who performed at least 60 OTG or LTG surgeries and two assistants (21).

Postoperative management. Patients with pStage II/III disease received adjuvant S-1 chemotherapy for one year. Since 2007, S-1 plus oxaliplatin or S-1 plus taxane has been an adjuvant treatment option for patients with pStage III disease. Patients were followed up with tumor marker data every three months for the first two years and every six months for the next three years; computed tomography (CT) scans were performed every six months for five years. Recurrent disease was detected mainly *via* CT scans.

Definition. We calculated body mass index (BMI) as weight in kilograms divided by height in meters squared (kg/m^2).

The prognostic nutritional index (PNI) is a specific method developed by Onodera to evaluate a patient's nutritional and immunological status (22). It is calculated *via* the following formula: $PNI = (10 \times \text{serum albumin level [g/dl]}) + (0.005 \times \text{total lymphocyte count [}/\text{mm}^3\text{]})$. In this study, staging *via* the T/N factor followed the Union for International Cancer Control TNM system, 8th edition (23). We evaluated postoperative complications *via* the Clavien–Dindo classification (24), with Grade III or higher complications considered present.

Propensity score matching (PSM). We adjusted for potential confounders in the LTG and OTG groups using 1:1 PSM to minimize patient selection bias and surgical bias. We used the following covariates of preoperative factors for matching: age, sex, American Society of Anesthesiologists (ASA), BMI, Glasgow Prognostic Score, PNI, Eastern Cooperative Oncology Group (ECOG) performance status, preoperative treatment, cT factor, cN factor, and combined resection of the liver, pancreas, transverse colon, and spleen. The caliper width was 0.2. Finally, we extracted data from 32 matched pairs (64 patients in total) for comparative analysis.

Statistical analysis. Continuous variables are shown as medians and ranges, and categorical variables are shown as event numbers and percentages. We tested continuous data with the Mann–Whitney *U*-test and categorical data with Fisher's test. We performed a prognostic analysis of overall survival (OS) and relapse-free survival (RFS) using the Kaplan–Meier method and evaluated differences using the log-rank test. A *p*-value of <0.05 was considered to indicate statistical significance. Statistical analysis was performed using R (version 4.4.1; June 14, 2024, R core team, Vienna, Austria).

Results

Before PSM. Table I shows the patient characteristics. A total of 158 patients were included, of whom 39 had undergone LTG and 119 had undergone OTG. The median patient ages

were 72 and 69 years in the LTG and OTG groups, respectively, with the LTG group tending to be slightly older. There were no significant differences between the two groups in sex, percentage of patients who received preoperative chemotherapy, or BMI. The number of ASA score class 3 patients was eight (20.5%) and five (4.2%) in the LTG and OTG groups, respectively, with a significantly greater value in the LTG group. There were no significant differences in the Eastern Cooperative Oncology Group–PS, PNI, or Glasgow prognostic score between the two groups. There was no difference in the clinical T factor, clinical N factor, or clinical stage, and there was no significant difference in the percentage of esophageal invasion.

Postoperative pathological examination revealed pT1a(M) in one patient (2.6%) in the LTG group and six patients (5.0%) in the OTG group and pT1b(SM) in three patients (7.7%) in the LTG group and 20 patients (16.8%) in the OTG group. Although we found no significant differences in the depth of invasion or lymph node metastasis, pStage I tended to be more frequent in the OTG group, with six patients (15.4%) in the LTG group and 37 patients (31.1%) in the OTG group. There was no significant difference in the number of harvested lymph nodes or the rate of postoperative adjuvant chemotherapy.

Table II shows the short-term outcomes. In the OTG and LTG groups, one (2.6%) and 76 (63.9%) patients, respectively, underwent combined splenectomy, with significantly more patients in the OTG group. There was no significant difference between the two groups in the number of combined resections of pancreaticosplenectomy, transverse colon resection, or liver resection. The median operative time for the LTG group was 539 min, which was significantly longer than the 295 min in the OTG group. The estimated median blood loss was 137 g in the LTG group, which was significantly less than the 546 g in the OTG group. Three patients in the LTG group underwent conversion to open surgery. One patient in the OTG group experienced postoperative mortality from anastomotic leakage leading to sepsis, whereas no postoperative mortality was observed in the LTG group. Postoperative morbidity (Clavien–Dindo grade ≥ 3) was observed in six

Table I. Patient characteristics for the original study cohort.

