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Laparoscopic gastrectomy vs open gastrectomy with D2 lymph node dissection in gastric cancer: Early postoperative outcomes and feasibility of laparoscopic procedures

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ABSTRACT

Introduction: Minimal invasive gastrectomy procedures offer better postoperative recovery and lower complication rates. Furthermore, oncological outcomes are not inferior to conventional open gastrectomy (OG) procedures. The aim of this study was to evaluate the short-term postoperative clinical outcomes and histopathological results after laparoscopic gastrectomy (LG) versus OG in our clinic.

Materials and Methods: A total of 50 eligible patients were included in the study. All the patients were divided into two main groups as LG (n=18) and OG (n=32). Demographic parameters, intraoperative findings, early postoperative outcomes, and histopathological findings were compared between the groups.

Results: Age, gender, BMI, comorbid diseases, ASA scores, neoadjuvant treatment history were similar in both LG and OG groups. The mean first flatus time (LG: 2.01 vs. OG: 2.62 days, p=0.002) and hospital stay (LG: 10.2 vs. OG: 14.4 days, p=0.004) were shorter and estimated blood loss was lesser (LG: 147.5 vs. OG: 194.5 ml, p=0.041) in LG patients. The duration of operation significantly higher in LG patients (285.7 vs. 239.7 min, p<0.001). Postoperative 30-day minor and major complications and mortality rates were lesser in LG patients but the differences were not significant. The mean number of retrieved total lymph nodes in total gastrectomy patients (LTG: 39.2 vs. OTG: 38.7, p=0.982) and in distal gastrectomy patients (LDG: 32.4 vs. ODG: 37.1, p=0.649) were similar to open procedures.

Conclusion: LG procedures are superior to OG with advantageous postoperative clinical outcomes and similar pathologic results in both distal or total gastrectomy patients and can be safely performed for early or locally advanced gastric carcinomas.

Keywords: Gastric cancer; laparoscopic gastrectomy; laparoscopy; locally advanced gastric cancer; open gastrectomy.

Introduction

Gastric cancer is the sixth most common cancer and the fourth leading cause of cancer death worldwide according to the 2020 data of the World Health Organization.[1] Surgical approaches still remain the mainstay of the treatment of gastric cancer, even if in advanced stages

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of the tumor. Conventional open gastrectomy (OG) was the preferred surgical approach until Kitano firstly described the laparoscopy-assisted gastrectomy for early gastric carcinoma (EGC) in the antrum.[2] Over the last decades, the advantages of the laparoscopic gastrectomy (LG) in early clinical outcomes have increased the popularity.

In the initial period of laparoscopy application for gastric cancers, it was preferred in early-stage and distal gastric located tumors. According to studies evaluating the early and long-term results of the technique, minimal invasive gastrectomy procedures provide less intraoperative blood loss, less analgesic medication requirement, faster postoperative recovery, fewer postoperative complications, shorter hospital stay, and similar oncological outcomes with OG.[3–7] Afterwards, the feasibility of the laparoscopic techniques was evaluated in proximally located EGCs, and similarly, it has been demonstrated that laparoscopic total gastrectomy (LTG) is more advantageous when compared to open total gastrectomy (OTG).[8,9] Consequently, LG has become the standard surgical approach for EGC due to its minimal invasiveness and similar long-term oncological outcomes compared with OG.

The application of laparoscopic procedures in the treatment of advanced gastric cancer (AGC) is more challenging because of the expansion of the lymph node dissection range in D2 dissection than in D1/D1+ dissection. Clinical studies have proven that, with the experience accumulated by laparoscopic surgeons and the advances in the laparoscopic device technology, the number of retrieved lymph nodes by minimal invasive surgery were similar when compared OG in AGC cases.[4,5,10,11] In recent prospective randomized clinical trials, there is no significant difference in overall survival and disease-free survival rates of AGC between LG and OG.[4,11–13] As a result, current papers emphasize that LG is not inferior to OG according to the oncological outcomes. However, LG is also associated with disadvantages such as increased operative time and hospital cost, the need for a surgeon skilled in laparoscopic techniques, and a longer learning curve.[14]

In the light of the recent developments in minimally invasive surgeries in gastric cancer, it was aimed in this study to compare the short-term postoperative clinical outcomes and histopathological results after LG versus OG in EGCs and locally-AGCs in our clinic with the literature data.

Materials and Methods

Patient Characteristics

Clinical and histopathological data from 63 consecutive gastric cancer patients operated on at Firat University Medical Faculty Hospital from April 2019 to April 2021 were analyzed from a prospectively collected database. All the patients were histologically confirmed gastric adenocarcinoma by preoperative endoscopic biopsy. To evaluate the extent of the disease, oral and intravenous contrast-enhanced thoracal and abdominal computed tomography were used for all patients. Endoscopic ultrasonography and PET examinations were also used if required.

