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Original Article

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Comparison of Laparoscopic and Open Gastrectomy for Patients With Gastric Cancer Treated With Neoadjuvant Chemotherapy: A Multicenter Retrospective Study Based on the Korean Gastric Cancer Association Nationwide Survey

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ABSTRACT

Purpose: Despite scientific evidence regarding laparoscopic gastrectomy (LG) for advanced gastric cancer treatment, its application in patients receiving neoadjuvant chemotherapy remains uncertain.
Materials and Methods: We used the 2019 Korean Gastric Cancer Association nationwide survey database to extract data from 489 patients with primary gastric cancer who received neoadjuvant chemotherapy. After propensity score matching analysis, we compared the surgical outcomes of 97 patients who underwent LG and 97 patients who underwent open gastrectomy (OG). We investigated the risk factors for postoperative complications using multivariate analysis.
Results: The operative time was significantly shorter in the OG group. Patients in the LG group had significantly less blood loss than those in the OG group. Hospital stay and overall postoperative complications were similar between the two groups. The incidence of Clavien–Dindo grade ≥3 complications in the LG group was comparable with that in the OG group (1.03% vs. 4.12%, P=0.215). No statistically significant difference was observed in the number of harvested lymph nodes between the two groups (38.60 vs. 35.79, P=0.182). Multivariate analysis identified body mass index (odds ratio [OR], 1.824; 95% confidence interval [CI], 1.029–3.234; P=0.040) and extent of resection (OR, 3.154; 95% CI, 1.084–9.174; P=0.035) as independent risk factors for overall postoperative complications.
Conclusions: Using a large nationwide multicenter survey database, we demonstrated that LG and OG had comparable short-term outcomes in patients with gastric cancer who received neoadjuvant chemotherapy.

Keywords: Gastric cancer; Neoadjuvant chemotherapy; Gastrectomy; Complication

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Conflict of Interest
No potential conflict of interest relevant to this article was reported.

Authors Contributions
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INTRODUCTION

Gastric cancer treatment guidelines in East Asian countries, particularly Korea and Japan, recommend surgical resection for resectable gastric cancers beyond the indications for endoscopic resection. After surgery, adjuvant chemotherapy is recommended for patients with stage II or III gastric cancer [1,2].

In Korea and Japan, adjuvant chemotherapy after curative gastrectomy is well established as a standard treatment. However, Western countries mainly rely on neoadjuvant chemotherapy for gastric cancer treatment based on large-scale randomized controlled trials, such as the MAGIC and FLOT, which have demonstrated its efficacy in advanced gastric cancer [3,4].

Based on the excellent results of these studies, a recent multicenter randomized controlled trial was conducted in Korea, demonstrating the benefits of neoadjuvant chemotherapy for patients with advanced gastric cancer. Progression-free survival was significantly higher in the neoadjuvant chemotherapy group than in the adjuvant chemotherapy group, and the complete remission rate after neoadjuvant chemotherapy was 10% [5]. These promising results demonstrate that neoadjuvant chemotherapy is effective for patients with locally advanced gastric cancer in Korea.

The effectiveness of neoadjuvant chemotherapy for Korean patients with advanced gastric cancer has been demonstrated through multicenter phase 3 clinical trials; however, surgical approaches, specifically laparoscopic gastrectomy (LG) or open gastrectomy (OG), have not yet been established in patients who have received neoadjuvant chemotherapy.

Therefore, this study aimed to compare the safety and effectiveness of LG and OG for patients with gastric cancer who underwent neoadjuvant chemotherapy using the 2019 Korean Gastric Cancer Association (KGCA) nationwide survey database.

MATERIALS AND METHODS

Patients

We used the 2019 KGCA nationwide survey database [6], comprising 54 clinical information data points registered by 68 institutions nationwide from 14,076 patients who underwent gastric cancer surgery at each institution between January 1, 2019, and December 31, 2019. We initiated a study involving 489 patients who received neoadjuvant chemotherapy. Patients aged <20 years and ≥80 years, those with distant metastasis during the operation, those who underwent palliative or robotic surgery, those who underwent limited gastrectomy, those with a history of previous stomach surgery, and those who underwent major organ combined resection, except for gall bladder resection, were excluded from this study. The final cohort comprised 334 patients from 19 institutions, with 140 who underwent OG and 194 who underwent LG. **Fig. 1** shows the CONSORT diagram used in this study.