	LTG (n=39)	OTG (n=119)	p-Value
Age, years	72 (45-88)	69 (29-90)	0.229
Sex, n (%)			0.272
Male	33 (84.6)	89 (74.8)	
Female	6 (15.4)	30 (25.2)	
Chemotherapy before surgery, n (%)	3 (7.7)	6 (5.0)	0.69
BMI, kg/m ²	22.4 (16.9-30.9)	21.9 (14.8-35.8)	0.308
ASA score, n (%)			<0.05
1	2 (5.1)	24 (20.2)	
2	29 (74.4)	90 (75.6)	
3	8 (20.5)	5 (4.2)	
ECOG-PS, n (%)			0.176
0	31 (79.5)	108 (90.8)	
1	5 (12.8)	7 (5.9)	
2	3 (7.7)	4 (3.3)	
PNI	46.4 (30.7-56.1)	47.5 (27.3-61.8)	0.338
Glasgow prognostic score, n (%)			1
0	31 (79.5)	92 (77.3)	
1	6 (15.4)	21 (17.6)	
2	2 (5.1)	6 (5.0)	
Histological type, n (%)			0.333
Differentiated	19 (48.7)	53 (44.5)	
Undifferentiated	18 (46.2)	64 (53.8)	
The others	2 (5.1)	2 (1.7)	
Tumor size, mm	50 (1-190) ^a	60 (2-200) ^a	0.551
Clinical T factor, n (%)			0.1
2	14 (35.9)	50 (42.0)	
3	15 (38.5)	25 (21.0)	
4	10 (25.6)	44 (37.0)	
Clinical N factor, n (%)			0.461
0	25 (64.1)	68 (57.1)	
1,2,3	14 (35.9)	51 (42.9)	
Clinical M factor, n (%)			1
0	39 (100)	119 (100)	
1	0 (0)	0 (0%)	
Clinical stage, n (%)			0.763
I	12 (30.8)	43 (36.1)	
II	15 (38.5)	34 (28.6)	
III	12 (30.8)	40 (33.6)	
IV	0 (0)	2 (1.7)	
Esophageal invasion, n (%)	3 (7.7)	13 (10.9)	0.763
Pathological T factor, n (%)			0.45
T1a	1 (2.6)	6 (5.0)	
T1b	3 (7.7)	20 (16.8)	
T2	4 (10.3)	21 (17.6)	
T3	16 (41.0)	34 (28.6)	
T4a	14 (35.9)	34 (28.6)	
T4b	1 (2.6)	4 (3.4)	
Pathological N factor, n (%)			0.781
N0	13 (33.3)	44 (37.0)	
N1	11 (28.2)	28 (23.5)	
N2	6 (15.4)	23 (19.3)	
N3a	8 (20.5)	17 (14.3)	
N3b	1 (2.6)	7 (5.9)	

Table I. Continued

Table I. *Continued*

	LTG (n=39)	OTG (n=119)	p-Value
Pathological stage, n (%)			0.0754
I	6 (15.4)	37 (31.1)	
II	16 (41.0)	30 (25.2)	
III	17 (43.6)	52 (43.7)	
Harvested number of lymph nodes	42 (11-82) ^a	36 (3-89) ^a	0.143
Adjuvant chemotherapy, n (%)	22 (56.4)	55 (46.2)	0.356

LTG: Laparoscopic total gastrectomy; OTG: Open total gastrectomy; BMI: body mass index; ASA: American Society of Anesthesiologists; ECOG: Eastern Cooperative Oncology Group; PS: Performance status; PNI: prognostic nutritional index. ^amedian (range).

(15.4%) and 23 (19.3%) patients in the LTG and OTG groups, respectively, with no significant difference. However, the incidence of pancreatic fistula was significantly greater in the OTG group (n=18, 15.1%) than in the LTG group (n=0%). The median postoperative hospital stay was significantly shorter in the LTG group (11 days) than in the OTG group (18 days).