Inclusion Criteria

18–75 years age, Eastern Cooperative Oncology Group (ECOG) score of 0 (asymptomatic) or 1 (symptomatic but completely ambulatory), American Society of Anesthesiology (ASA) score 1–3, EGC and locally-AGC. Exclusion criteria: History of previous gastrectomy, endoscopic submucosal dissection or endoscopic mucosal resection, history of other malignant disease, emergency surgeries due to complications caused by gastric cancer as bleeding, obstruction or perforation, ECOG score of 2 or more, the patients who had larger than 3 cm at the long diameter or bulky regional lymph nodes and T4b or M1 stage according to preoperative imaging or intraoperative findings. In addition, two patients who were converted to OG during LG procedure due to anastomosis failure were also excluded from the study. Out of 87 patients, 50 patients fulfilled the inclusion criteria and were included for further analysis. The patients were categorized into two groups according to surgical procedure as OG and LG. The flow chart of patient enrollment is shown in Figure 1.

Data Collection Process

Demographic parameters, preoperative laboratory tests, intraoperative findings, early-postoperative outcomes, and histopathological data of the patients were recorded. Among these sex, age, comorbid diseases, smoking status, body mass index (BMI) (kg/m^2), ASA scores, and history of neoadjuvant treatment for gastric cancer were recorded. Surgical techniques and procedures (Laparoscopic/open surgery and distal/total gastrectomy), type of anastomosis, duration of operation (min), estimated intraoperative

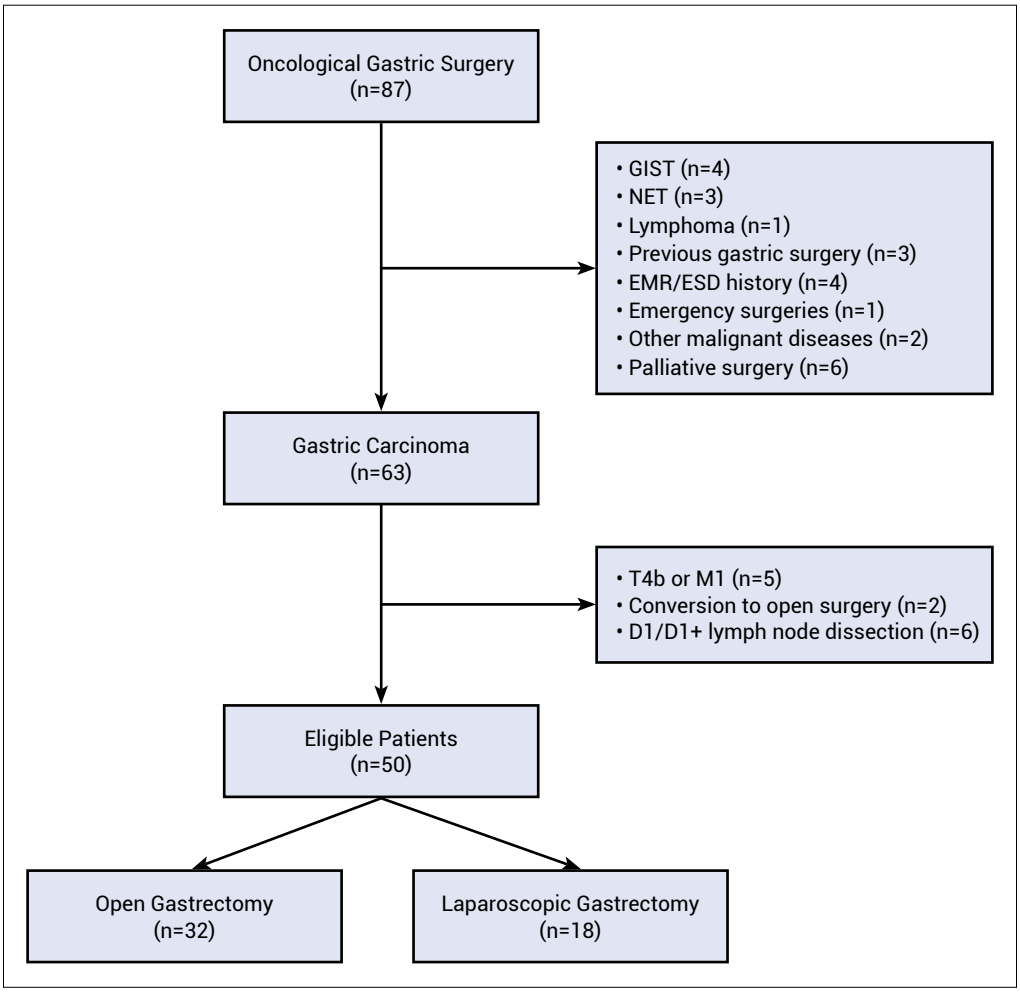

Figure 1. Flow chart illustrating patient enrollment.

blood loss (ml), serum pH and lactate levels at the end of the surgery, intraoperative complications, hospital stay (day), first flatus time (day), postoperative 30-day complications and mortality rates, tumor localization and histological type, tumor size (cm), proximal and distal surgical margin (cm), number of retrieved lymph nodes, number of metastatic lymph nodes and the pathological stage of the tumor were also recorded.