We used propensity score matching (PSM) to compare both groups and minimize differences in baseline characteristics. For PSM analysis, we selected baseline variables, including age, sex, body mass index (BMI), American Society of Anesthesiologists (ASA) score, Eastern Cooperative Oncology Group (ECOG) score, comorbidities, previous history of abdominal surgery, extent of resection, combined resection, extent of lymph node dissection, yp T stage,

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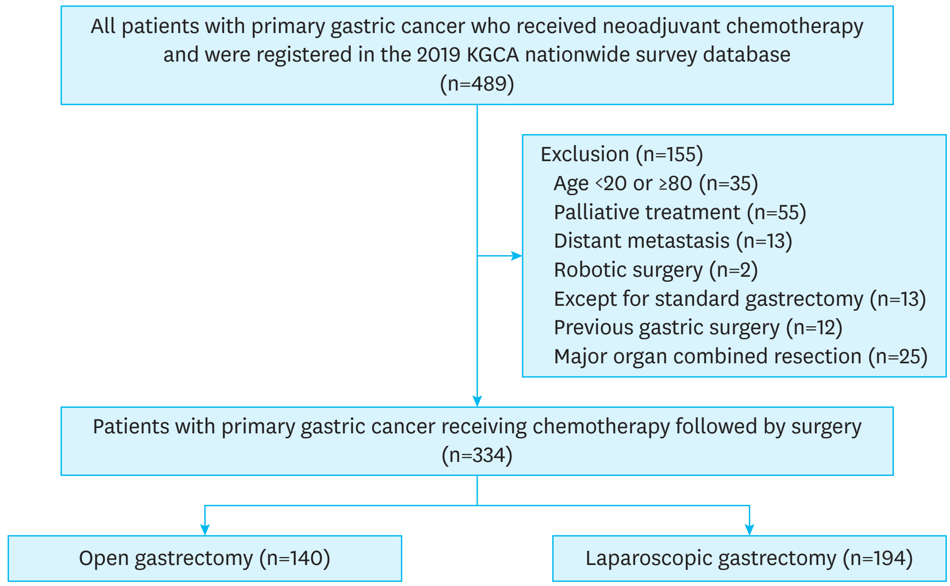

Fig. 1. CONSORT diagram of this study.
KGCA = Korean Gastric Cancer Association.

and yp N stage. Following PSM analysis, we identified 97 matched patients in each group. The Institutional Review Board of Asan Medical Center approved this study (2022-1453).

Clinical information: baseline characteristics

We collected the following baseline patient characteristics from the 2019 KGCA nationwide survey database: age, sex, BMI, ASA score, ECOG score, comorbidities, and previous history of abdominal surgery.

Clinical information: surgical outcomes, pathologic results, and postoperative morbidity

To compare the surgical outcomes between the LG and OG groups, we used parameters of several surgical outcomes, including operative time, hospital stay, intraoperative blood loss, and reconstruction method.

Moreover, we used the pathologic data of each resected specimen, including tumor size, yp T stage, yp N stage, yp tumour, node and metastasis stage, number of metastatic lymph nodes, number of harvested lymph nodes, tumor location, macroscopic type, histologic type, Lauren's classification, lymphovascular invasion, and perineural invasion.

Data on overall complications, Clavien–Dindo grade ≥3 complications, and postoperative mortality were used to analyze postoperative morbidity and mortality. Additionally, we used detailed information on postoperative complications, including postoperative bleeding, anastomotic complications, and fluid collection, to compare the two groups.