We observed recurrence in nine patients (23.1%) in the LTG group and 40 patients (33.6%) in the OTG group (Table III). Peritoneal dissemination was the most common in both groups, occurring in seven patients (17.9%) in the LTG group and 21 patients (17.6%) in the OTG group. There were significantly more recurrences of lymph node metastasis in the OTG group, with zero patients (0%) in the LTG group and 13 patients (10.9%) in the OTG group.

The median postoperative observation periods were 32 and 82 months for the LTG and OTG groups, respectively. We found that the OS and RFS rates were comparable between the LTG and OTG groups (Figure 1A and B).

After PSM. We matched patient background factors, oncologic factors, and surgical factors by propensity score and selected 64 patients (32 LTG patients and 32 OTG patients) for analysis. As shown by the standardized mean difference values, the propensity score-matched cohorts presented comparable preoperative patient characteristics and tumor factors. The pathological depth of invasion was significantly deeper in the LTG group. There was no significant difference in lymph node metastasis between

the two groups. The LTG tended to have a greater number of harvested lymph nodes. There was no significant difference in the rate of postoperative adjuvant chemotherapy (Table IV).

One patient each in the LTG and OTG groups underwent combined splenectomy and pancreaticosplenectomy. The median operative time for the LTG group was 512.5 min, which was significantly longer than the 267 min for the OTG group. The estimated median blood loss was 125 g in the LTG group, which was significantly less than the 411 g in the OTG group. Four (12.5%) and three (9.4%) patients in the LTG and OTG groups, respectively, experienced postoperative morbidity (Clavien–Dindo grade ≥ 3), with no significant difference between the groups. There were no differences between the two groups in terms of postoperative morbidity, including splenectomy. The median postoperative hospital stay was significantly shorter in the LTG group (11 days) than in the OTG group (17 days) (Table V).

We observed recurrence in six patients (18.8%) in the LTG group and eight patients (25.0%) in the OTG group (Table VI). There was no significant difference in the site of recurrence between the two groups. OS and RFS were comparable between the LTG and OTG groups (Figure 1C and D).

Discussion

This study revealed that laparoscopic surgery is noninferior to open surgery for short-term and long-term

Table II. Short-term outcomes for the original study cohort.

	LTG (n=39)	OTG (n=119)	p-Value
Operative time (min)	539 (293-697) ^a	295 (154-528) ^a	<0.05
Estimated blood loss (g)	137 (5-753) ^a	546 (111-1,965) ^a	<0.05
Conversion to open, n (%)	3 (7.7)	-	
Postoperative mortality	0 (0)	1 (0.8)	1
Postoperative morbidity ($\geq$ C.D. grade 3)			
Overall, n (%)	6 (15.4)	23 (19.3)	0.643
Anastomotic leak, n (%)	1 (2.6)	3 (2.5)	1
Pancreatic fistula, n (%)	0 (0)	18 (15.1)	<0.05
Respiratory complications, n (%)	4 (10.3)	4 (3.4)	0.104
Surgical Site Infection, n (%)	1 (2.6)	1 (0.8)	0.434
Intraabdominal abscess, n (%)	1 (2.6)	3 (2.5)	1
Intraabdominal bleeding, n (%)	0 (0)	1 (0.8)	1
Others, n (%)	1 (2.6)	3 (2.5)	1
Length of postoperative hospital stay (days)	11 (7-63) ^a	18 (8-135) ^a	<0.05

LTG: Laparoscopic total gastrectomy; OTG: Open total gastrectomy. C.D.: Clavien-Dindo. ^amedian (range).

Table III. Sites of disease recurrence for the original study cohort.