The greatest dimension was recorded for tumor size. Where there are multiple lesions, with the largest or advanced T category were classified. Tumor localization was categorized into three portions as upper, middle, and lower parts according to the Japanese Classification of gastric carcinoma (JCGC) 3rd edition.[15] The esophagogastric junction (EGJ) tumor was defined as border between the esophageal and gastric muscles. Histological type categorized as signet ring cell carcinoma (SRCC) and non-SRCC. Surgical margin status grouped as R0 (no cancer cells seen microscopically), R1 (cancer cells present microscopically), and R2 (presence of macroscopic residual tumor) according to the American Joint Committee on Cancer's (AJCC) 8th edition.[16] Estimated blood loss was measured by checking suction volumes and the number of gauzes used during surgery. Intraoperative complications were classified as bleeding, vascular injury, and organ injuries. Postoperative 30-day complications were classified as systemic and local complications and were graded according to the modified Clavien-Dindo Classification (CDC) system (Table 1).[17] Minor complications were defined as CDC grades I and II, and major complications were defined as CDC grades III–V.

Tumor Staging

Gross tumor morphology was categorized as localized, locally advanced, and metastatic according to the JCGC. Locally-AGC defined as clinical T2-4aN0-3M0 (excluding T1 or T4b tumors), clinical stages IB to IIIC according to AJCC staging manual 8th edition (stage IB: T2N0M0, stage II: T2N1-2M0, T3N0-1M0, T4aN0M0, stage III: T2N3M0, T3N2-3M0, T4aN1-3M0).[16]

Table 1. Clavien – Dindo Classification

Grade	Definition
Grade I	Any deviation from the normal postoperative course without the need for pharmacological treatment or surgical, endoscopic, and radiological interventions Allowed therapeutic regimens are: drugs as antiemetics, antipyretics, analgesics, diuretics, electrolytes, and physiotherapy. This grade also includes wound infections opened at the bedside
Grade II	Requiring pharmacological treatment with drugs other than such allowed for grade I complications Blood transfusions and total parenteral nutrition are also included
Grade III	Requiring surgical, endoscopic or radiological intervention
Grade IIIa	Intervention not under general anesthesia
Grade IIIb	Intervention under general anesthesia
Grade IV	Life-threatening complication (including CNS complications) requiring IC/ICU management
Grade IVa	Single organ dysfunction (including dialysis)
Grade IVb	Multiorgan dysfunction
Grade V	Death of a patient

CNS: Central nerve system.

Surgical Procedures

All patients with gastric carcinoma included in the study were operated by the same surgical team. LG procedures were performed using 5 trocars in both total and distal gastrectomy (Fig. 2). In laparoscopic and open procedures, electronic scalpel was adopted for mobilization and dissection. Laparoscopic and open distal or total gastrectomy were performed with the principles of the extent of distal and total gastrectomy and D2 lymph node dissection in accordance with the Japanese Gastric Cancer Treatment Guidelines 2018 (5th edition).[18] Accordingly, the extent of lymph node dissection in distal and middle located gastric carcinomas was 1, 3, 4sb, 4d, 5, 6, 7, 8a, 9, 11p, and 12a lymph nodes for distal gastrectomy. In upper and EGJ located gastric carcinomas 1, 2, 3, 4sa, 4sb, 4d, 5, 6, 7, 8a, 9, 11p, 11d, and 12a lymph nodes were dissected for total gastrectomy. In the upper gastric located or EGJ tumors, it was aimed to achieve a proximal margin of at least 4 cm. Safe proximal surgical margin was confirmed by intraoperative frozen section examination when proximal margin shorter than 4 cm. Greater omentum was removed in the standard gastrectomy for T3 or deeper tumors in both distal and total gastrectomy procedures.

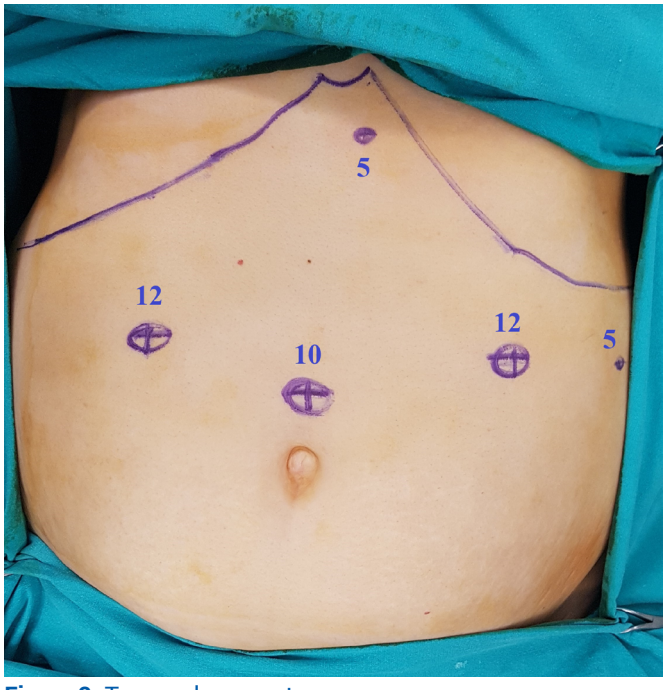

Figure 2. Trocar placements.