Statistical analysis

This study aimed to determine the differences between the LG and OG groups using PSM. First, the missing values for ECOG score_1 (11%), comorbidity_1 (6%), previous abdominal surgery_1 (5%), and depth of invasion_1 (1%) were filled by multiple imputations using the Markov chain Monte Carlo method (10 times). Multiple logistic regression analysis was then

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Table 1. Clinical characteristics of patients who underwent LG and OG after neoadjuvant chemotherapy

Variables	Total set (n=332)		P-value	Standardized difference	PSM set (1:1) (n=194)		Standardized difference
	LG (n=193)	OG (n=139)			LG (n=97)	OG (n=97)	
Age (yr)	62.0±11.4	63.5±10.8	0.210	0.140	65.6±9.2	64.1±11.2	0.143
Sex			0.163	0.156			0.022
Male	119 (61.7)	96 (69.1)			67 (69.1)	68 (70.1)	
Female	74 (38.3)	43 (30.9)			30 (30.9)	29 (29.9)	
BMI (kg/m²)	24.4±3.5	23.3±3.2	0.003	0.338	24.0±3.4	23.8±3.1	0.062
Comorbidity			0.304	0.120			0.224
No	88 (46.1)	49 (40.2)			25 (26.3)	33 (36.7)	
Yes	103 (53.9)	73 (59.8)			70 (73.7)	57 (63.3)	
ECOG score			0.066	0.230			0.050
0/1	176 (97.8)	106 (93.0)			83 (95.4)	80 (96.4)	
2	4 (2.2)	8 (7.0)			4 (4.6)	3 (3.6)	
ASA score			0.008	0.293			0.027
1/2	172 (89.1)	109 (78.4)			79 (81.4)	80 (82.5)	
3/4	21 (10.9)	30 (21.6)			18 (18.6)	17 (17.5)	
Extent of gastrectomy			<0.0001	0.540			0.024
Distal	168 (87.0)	90 (64.7)			73 (75.3)	72 (74.2)	
Total	25 (13.0)	49 (35.3)			24 (24.7)	25 (25.8)	
Extent of lymph node dissection			<0.0001	0.735			0.073
Less than D2	91 (47.2)	21 (15.1)			24 (24.7)	21 (21.7)	
D2	102 (52.9)	118 (84.9)			73 (75.3)	76 (78.4)	
Combined resection			0.994	0.001			0.104
No	175 (90.7)	126 (90.7)			86 (88.7)	89 (91.8)	
Yes	18 (9.3)	13 (9.4)			11 (11.3)	8 (8.3)	
Previous abdominal surgery			0.525	0.074			0.061
No	168 (87.1)	110 (89.4)			88 (90.7)	80 (88.9)	
Yes	25 (13.0)	13 (10.6)			9 (9.3)	10 (11.1)	

Values are expressed as mean ± standard deviation or number (%).
LG = laparoscopic gastrectomy; OG = open gastrectomy; PSM = propensity score matching; BMI = body mass index; ECOG = Eastern Cooperative Oncology Group; ASA = American Society of Anesthesiologists Physical Status Classification.

performed on the probability of being in the OG group in each of the 10 imputed datasets. A fully non-parsimonious model was developed, which included all the variables in **Table 1**. The mean of the predicted probabilities was used to estimate the propensity score. Model discrimination and calibration were assessed using c statistics (c=0.814) and the Hosmer–Lemeshow goodness-of-fit test (χ^2=8.5626, P=0.3805). Matching was performed in a 1:1 ratio by greedy matching using a caliper with 0.2 standard deviations of the logit of the propensity score. Absolute standardized differences were used to diagnose balance after matching. All absolute standardized differences after matching were <0.25. Differences in patient clinical characteristics and pathologic data were compared using t-test and χ^2 test or Fisher's exact test.

Risk factors for postoperative complications were identified using logistic regression, and variables in the multivariate analysis were selected using the backward elimination method. In the propensity score-matched set, paired comparisons were performed using the paired t-test for continuous variables and conditional logistic regression for binary variables. Statistical analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC, USA), and P-values <0.05 were considered statistically significant (two-sided).