	LTG (n=39)	OTG (n=119)	p-Value
Site of recurrence, n (%)			
Overall	9 (23.1)	40 (33.6)	0.239
Peritoneal	7 (17.9)	21 (17.6)	1
Liver	4 (10.3)	6 (5.0)	0.264
Lung	1 (2.6)	1 (0.8)	0.434
Brain	0 (0)	1 (0.8)	1
Bone	0 (0)	1 (0.8)	1
Nodal	0 (0)	13 (10.9)	<0.05
Local	0 (0)	1 (0.8)	1
Other	0 (0)	1 (0.8)	1

LTG: Laparoscopic total gastrectomy; OTG: Open total gastrectomy.

outcomes for total gastrectomy for AGC, including complicated resection. In addition, PSM also showed comparable results with regard to minimizing patient and surgical bias.

A study using a national database in the U.S. reported that LTG is comparable to OTG (25), whereas a study using a national database in Japan reported that LTG significantly increases anastomotic leakage (26). Several studies in elderly patients have reported that gastrectomy can be safely performed in patients with comorbidities (27-30). The indications for surgery in gastrectomy patients are expanding against this background. The LTG group in this study was slightly older and had a

significantly higher ASA score, but morbidity was similar to that of the OTG group, suggesting that LTG is useful for elderly patients and patients with high ASA scores.

Traditionally, prophylactic splenectomy has been performed to dissect lymph nodes 10 and 11 in patients with proximal gastric cancer. The JCOG0110 trial evaluated the role of prophylactic splenectomy for patients with AGC who had not invaded the greater upper third of the stomach and had no lymph node metastases. The results showed that prophylactic splenectomy was associated with increased morbidity and greater blood loss without improving survival (31). However, in patients with proximal AGC with involvement of the greater