The digestive tract reconstruction method was performed for all the patients as retro-colic Roux-en-Y procedure in all total and distal gastrectomy cases. In LG cases, both esophagojejunostomy and gastrojejunostomy anastomoses were performed intracorporeally as side-to-side with endo-stapler. Stapler openings were closed in double layers with 3/0 PDS sutures. Unlike, esophagojejunostomy anastomosis with a circular stapler to be end-to-side was the preferred method in OG cases. A Pfannenstiel incision was made for specimen retraction in LG cases.

Postoperative Follow-up

The vital signs of the patients and the characteristics and amounts of the contents of the drainage catheter were recorded. Antibiotic medications and deep vein thrombosis prophylaxis were applied to all patients after surgery. All the patients were undergoing oral radiopaque-induced X-ray scope for examine anastomotic leakage in the 3rd postoperative day for distal gastrectomy patients and in the 5th postoperative day for total gastrectomy patients routinely. If there were no leakage signs according to scope findings and the contents of the drainage catheters, the fluid-content oral feeding was started at the same day.

Statistical Analyzes

All analyses were performed using IBM SPSS Statistics Version 22.0 statistical software and RStudio packages. Categorical variables were expressed as numbers and percentages, whereas continuous variables were summarized as median and minimum-maximum. According to the distribution of variables, χ^2 or Fisher's exact tests were used to compare differences in discrete or categorical variables. The Mann-Whitney U test was used for the comparison of continuous variables between the groups. The statistical level of significance for all tests was considered to be <0.05.

Results

The mean age of the patients include in the study was 59.3 (37–75) years. 84.0% (42/50) of gastric cancers were locally-AGCs and 16.0% (8/50) were EGCs. Distal gastrectomy was performed in 44.0% (22/50) of the patients, and total gastrectomy in 56.0% (28/50). Conventional OG procedure was performed to 64.0% (32/50) of the patients and 36.0% (18/50) was performed LG. Overall complication rates were 22.2% in the LG group and 31.3% in the OG group and the difference was not significant (p=0.495). The differences in minor and major complication rates (Minor; LG: 16.7% vs. OG: 18.8%, Major; LG: 5.6% vs. OG: 12.5%, p=0.700) were insignificant.

When the demographic characteristics of the OG and LG groups were compared, there were no significant differences in the distribution of gender, age, comorbid diseases, BMI, smoking status, ASA scores, and neoadjuvant treatment history (Table 2). When patients were subgrouped as OTG and LTG, tumor location, tumor morphology, tumor size, pathological stage, the number of retrieved total

Table 2. Demographic parameters

		OG (n=32)	LG (n=18)	p
Sex	Male	18 (56.3)	13 (72.2)	0.264
	Female	14 (43.8)	5 (27.8)	
Age (mean±SD)		59.2±12.2	59.3±14.3	0.808
Comorbid diseases	Diabetes Mellitus	5 (15.6)	0 (0.0)	0.145
	Hypertension	9 (28.1)	6 (33.3)	0.700
	Hearth failure/Coronary artery occlusion	8 (25.0)	6 (33.3)	0.529
	Asthma/COPD /OSAS	1 (3.1)	1 (5.6)	0.674
	Hyperlipidemia	3 (9.4)	0 (0.0)	0.180
	Others	4 (12.5)	1 (5.6)	0.432
	Total	16 (50.0)	7 (38.9)	0.449
BMI (kg/m^2)		27.06±3.33	26.94±3.58	0.800
Smoke	No	26 (81.3)	15 (83.3)	0.854
	Yes	6 (18.8)	3 (16.7)	
ASA score	2	8 (25.0)	7 (38.9)	0.304
	3	24 (75.0)	11 (61.1)	
Neoadjuvant treatment	No	22 (68.8)	10 (55.6)	0.351
	Yes	19 (31.3)	8 (44.4)	

Data presented as mean±SD, or numbers (%). Bold values indicate statistical significance p<0.05.
OG: Open gastrectomy; LG: Laparoscopic gastrectomy; COPD: Chronic obstructive pulmonary disease; OSAS: Obstructive sleepy apnea syndrome; BMI: Body mass index; ASA: Physical status classification by the American Society of Anesthesiologists.