RESULTS

Baseline patient characteristics

Table 1 presents the baseline characteristics of the patients in the LG and OG groups. Significant differences in BMI, ASA score, the extent of resection, extent of lymph node

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dissection, T stage, and N stage were observed between the two groups before PSM analysis. However, these differences were eliminated after PSM analysis, and the baseline characteristics were well balanced between the two groups.

Surgical outcomes and pathologic results

Tables 2 and **3** present the surgical outcomes and pathological results of the two groups after PSM analysis. The operative time was shorter in the OG group than in the LG group (178.8 minutes vs. 236.1 minutes; P<0.0001). Intraoperative blood loss was significantly lower in the LG group than in the OG group (126.3 mL vs. 288.2 mL, P<0.0001). Hospital stay after surgery in the LG group was 8.7 days, whereas that in the OG group was 9.7 days. However, no significant difference was observed between the two groups (P=0.212). Moreover, a significant difference in the reconstruction methods was observed between the two groups (P<0.0001). The mean numbers of harvested lymph nodes were 38.6 and 35.8 in the LG and OG groups, respectively (P=0.182). No significant differences in other pathologic data, including tumor size, number of metastatic lymph nodes, tumor location, macroscopic type, histologic type, Lauren's classification, yp stage, lymphovascular invasion, and perineural invasion, were observed between the two groups.

Postoperative complications

The postoperative complications are presented in **Table 4**. No statistically significant differences in the overall postoperative complications were observed between the two groups (LG: 9.28% vs. OG: 6.19%; P=0.410). Additionally, the rate of Clavien–Dindo grade ≥3 complications (1.03% vs. 4.12%, P=0.215) in the LG group was comparable to that in the OG group. Postoperative mortality was observed in one patient in the OG group, whereas none was reported in the LG group. The two groups showed no significant differences regarding other complications, such as anastomotic complications, postoperative bleeding, and fluid collection.

Risk factors for postoperative morbidity

Table 5 presents the risk factors for postoperative morbidity after LG and OG. BMI and the extent of resection were significantly associated with overall postoperative complications in univariate and multivariate analyses. Multivariate analysis showed that lower BMI had a negative impact on postoperative morbidity (odds ratio [OR], 0.39; 95% confidence interval [CI], 0.15–0.98, P=0.045). Additionally, postoperative morbidity was statistically significantly more frequent among those who underwent total gastrectomy than those who underwent distal gastrectomy (OR, 2.47; 95% CI, 1.11–5.46; P=0.026).

Table 2. Early surgical outcomes for patients undergoing LG and OG after neoadjuvant chemotherapy

Variables	Total set (n=332)		P-value	PSM set (1:1) (n=194)		P-value
	LG (n=193)	OG (n=139)		LG (n=97)	OG (n=97)	
Operative time (min)	226.6±67.5	180±62.8	<0.0001	236.1±67.1	178.8±58.2	<0.0001
Blood loss (mL)	128.1±121.5	266.7±292.6	<0.0001	126.3±97.4	288.2±329.3	<0.0001
Reconstruction method			<0.0001			<0.0001
B-I	54 (28.0)	51 (36.7)		14 (14.4)	45 (46.4)	
B-II	53 (27.5)	9 (6.5)		25 (25.8)	7 (7.2)	
RYGJ	61 (31.6)	30 (21.6)		34 (35.1)	20 (20.6)	
RYEJ	25 (13.0)	49 (35.3)		24 (24.7)	25 (25.8)	
Hospital day after surgery (days)	8.4±3.7	10.8±9.9	0.0002	8.7±4.1	9.7±7.1	0.212

Values are expressed as mean ± standard deviation or number (%).
LG = laparoscopic gastrectomy; OG = open gastrectomy; PSM = propensity score matching; B-I = Billroth I; B-II = Billroth II; RYGJ = Roux-en-Y gastrojejunostomy; RYEJ = Roux-en-Y esophagojejunostomy.