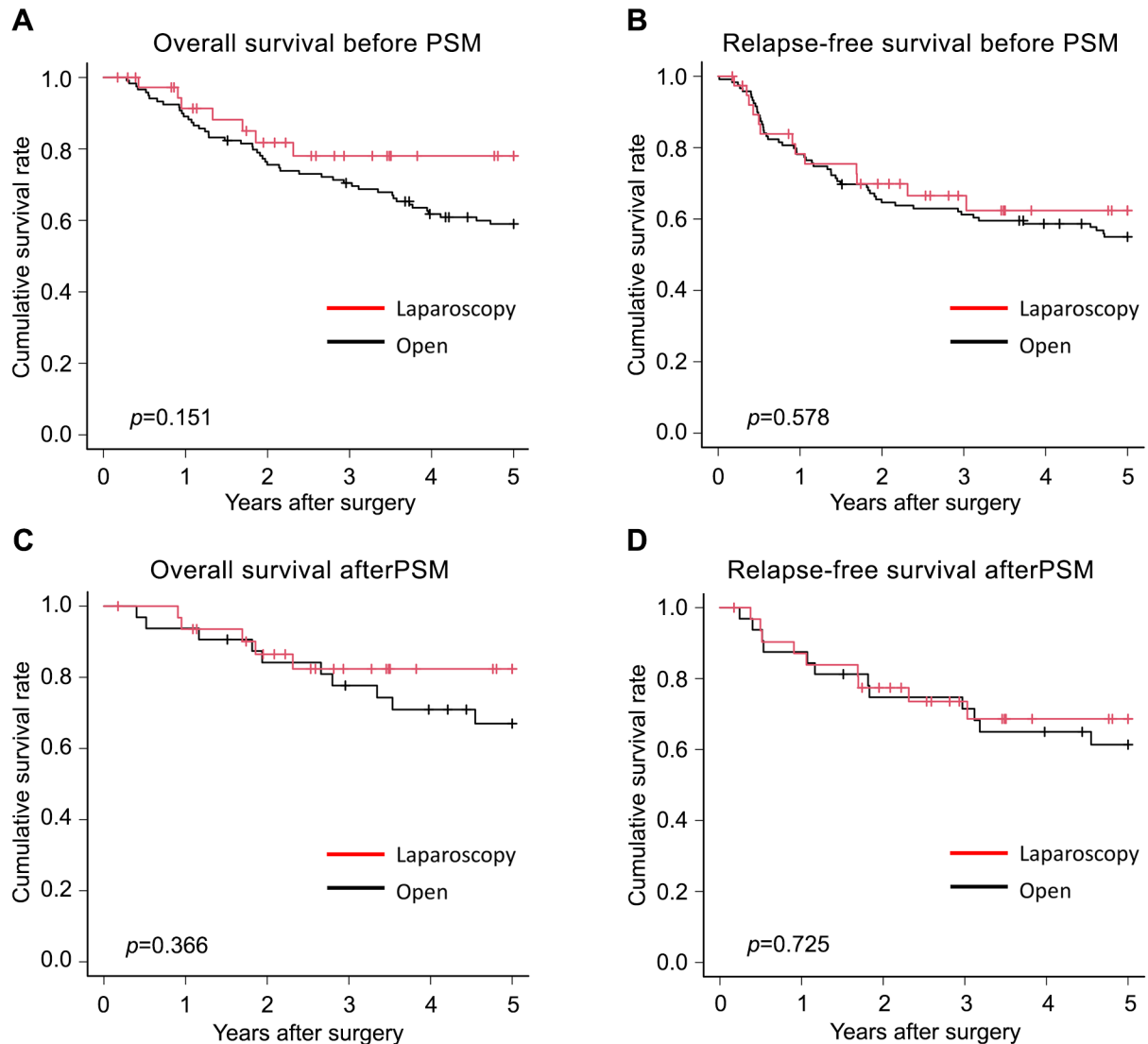


Figure 1. Kaplan-Meier curves between the laparoscopic total gastrectomy and the open total gastrectomy groups. A) Overall survival before propensity score matching (PSM); B) Relapse-free survival before PSM; C) Overall survival after PSM; D) Relapse-free survival after PSM.

curvature, the incidence of splenic hilar (No. 10) metastasis has been reported to range from 8.4% to 15.9%, with some retrospective analyses suggesting a survival impact of node 10 dissection (31, 32). On the basis of these reports, splenectomy has been limited to only a few patients in this study since 2018.

Postoperative pancreatic fistula (POPF) is one of the most serious complications after gastric cancer surgery.

The risk of POPF is due mainly to invasive surgical procedures, but other factors, such as high BMI, have been reported (33). Furthermore, in a report of 39,253 total gastrectomy cases using the Japanese National Clinical Database, male sex, splenectomy, and the Brinkman index were detected as common risk factors for POPF (34). Risk factors for POPF due to intraoperative manipulation include pressure (35) and thermal injury to the pancreas

Table IV. Patient characteristics for the propensity score-matched cohort.

	LTG (n=32)	OTG (n=32)	p-Value	Standardized mean difference
Age, years	71.5 (50-84)	70.0 (43-83)	0.877	0.06
Sex, n (%)			1	<0.001
Male	26 (81.3)	26 (81.3)		
Female	6 (18.7)	6 (18.7)		
Chemotherapy before surgery, n (%)	1 (3.1)	2 (6.2)	1	0.148
BMI, kg/m ²	21.4 (16.9-30.9)	21.5 (15.3-35.8)	0.724	0.048
ASA score, n (%)			0.419	0.333
1	2 (6.3)	5 (15.6)		
2	26 (81.3)	22 (68.7)		
3	4 (12.5)	5 (15.6)		
ECOG-performance status, n (%)			1	0.183
0	28 (87.5)	28 (87.5)		
1	2 (6.3)	3 (9.4)		
2	2 (6.3)	1 (3.1)		
PNI	47.5 (30.7-56.1)	48.7 (27.3-59.4)	0.799	0.028
Glasgow prognostic score, n (%)			0.513	0.395
0	26 (81.3)	26 (81.3)		
1	4 (12.5)	6 (18.7)		
2	2 (6.3)	0		
Histological type, n (%)			0.473	0.327
Differentiated	14 (43.8)	19 (59.4)		
Undifferentiated	16 (50.0)	12 (37.5)		
The others	2 (6.3)	1 (3.1)		
Tumor size, mm	50 (20-190) ^a	60 (10-200) ^a	0.968	0.036
Clinical T factor, n (%)			0.2	0.481
2	12 (37.5)	16 (50.0)		
3	14 (43.8)	7 (21.9)		
4	6 (18.7)	9 (28.1)		
Clinical N factor, n (%)			1	<0.001
0	21 (65.6)	21 (65.6)		
1,2,3	11 (34.4)	11 (34.4)		
Clinical M factor, n (%)			1	
0	32 (100)	32 (100)		
1	0 (0)	0 (0)		
Clinical stage, n (%)			0.783	0.207
I	10 (31.3)	13 (40.6)		
II	13 (40.6)	12 (37.5)		
III	9 (28.1)	7 (21.9)		
Esophageal invasion, n (%)	3 (9.4)	2 (6.2)	1	0.117
Pathological T factor, n (%)			<0.05	
T1a	1 (3.1)	0 (0)		
T1b	2 (6.3)	9 (28.1)		
T2	4 (12.5)	10 (31.3)		
T3	13 (40.6)	6 (18.8)		
T4a	11 (34.4)	5 (15.6)		
T4b	1 (3.1)	2 (6.3)		
Pathological N factor, n (%)			0.463	
N0	11 (34.4)	9 (28.1)		
N1	10 (31.3)	12 (37.5)		
N2	6 (18.8)	6 (18.8)		
N3a	4 (12.5)	1 (3.1)		
N3b	1 (3.1)	4 (12.5)		