Table 3. Histopathological findings of distal gastrectomy patients

		ODG (n=17)	LDG (n=5)	p
Morphological type	Signet ring cell carcinoma	3 (17.6)	0 (0.0)	0.312
	Non-signet ring cell carcinoma	14 (82.4)	5 (100.0)	
Tumor size (cm)		4.7±4.0	3.7±(2.2)	0.784
Pathological Stage	IA	4 (23.5)	1 (20.0)	0.472
	IB	3 (17.6)	1 (20.0)	
	IIA	2 (11.8)	1 (20.0)	
	IIB	0 (0.0)	1 (20.0)	
	IIIA	2 (11.8)	1 (20.0)	
	IIIB	5 (29.4)	0 (0.0)	
	IIIC	1 (5.9)	0 (0.0)	
	IV	0 (0.0)	0 (0.0)	
Total Retrieved Lymph Nodes		37.1±18.7 (11–84)	32.4±15.3 (16–54)	0.649
Metastatic retrieved lymph nodes		5.4±7.4 (0–26)	2.2±2.5 (0–6)	0.704
Proximal margin distance (cm)		7.8±3.4	4.8±4.1	0.130
Surgical margin status	R0	15 (88.2)	5 (100.0)	0.421
	R1	2 (11.8)	0 (0.0)	
	R2	0 (0.0)	0 (0.0)	

Data presented as mean±SD, min - max or numbers (%). Bold values indicate statistical significance p<0.05.
ODG: Open distal gastrectomy; LDG: Laparoscopy distal gastrectomy.

lymph nodes, the number of retrieved metastatic lymph nodes, surgical margin positivity, and tumor proximal margin distance were similar (Table 3).

Distally located tumors were divided into subgroups as open distal gastrectomy (ODG) and laparoscopic distal gastrectomy (LDG). Morphological type, tumor diameter, pathological stage, the number of retrieved total lymph nodes, the number of retrieved metastatic lymph nodes, surgical margin status, and tumor proximal margin distance were similar between the groups (Table 4).

When OG and LG patients were compared in terms of intraoperative and early postoperative findings, estimated blood loss was lesser (LG: 147.5 ml vs. OG: 194.5 ml, p=0.041), first flatus time was earlier (LG: 2.01 vs. OG: 2.62 days, p=0.002) and hospital stay was shorter (LG: 10.2 vs. OG: 14.4 days, p=0.004) in LG patients. On the other hand, the duration of operation was found to be significantly longer (LG: 285.7 vs. OG: 239.7 min, p<0.001) in LG patients. The pH and lactate values at the end of the operation, intraoperative complications, 30-day morbidity and mortality rates were similar between the groups (Table 5).

Discussion

This study demonstrates that LG is more favorable than OG in terms of its advantages in the perioperative period as intraoperative blood loss, time to first flatus, postoperative recovery, complications and hospital stay. Moreover, LG is not inferior to OG for performing lymphatic dissection in accordance with the surgical oncological principles even in locally-AGC. However, operation time was longer in the LG procedure.

Laparoscopic procedures have begun to be widely preferred surgical method by the surgeons in the last few decades with the increasing laparoscopic experience, technological developments, and increasing availability. Especially eastern countries where the gastric cancer is endemic, such as Japan, China, and Korea have led the spread of laparoscopic surgical approaches in gastric cancers. Initial randomized controlled studies in high volume centers in these countries were concerned with distal gastric located and early stages of gastric cancers. The Korean Laparoendoscopic Gastrointestinal Surgery Study (KLASS)-01 and Japan Clinical Oncology Group Study (JCOG-0912) are the most popular high volume multicenter randomized controlled studies.[6,7] The pa-

Table 4. Histopathological findings of total gastrectomy patients

		OTG (n=15)	LTG (n=13)	p
Tumor location	Corpus	9 (60.0)	7 (53.8)	0.122
	Cardia - EGJ	5 (33.3)	3 (23.1)	
	Linitis Plastica	1 (6.7)	3 (23.1)	
Morphological type	Signet ring cell carcinoma	5 (15.6)	1 (5.6)	0.293
	Non-signet ring cell carcinoma	27 (84.4)	17 (94.4)	
Tumor size (cm)		5.6±3.0	6.0±3.6	0.854
Pathological Stage	IA	0 (0.0)	1 (7.7)	0.586
	IB	0 (0.0)	0 (0.0)	
	IIA	1 (6.7)	2 (15.4)	
	IIB	1 (6.7)	0 (0.0)	
	IIIA	4 (26.7)	3 (23.1)	
	IIIB	4 (26.7)	5 (38.5)	
	IIIC	0 (0.0)	2 (15.4)	
	IV	0 (0.0)	0 (0.0)	
Total Retrieved Lymph Nodes		38.7±15.6 (13–64)	39.2±17.9 (19–76)	0.982
Metastatic retrieved lymph nodes		13.4±11.5 (0–40)	9.4±11.5 (0–43)	0.278
Proximal margin distance (cm)		3.5±2.4	3.1±2.3	0.433
Surgical margin status	R0	15 (100.0)	12 (92.3)	0.274
	R1	0 (0.0)	1 (7.7)	
	R2	0 (0.0)	0 (0.0)	