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Table 3. Pathologic data for patients undergoing LG and OG after neoadjuvant chemotherapy

Variables	Total set (n=332)		P-value	PSM set (1:1) (n=194)		P-value
	LG (n=193)	OG (n=139)		LG (n=193)	OG (n=139)	
Tumor size (cm)	3.6±2.5	4.9±2.8	<0.0001	4.4±3.0	4.5±2.6	0.700
Tumor location (tubular)			0.0002			0.894
Upper third	23 (11.9)	41 (29.5)		19 (19.6)	21 (21.7)	
Middle third	39 (20.2)	29 (20.9)		21 (21.7)	24 (24.7)	
Lower third	130 (67.4)	67 (48.2)		56 (57.7)	51 (52.6)	
Whole stomach	1 (0.5)	2 (1.4)		1 (1.0)	1 (1.0)	
Tumor location (circular)			0.395			0.974
Lesser curvature	78 (40.4)	67 (48.2)		47 (48.5)	49 (50.5)	
Greater curvature	49 (25.4)	24 (17.3)		18 (18.6)	17 (17.5)	
Anterior wall	33 (17.1)	21 (15.1)		16 (16.5)	14 (14.4)	
Posterior wall	29 (15.0)	23 (16.6)		12 (12.4)	14 (14.4)	
Circular	4 (2.1)	4 (2.9)		4 (4.1)	3 (3.1)	
Macroscopic type			<0.0001			0.534
EGC	143 (75.3)	58 (41.7)		55 (56.7)	51 (52.6)	
Borrmann 1/2	11 (5.8)	23 (16.6)		9 (9.3)	14 (14.4)	
Borrmann 3/4	36 (19.0)	58 (41.7)		33 (34.0)	32 (33.0)	
Histologic type			0.203			0.248
Differentiated	97 (50.3)	66 (47.5)		46 (47.4)	51 (52.6)	
Undifferentiated	92 (47.7)	73 (52.5)		48 (49.5)	46 (47.4)	
Others	4 (2.1)	0 (0.0)		3 (3.1)	0 (0.0)	
Lauren's classification			0.909			0.864
Intestinal	93 (48.7)	68 (48.9)		47 (49.0)	53 (54.6)	
Diffuse	70 (36.7)	52 (37.4)		36 (37.5)	32 (33.0)	
Mixed	23 (12.0)	14 (10.1)		9 (9.4)	9 (9.3)	
Unknown	5 (2.6)	5 (3.6)		4 (4.2)	3 (3.1)	
ypTstage			0.567			0.372
T1	147 (77.0)	55 (40.1)		57 (58.8)	50 (51.6)	
T2	19 (9.9)	16 (11.7)		14 (14.4)	10 (10.3)	
T3	17 (8.9)	30 (21.9)		17 (17.5)	15 (15.5)	
T4	8 (4.2)	36 (26.3)		8 (8.3)	20 (20.6)	
ypNstage			0.673			0.224
N0	162 (83.9)	84 (60.4)		73 (75.3)	66 (68.0)	
N1	19 (9.8)	19 (13.7)		12 (12.4)	11 (11.3)	
N2	7 (3.6)	16 (11.5)		7 (7.2)	12 (12.4)	
N3	5 (2.5)	20 (14.4)		5 (5.1)	8 (8.3)	
ypStage			<0.0001			0.133
I	162 (84.4)	63 (45.7)		69 (71.1)	55 (57.3)	
II	18 (9.4)	39 (28.3)		16 (16.5)	23 (24.0)	
III	12 (6.3)	36 (26.1)		12 (12.4)	18 (18.8)	
Retrieved LN	36.3 (14.6)	37.1 (13.3)	0.585	38.6 (16.6)	35.8 (13.0)	0.182
Metastatic LN	0.8 (3.5)	3.1 (7.0)	<0.0001	1.5 (4.9)	1.9 (4.7)	0.240

Values are expressed as mean ± standard deviation or number (%).
LG = laparoscopic gastrectomy; OG = open gastrectomy; PSM = propensity score matching; EGC = early gastric cancer; LN = lymph node.