Table IV. Continued

Table IV. *Continued*

	LTG (n=32)	OTG (n=32)	p-Value	Standardized mean difference
Pathological stage, n (%)			0.0905	
I	5 (15.6)	13 (40.6)		
II	14 (43.8)	10 (31.3)		
III	13 (40.6)	9 (28.1)		
Harvested number of lymph nodes	42.5 (11-82) ^a	35.5 (3-76) ^a	0.0677	
Adjuvant chemotherapy, n (%)	19 (59.4)	16 (50)	0.616	

LTG: Laparoscopic total gastrectomy; OTG: Open total gastrectomy; BMI: Body mass index; ASA: American Society of Anesthesiologists; ECOG: Eastern Cooperative Oncology Group; PNI: Prognostic nutritional index. ^amedian (range).

(36). However, since these matters have become widely known, the incidence of POPF has decreased (37). In this study, pancreatic fistulas occurred significantly more frequently in the OTG group. The presence or absence of splenectomy was one factor, but the LTG group also had less frequent POPF after PSM, suggesting that an improved surgical technique is also a factor.

The enhanced recovery after surgery (ERAS) protocol has been successfully integrated into the perioperative management of a variety of cancer surgeries, including those for colorectal and gastric cancer. ERAS for gastric cancer surgery has been reported to reduce the length of hospital stay, time to flatus, and hospitalization costs, with consistent results for both open and laparoscopic surgery. With regard to this study's background, ERAS was introduced in 2014, and prior to that, many OTGs were included, which may have caused differences in postoperative hospital stay (38).

In this study, we included patients in clinical stages cT2-4a, N-/+, and cM0, defined as having advanced cancer. However, pathologic T1 was present in 21% of the OTG group and 10.3% of the LTG group. Because preoperative chemotherapy was not administered to most of the patients, this could be a difference in the difficulty in diagnosing the depth of the lesion. The usefulness of endoscopic ultrasound (EUS) in diagnosing the depth of gastric cancer has been reported, and a meta-analysis revealed that the sensitivity and specificity of EUS in differentiating T1-T2 (superficial) and T3-T4

(advanced) gastric cancer were 0.86 [95% confidence interval (CI)=0.81-0.90] and 0.90 (95%CI=0.87-0.93), respectively (39). In the initial cases of the OTG group in this study, the depth diagnosis was made only *via* conventional white-light imaging, which may have been one of the reasons for the false diagnosis of depth.

Distant metastasis and peritoneal dissemination are subsequently reported as recurrence patterns. In this study, peritoneal dissemination recurrence was the most common, but researchers have reported that this ratio varies depending on the histologic type, T factor, and N factor (40). Although we observed no lymph node recurrence in the LTG group, there was no significant difference in lymph node recurrence after PSM. This finding suggests the possible involvement of oncologic and surgical factors.