Data presented as mean±SD, min - max or numbers (%). Bold values indicate statistical significance p<0.05.
OTG: Open total gastrectomy; LTG: Laparoscopy total gastrectomy; EGJ: Esophago-gastric junction.

tients included in these studies had stage I gastric cancer and all underwent LDG or ODG. In the KLASS-01 study, the authors demonstrated that the overall complication rate was significantly lower in the LDG when compared to ODG (13.0% vs. 19.9%, respectively) and mortality rates were similar (0.3% vs. 0.9%, respectively). One of the most important issues emphasized in this study was the significantly lower incidence of wound infections in LDG.[6] In the JCOG-0912 study, it was reported that the usage of postoperative analgesic medication was lesser and the first flatus time was shorter in LDG patients when compared to ODG patients.[7] These findings support that LDG is a safe surgical approach in patients with EGC. However, it was emphasized that the operation time was significantly longer in LDG patients in both the KLASS-01 and JCOG-0912 studies.

In the following years, several eastern randomized controlled studies have been published which questioning the applicability of LDG in locally-AGC. One of them is KLASS-02 trial and the comparison of short-term clinical outcomes of LDG and ODG was evaluated in this study. It was underlined by the authors that LDG in locally-AGC has some advantages as lower complication rates, faster recovery, and less postoperative pain. And also, first flatus time was lower (3.5 vs. 3.7 days, respectively), hospital stay was shorter (8.1 vs. 9.3 days, respectively) and early postoperative complications were lower (16.6% vs. 24.1%, respectively) in LDG patients. Ninety days' mortality rates and retrieved lymph node numbers were reported as similar.[13] In the same period, the Chinese Laparoscopic Gastrointestinal Surgery Study (CLASS)-01 Group study was published, which evaluated the long-term oncologic results of LDG in locally-AGCs. In this large-series multicenter randomized controlled study, it was shown that there was no significant difference between 3-year disease-free survival rates (LDG: 76.5% vs. ODG: 77.8%), 3-year overall survival rates (LDG: 83.1% vs. ODG: 85.2%) and 3-year cumulative recurrence rates (LDG: 18.8% vs. ODG: 16.5%). These findings suggest that the long-term oncologic outcomes of LDG in distal gastric located can-

Table 5. Comparison of intraoperative findings and early-period clinical outcomes for LG vs. OG in both total and distal gastrectomy patients

		OG (n=32)	LG (n=18)	p
Duration of operation (min)		239.7	285.7	**<0.001**
Estimated blood loss (ml)		194.5	147.5	**0.041**
pH (min–max)		7.30 (7.21–7.42)	7.29 (7.19–7.41)	0.675
Lactate (min–max)		1.27 (0.1–4.3)	1.21 (0.1–3.7)	0.823
Intraoperative complications	None	31 (84.4)	16 (88.9)	0.289
	Bleeding	3 (9.4)	0 (0.0)	
	Vascular injury	2 (6.3)	1 (5.6)	
	Organ injury	0 (0.0)	1 (5.6)	
First flatus (day)		2.62	2.01	**0.002**
Hospital stay (day)		14.4	10.2	**0.004**
Postoperative surgery-related complications	None	23 (71.9)	15 (83.3)	0.256
	Anastomosis leakage	1 (3.1)	0 (0.0)	
	Hemorrhage	0 (0.0)	2 (11.1)	
	Lymphatic fistula	0 (0.0)	1 (5.6)	
	Pancreatic fistula	0 (0.0)	0 (0.0)	
	Wound infection	2 (6.3)	0 (0.0)	
	Internal herniation	1 (3.1)	0 (0.0)	
	Duodenal stump leakage	1 (3.1)	0 (0.0)	
	Delayed gastric emptying	2 (6.3)	0 (0.0)	
	Evisceration	2 (6.3)	0 (0.0)	
Postoperative systemic complications	None	27 (84.4)	17 (94.4)	0.690
	Pneumonia	3 (9.4)	1 (5.6)	
	Organ failure	1 (3.1)	0 (0.0)	
	Pulmonary emboli	1 (3.1)	0 (0.0)	
Postoperative overall complications (30-days)		10 (31.3)	4 (22.2)	0.495
Postoperative mortality (30-days)		2 (6.3)	0 (0.0)	0.279
CDC score	Minor (I–II)	6 (18.8)	3 (16.7)	0.700
	Major (III–V)	4 (12.5)	1 (5.6)	

Data presented as mean or numbers (%). Bold values indicate statistical significance p<0.05.
OG: Open gastrectomy; LG: Laparoscopic gastrectomy; CDC: Clavien-Dindo Classification.

cers are not inferior to conventional ODG. Therefore, the authors emphasized that the LDG procedure could be perform safely in locally-AGC patients.[11]