Table 4. Postoperative complications

Variables	Total set (n=332)		P-value	PSM set (1:1) (n=194)		P-value
	LG (n=193)	OG (n=139)		LG (n=193)	OG (n=139)	
Overall complications	17 (8.8)	17 (12.2)	0.312	9 (9.3)	6 (6.2)	0.410
Clavien–Dindo classification ≥3	3 (1.6)	10 (7.2)	0.017	1 (1.0)	4 (4.1)	0.215
Anastomotic complication	3 (1.6)	2 (1.4)	0.932	2 (2.1)	0 (0.0)	NA
Postoperative bleeding	0 (0.0)	1 (0.7)	NA	0 (0.0)	1 (1.0)	NA
Fluid collection	4 (2.1)	8 (5.8)	0.089	1 (1.0)	2 (2.1)	NA
Mortality	0 (0.0)	1 (0.7)	NA	0 (0.0)	1 (1.0)	NA

Values are expressed as mean ± standard deviation or number (%).
LG = laparoscopic gastrectomy; OG = open gastrectomy; PSM = propensity score matching.

Table 5. Risk factors for postoperative complication

Variables	Univariate			Multivariate		
	OR	95% CI	P-value	OR	95% CI	P-value
Age (yr)			0.549			
<70	1.00	0.97–1.03				
≥70	0.79	0.36–1.71				
Sex			0.136			
Male	Ref					
Female	0.53	0.23–1.22				
BMI			0.021			0.045
<25	Ref			Ref		
≥25	0.34	0.14–0.85	0.166	0.39	0.15–0.98	
Type of approach			0.312			
LG	Ref					
OG	1.44	0.71–2.94				
Extent of gastrectomy			0.007			0.026
Distal	Ref			Ref		
Total	2.78	1.33–5.82		2.47	1.11–5.46	
ASA score			0.168			
1/2	Ref					
3/4	1.83	0.78–4.29				
ECOG score						
0/1	Ref					
2	2.06	0.43–9.91	0.369			
Comorbidity						
No	Ref					
Yes	0.82	0.38–1.76	0.608			
Previous abdominal surgery			0.817			
Yes	1.14	0.38–3.47				
No	Ref					
Combined resection			0.262			
Yes	1.80	0.64–5.06				
No	Ref					
Extent of LN dissection			0.189			
Less than D2	Ref					
D2	1.74	0.76–3.99				
Pathologic tumor stage			0.091			
T1/2	Ref					
T3/4	1.91	0.90–4.05				
Pathologic nodal stage			0.287			
N0/1	Ref					
N2/3	1.63	0.67–3.97				

OR = odds ratio; CI = confidence interval; BMI = body mass index; LG = laparoscopic gastrectomy; OG = open gastrectomy; ASA = American Society of Anesthesiologists Physical Status Classification; ECOG = Eastern Cooperative Oncology Group; LN = lymph node.

DISCUSSION

This study is the first to demonstrate the safety of LG in patients with advanced gastric cancer who received neoadjuvant chemotherapy using a nationwide multicenter retrospective database. This study contributes to the body of research in several ways. First, we attempted to address the limitations of previous studies. Unlike most previous studies on patients with advanced gastric cancer treated with neoadjuvant chemotherapy were conducted at a single institution with less than 50 patients [7-9], our study used nationwide data from over 400 patients with advanced gastric cancer who were treated with neoadjuvant chemotherapy at more than 50 institutions. Furthermore, we conducted a PSM analysis to improve the statistical power of the study.

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Second, our study confirmed the advantages of LG as an upfront surgery for patients with advanced gastric cancer in a neoadjuvant chemotherapy setting. The safety of LG in patients with advanced gastric cancer without neoadjuvant chemotherapy has been verified in previous studies. For instance, in the CLASS-01 trial, no difference in the postoperative morbidity rate was observed between the LG and OG groups, and the LG group was non-inferior to the OG group in terms of the 3-year disease-free survival rate [10,11]. Moreover, in the KLASS-2 trial, LG showed superior results regarding early complication rates compared with OG [12]. Our findings are in line with those of previous reports, as we observed that the intraoperative blood loss in the LG group was lower, and that the hospital stay and complication rates were comparable to those in the OG group.