The reports on the long-term prognosis of LTG in AGC are based on single-center studies (41, 42) or national databases (25). All of these reports showed that the long-term prognosis of LTG is comparable to that of open surgery. In this study, we found no significant difference in the prognosis between OTG and LTG patients in terms of OS and RFS, with similar results observed after PSM. Patient-related factors such as age, comorbidities, and nutritional status, as well as postoperative complications and the administration of adjuvant postoperative chemotherapy, have been reported to significantly influence long-term outcomes (43, 44). In our matched cohort, there were no significant differences in age, BMI,

Table V. Short-term outcomes for the propensity score-matched cohort.

	LTG (n=32)	OTG (n=32)	p-Value
Operative time (min)	512.5 (293-695) ^a	267.0 (168-435) ^a	<0.05
Estimated blood loss (g)	125 (5-753) ^a	411 (120-1,602) ^a	<0.05
Conversion to open, n (%)	3 (9.4)	-	
Postoperative mortality	0 (0)	0 (0)	1
Postoperative morbidity ($\geq$ C.D. grade 3)			
Overall, n (%)	4 (12.5)	3 (9.4)	1
Anastomotic leak, n (%)	0 (0)	1 (3.1)	1
Pancreatic fistula, n (%)	0 (0)	1 (3.1)	1
Respiratory complications, n (%)	3 (9.4)	2 (6.3)	1
Surgical site infection, n (%)	1 (3.1)	1 (3.1)	1
Intraabdominal abscess, n (%)	1 (3.1)	1 (3.1)	1
Intraabdominal bleeding, n (%)	0 (0)	0 (0)	1
Others ^b , n (%)	1 (3.1)	0 (0)	1
Length of postoperative hospital stay (days)	11 (8-63) ^a	17 (8-54) ^a	<0.05

LTG: Laparoscopic total gastrectomy; OTG: Open total gastrectomy. C.D.: Clavien-Dindo. ^amedian (range); ^bIncluding pneumonia, atelectasis, pneumothorax.

Table VI. Sites of disease recurrence for the propensity score-matched cohort.

	LTG (n=32)	OTG (n=32)	p-Value
Site of recurrence, n (%)			
Overall	6 (18.8)	8 (25.0)	0.763
Peritoneal	5 (15.6)	5 (15.6)	1
Liver	2 (6.3)	1 (3.1)	1
Lung	0 (0)	0 (0)	1
Brain	0 (0)	0 (0)	1
Bone	0 (0)	0 (0)	1
Nodal	0 (0)	1 (3.1)	1
Local	0 (0)	1 (3.1)	1
Other	0 (0)	0 (0)	1

LTG: Laparoscopic total gastrectomy; OTG: Open total gastrectomy.

postoperative complication rate, or postoperative chemotherapy between the two groups. Given that more patients in the LTG group progressed, the prognosis with LTG may be equal to or better than that with OTG.

There have been several reports in recent years on quality of life (QOL) after gastrectomy (45, 46). Compared with other gastrectomy procedures, total gastrectomy is associated with greater weight loss and poorer QOL (47), and some reports suggest the feasibility of small remnant distal gastrectomy (48) or proximal gastrectomy (49-51). In the selection of gastrectomy procedures, it is necessary

to consider not only short- and long-term outcomes but also postoperative QOL.

The main limitation of this study is its single retrospective design. The number of cases was also small, and we conducted PSM to balance the baseline characteristics of patients, further reducing the sample size. Furthermore, the duration of data collection in this study was long, and there were differences in potential patient factors, accuracy of preoperative diagnoses, and postoperative management. Therefore, large, prospective, multicenter clinical trials are needed to evaluate the surgical and oncologic outcomes of LTG.

Conclusion

LTG for AGC is a feasible and safe approach compared with OTG in terms of both short-term and long-term outcomes.

Conflicts of Interest

The Authors declare no conflicts of interest in relation to this study.

Authors' Contributions

All the Authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by YK. The first draft of the manuscript was written by YK, and all the authors commented on previous versions of the manuscript. All the Authors read and approved the final manuscript.

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Artificial Intelligence (AI) Disclosure

No artificial intelligence AI tools were used in the preparation of this manuscript.

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