The demonstration that LDG provides advantageous postoperative clinical outcomes and adequate long-term oncological results in distal gastric located EGCs and locally-AGCs has paved the way for the development of LTG approaches in proximal gastric cancers. In relation, in a Korean prospective multi-center phase 2 clinical trial (KLASS-03), it was emphasized that LTG showed acceptable postoperative morbidity (20.6%) and mortality (0.6%) rates for patients with clinical stage I gastric cancer, and these results did not significantly differ from that reported in previous studies for OTG.[8] In another single-arm trial of LTG or laparoscopic proximal gastrectomy (LPG) for clinical stage I gastric cancer (JCOG-1401), the authors confirmed the safety of LTG/LPG on postoperative complications.[9] In the CLASS-02 trial from China, a multicenter randomized controlled study for EGCs, overall morbidity and mortality rates were not significantly different between the groups. Additionally, the retrieved lymph node counts were similar. However, the expected positive effects of laparoscopic procedures on time to first

flatus, time to first liquid intake, and the duration of hospital stay were not seen. Only intraoperative blood loss significantly lesser in LTG than OTG patients.[10]

Standard D2 lymph node dissection procedure was performed for all patients included in the present study. The number of total lymph nodes to be retrieved in the D2 dissection procedure for gastric cancer is related to oncological adequacy and reliability. In large series prospective randomized studies, the mean number of lymph nodes retrieved for LTG is 18–48.8 (min–max), in LDG cases is 23.5–46.6 (min–max).[4,12] In this study, similar lymph node dissection numbers were obtained in accordance with the literature data. In the systemic reviews, longer duration of operation was required for patients in the LG group than the OG group (LG: 180–378 min vs. OG: 121–235 min). It was emphasized that mean difference between the procedures is approximately 59 min, similar to the recent study's findings (46 min).[19] Recent papers demonstrate that patients in the LG group lost less blood during operation (38–336 ml) when compared to OG group (108–489 ml). It was reported in the same review that the mean difference of blood loss between the surgical approaches is 54 ml.[19] This value was found as 47 ml in the recent study.

Another advantage of LG is on the bowel movements after surgery. There are many comparative studies that evaluate the first flatus time after open and laparoscopic procedures. Accordingly, the mean first flatus time in LG patients was 0.54–0.58 days shorter than in OG patients.[4,19] Similarly, it was found as 0.61 day in this study. Shorter hospital stay is the most important clinical outcome that expected in minimally invasive gastrectomy procedures. This is an indicator for postoperative faster recovery and reduced hospital costs. Similar to the literature findings, the mean hospital stay was approximately 10 days in LG and 14 days in OG. Minor and severe postoperative complications, systemic and surgical-related 30-day morbidity were lower in LG than in OG. Although complication rates were more favorable in LG, statistical insignificance was probably due to the small number of patients in the groups included in the study.

The potency of this study is limited due to its retrospective nature. The statistical insignificance of the advantageous effects of laparoscopic procedures on postoperative complications and 30-day morbidity rate was attributed to the insufficient number of the patients included in this study. In addition, long-term survival outcomes and disease-free survival rates could not be evaluated because the follow-up periods of the patients were not yet sufficient. Further studies may need to be in a publicly available registry to enroll enough patients or a multicenter prospective randomized controlled trial.

Conclusion

This study demonstrates that LG is advantageous in terms of early postoperative outcomes, and not inferior in the application of lymph nodes dissection according to oncological principles compared to OG. LG can be safely performed in experienced hands with an acceptable increase in the duration of operation. Surgeons should have focus on the clinical and oncological outcomes of LTG in locally-AGCs.

Disclosures

Ethichs Committee Approval: The study was approved by the Firat University Faculty of Medicine Ethics Committee (date: date: 18/05/2021, decision no: 44396).

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

Authorship Contributions: Concept – A.L., E.A.; Design – A.L., E.A.; Supervision – A.L., E.A.; Materials – A.L., E.A.; Data collection and/or processing – A.L., E.A.; Analysis and/ or interpretation – A.L., E.A.; Literature search – A.L., E.A.; Writing – A.L., E.A.; Critical review – A.L., E.A.

References

1. WHO. Cancer. Available at: https://www.who.int/news-room/fact-sheets/detail/cancer. Accessed Mar 3, 2021.
2. Kitano S, Iso Y, Moriyama M, Sugimachi K. Laparoscopy-assisted Billroth I gastrectomy. Surg Laparosc Endosc 1994;4:146–8. Erratum in: Surg Laparosc Endosc 2013;23:480.
3. Lu J, Huang CM, Zheng CH, Li P, Xie JW, Wang JB, et al. Short- and long-term outcomes after laparoscopic versus open total gastrectomy for elderly gastric cancer patients: a propensity score-matched analysis. J Gastrointest Surg 2015;19:1949–57. [CrossRef]
4. Chen X, Feng X, Wang M, Yao X. Laparoscopic versus open distal gastrectomy for advanced gastric cancer: A meta-analysis of randomized controlled trials and high-quality nonrandomized comparative studies. Eur J Surg Oncol 2020;46:1998–2010. [CrossRef]
5. Shan F, Gao C, Li XL, Li ZY, Ying XJ, Wang YK, et al. Short- and long-term outcomes after laparoscopic versus open gastrectomy for elderly gastric cancer patients: a systematic review and meta-analysis. J Laparoendosc Adv Surg Tech A 2020;30:713–22. [CrossRef]