Finally, our study provides empirical evidence on potential technical and oncological issues associated with neoadjuvant chemotherapy. When a patient is treated with neoadjuvant chemotherapy, there are several concerns during laparoscopic surgery: it is difficult to manipulate tissues for delicate procedures because of fibrotic tissue changes and edema, touch bleeding occurs easily, and the correct surgical planes are difficult to identify [8,13]. However, despite these concerns, our study observed no difference in complications, such as fluid collection after surgery that could occur with lymph node dissection. Additionally, intraoperative blood loss in the LG group was less than that in the OG group; thus, laparoscopic surgery was safely and effectively performed, which is consistent with the findings of previous studies [7,14].

Another technical and oncological issue in advanced gastric cancer surgery with neoadjuvant chemotherapy is the appropriate lymph node dissection. In this study, no difference in the number of harvested lymph nodes was observed between the two groups. An average of 35 or more lymph nodes was obtained in both groups, which meets or exceeds what was reported in other studies [8,14-16]. Additionally, laparoscopic surgery for gastric cancer treated with neoadjuvant chemotherapy could be an oncologically competent surgery because it satisfies the recommendations for >30 harvested lymph nodes proposed by the American Joint Committee on Cancer [17].

The favorable outcomes in this study were due to accumulated experience with various laparoscopic surgeries. In Korea, where this study was conducted, there is a high incidence of gastric cancer, and upper gastrointestinal surgeons perform more than 70% of all gastric cancer surgeries via minimally invasive approaches [6].

We assumed that the patients enrolled in our study had either favorable responses to neoadjuvant chemotherapy or less severe gastric cancer before chemotherapy; hence, the surgical procedure is relatively easier, leading to increasing rates of laparoscopic surgery. In certain cases, D2 lymph node dissection is deemed unnecessary. Consequently, before conducting the PSM analysis, the laparoscopic group may have had more patients who underwent less than D2 dissection. Regarding overall outcomes, the complication rate showed a favorable trend.

Unlike the results of risk factor analyses of gastric cancer surgery from previous reports, this study showed that a lower BMI was related to a higher complication rate [18]. Patients with a lower BMI have lower nutritional status, poor chemotherapy compliance, decreased overall immunity, and frailty. These factors are presumed to negatively affect postoperative recovery and tissue healing [19,20]. In the future, because underweight patients who have undergone neoadjuvant chemotherapy before gastric cancer surgery in the clinical field have a high risk of morbidity, surgeons should be cautious during surgery and the perioperative management of such patients.

The current study had some limitations. First, no information related to the clinical stage, chemotherapy regimen, compliance with chemotherapy, and response rate after chemotherapy was collected. Second, over half of the patients in the final cohort were recruited from a single institution. Despite the disproportionate distribution of patients across institutions, our study is significant because we used large-scale nationwide survey data. Additionally, the complication rate may have been underestimated. According to other reports, while the complication rate after gastrectomy for patients with advanced gastric cancer treated with neoadjuvant chemotherapy was 11.8%–46.0% in Eastern studies, in the current study, the overall complication rate was slightly lower at 8.8%–12.2% [7,8,14,16]. Thus, attention should be paid when interpreting the results. Moreover, quality control by the surgeon was impossible, and there was no information on surgical experience and expertise. Finally, there was no information on pain scores and bowel recovery data, which are parameters also indicating the advantages of laparoscopic surgery.

In conclusion, LG had comparable short-term outcomes to OG, even in patients with gastric cancer, following neoadjuvant chemotherapy, in a multicenter study with a relatively large sample size. We believe this study provides critical empirical evidence that the scope of LG can be safely expanded to include patients with gastric cancer who received neoadjuvant chemotherapy. However, the issue of oncological safety, which was not analyzed in this study, should be addressed in large-scale phase 3 randomized controlled trials.

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