6. Kim W, Kim HH, Han SU, Kim MC, Hyung WJ, Ryu SW, et al; Korean Laparo-endoscopic Gastrointestinal Surgery Study (KLASS) Group. Decreased morbidity of laparoscopic distal gastrectomy compared with open distal gastrectomy for stage i gastric cancer: short-term outcomes from a multicenter randomized controlled trial (KLASS-01). Ann Surg 2016;263:28–35. [CrossRef]
7. Katai H, Mizusawa J, Katayama H, Takagi M, Yoshikawa T, Fukagawa T, et al. Short-term surgical outcomes from a phase III study of laparoscopy-assisted versus open distal gastrectomy with nodal dissection for clinical stage IA/IB gastric cancer: Japan Clinical Oncology Group Study JCOG0912. Gastric Cancer 2017;20:699–708. [CrossRef]
8. Hyung WJ, Yang HK, Han SU, Lee YJ, Park JM, Kim JJ, et al. A feasibility study of laparoscopic total gastrectomy for clinical stage I gastric cancer: a prospective multi-center phase II clinical trial, KLASS 03. Gastric Cancer 2019;22:214–22.
9. Katai H, Mizusawa J, Katayama H, Kunisaki C, Sakuramoto S, Inaki N, et al; Stomach Cancer Study Group of Japan Clinical Oncology Group. Single-arm confirmatory trial of laparoscopy-assisted total or proximal gastrectomy with nodal dissection for clinical stage I gastric cancer: Japan Clinical Oncology Group study JCOG1401. Gastric Cancer 2019;22:999–1008. [CrossRef]
10. Liu F, Huang C, Xu Z, Su X, Zhao G, Ye J, et al; Chinese Laparoscopic Gastrointestinal Surgery Study (CLASS) Group. Morbidity and mortality of laparoscopic vs open total gastrectomy for clinical stage i gastric cancer: The CLASS02 multicenter randomized clinical trial. JAMA Oncol 2020;6:1590–7. [CrossRef]
11. Yu J, Huang C, Sun Y, Su X, Cao H, Hu J, et al; Chinese Laparoscopic Gastrointestinal Surgery Study (CLASS) Group. Effect of laparoscopic vs open distal gastrectomy on 3-year disease-free survival in patients with locally advanced gastric cancer: The CLASS-01 randomized clinical trial. JAMA 2019;321:1983–92. [CrossRef]
12. Li B, Yu-Hong Wong I, Siu-Yin Chan F, Chan KK, Lai-Yin Wong C, Law TT, et al. Comparison of laparoscopic versus open gastrectomy for gastric cancer. Surg Oncol 2020;35:14–21.
13. Lee HJ, Hyung WJ, Yang HK, Han SU, Park YK, An JY, et al; Korean Laparo-endoscopic Gastrointestinal Surgery Study (KLASS) Group. Short-term outcomes of a multicenter randomized controlled trial comparing laparoscopic distal gastrectomy with D2 lymphadenectomy to open distal gastrectomy for locally advanced gastric cancer (KLASS-02-RCT). Ann Surg 2019;270:983–91. [CrossRef]
14. Kim HH, Han SU, Kim MC, Hyung WJ, Kim W, Lee HJ, et al. Long-term results of laparoscopic gastrectomy for gastric cancer: a large-scale case-control and case-matched Korean multicenter study. J Clin Oncol 2014;32:627–33. [CrossRef]
15. Japanese Gastric Cancer Association. Japanese classification of gastric carcinoma: 3rd English edition. Gastric Cancer 2011;14:101–12. [CrossRef]
16. Amin MB, Greene FL, Edge SB, Compton CC, Gershenwald JE, Brookland RK, et al. The eighth edition ajcc cancer staging manual: continuing to build a bridge from a population-based to a more "personalized" approach to cancer staging. CA Cancer J Clin 2017;67:93–9. [CrossRef]
17. Dindo D, Demartines N, Clavien PA. Classification of surgical complications: a new proposal with evaluation in a cohort of 6336 patients and results of a survey. Ann Surg 2004;240:205–13. [CrossRef]
18. Japanese Gastric Cancer Association. Japanese gastric cancer treatment guidelines 2018 (5th edition). Gastric Cancer 2021;24:1–21. [CrossRef]
19. Zeng F, Chen L, Liao M, Chen B, Long J, Wu W, et al. Laparoscopic versus open gastrectomy for gastric cancer. World J Surg Oncol 2020;18:20. [CrossRef]