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Original Article

The Effect of Endoscopic Resection on Short-Term Surgical Outcomes in Patients with Additional Laparoscopic Gastrectomy after Non-Curative Resection for Gastric Cancer

Eun-Gyeong Lee[1,2], Keun-Won Ryu[2], Bang-Wool Eom[2], Hong-Man Yoon[2], Yong-Il Kim[2], Soo-Jeong Cho[2], Jong-Yeul Lee[2], Chan-Gyoo Kim[2], Il-Ju Choi[2], Young-Woo Kim[2]

[1]Department of Surgery, Seoul National University Hospital, Seoul National University College of Medicine, Seoul, Korea
[2]Gastric Cancer Branch, Division of Translational & Clinical Research I, Research Institute, National Cancer Center, Goyang, Korea

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Correspondence to
Keun Won Ryu
Gastric Cancer Branch, Division of Translational & Clinical Research I, Research Institute, National Cancer Center, 323 Ilsan-ro, Ilsandong-gu, Goyang 10408, Korea.
Tel: +82-31-920-1628
Fax: +82-31-920-0069
E-mail: docryu@ncc.re.kr

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ABSTRACT

Purpose: Endoscopic submucosal dissection (ESD) in early gastric cancer causes an artificial gastric ulcer and local inflammation that has a negative intraprocedural impact on additional laparoscopic gastrectomy in patients with noncurative ESD. In this study, we analyzed the effect of ESD on short-term surgical outcomes and evaluated the risk factors.
Materials and Methods: From January 2003 to January 2013, 1,704 patients of the National Cancer Center underwent laparoscopic gastrectomy with lymph node dissection because of preoperative stage Ia or Ib gastric cancer. They were divided into 2 groups: (1) with preoperative ESD or (2) without preoperative ESD. Clinicopathologic factors and short-term surgical outcomes were retrospectively evaluated along with risk factors such as preoperative ESD.
Results: Several characteristics differed between patients who underwent ESD-surgery (n=199) or surgery alone (n=1,505). The mean interval from the ESD procedure to the operation was 43.03 days. Estimated blood loss, open conversion rate, mean operation time, and length of hospital stay were not different between the 2 groups. Postoperative complications occurred in 23 patients (11.56%) in the ESD-surgery group and in 189 patients (12.56%) in the surgery-only group, and 3 deaths occurred among patients with complications (1 patient [ESD-surgery group] vs. 2 patients [surgery-only group]; P=0.688). A history of ESD was not significantly associated with postoperative complications (P=0.688). Multivariate analysis showed that male sex (P=0.008) and laparoscopic total or proximal gastrectomy (P=0.000) were independently associated with postoperative complications.
Conclusions: ESD did not affect short-term surgical outcomes during and after an additional laparoscopic gastrectomy.

Keywords: Complications; Endoscopic submucosal dissection; Gastrectomy; Laparoscopy

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

The data for this study was obtained from the database of the Korean Gastric Cancer Cohort Study. A total of 14 institutions are participating in this cohort study, and the investigators are as follows: JSK, HSC from the National Cancer Center; HYJ, SYK, JYS, JS, HSM, SHK from the Chungnam National University Hospital; YKP, SSK, YEJ, IJC from the Chonnam National University Hospital; YJL, SHJ, JHP form the Gyeongsang National University Hospital; HKY, HJL, SHK, YSS from the Seoul National University Hospital; WY, OKK, SKK, SWJ, JGK, BWK from the Kyungpook National University Medical Center; JHY, MHL, HYC, YKK from the University of Ulsan College of Medicine; GAS, GHK, DHK, DHK, YMS, BEL, TYJ, CIC from the Pusan National University Hospital, SJY; YJS, HK, HYY, KSP, SMP, SMY, JHH, WDK, HSH, HCL, DHK from the Chungbuk National University Hospital; HEK, IHJ, JMK, HJS from the Jeju National University School of Medicine; SHN, SYR, WJH, JHC, JYA, HIK, SKL, YCL, JCP, SKS from the Severance Hospital, Yonsei University College of Medicine; SBP, SSK, KHL, SKH, HYL, YHK, SJN from the Gangwon National University Hospital; DHY, STL, EKS, JSK from the Chonbuk National University Hospital; SK, WKK, KMK, ERK, JJK, JHN, BHM, SHP, YSP, JOP, CKP, HCP, JMB, TSS, MWL, WJL, JHL, JHL, JYL, PLL, DHL, HYL, KTJ, DIC, MGC from the Samsung Medical Center.

INTRODUCTION

Gastric cancer has a high incidence in Asian countries and is the most prevalent malignancy in Korea [1]. The development and application of the national screening program in Korea has increased the early detection of gastric cancer. A cure of gastric cancer can be achieved by surgical resection and lymph node (LN) dissection. In the current era of minimally invasive surgery, some patients with preoperatively evaluated early gastric cancer (EGC) and minimal risk of LN metastasis are treated by endoscopic submucosal dissection (ESD) [2,3]. By minimizing the resection size, ESD allows for en bloc resection of the entire lesion, a higher curative resection rate, and increased quality of life [4]. Indications for ESD proposed by the Japanese Gastric Cancer Association (JGCA) include differentiated adenocarcinoma, clinical T1a lesion, and a tumor size of ≤2 cm without ulceration [4,5].

Noncurative factors after an ESD procedure are submucosal invasion (sm1) >500 μm, lymphovascular invasion, undifferentiated histology, large tumor size, and a tumor-involved margin [6,7]. Surgical treatment is recommended for patients of noncurative factors. However, many surgeons have concerns about the deleterious effect of ESD on the surgical procedure because ESD causes an artificial gastric ulcer, local inflammation, and intra-abdominal adhesions, and consequent technical difficulties in the additional laparoscopic gastrectomy [8]. In this study, we aimed to evaluate the effect of ESD on short-term surgical outcomes in patients who undergo an additional laparoscopic gastrectomy after a noncurative resective ESD procedure. In addition, we analyzed surgical complications that were associated with risk factors of laparoscopic gastrectomy.

MATERIALS AND METHODS

Patients and indications

We retrospectively reviewed the medical records of 1,704 patients who underwent laparoscopic surgery from January 2003 to January 2013 at the National Cancer Center because of preoperative stage Ia or Ib gastric cancer. Routine preoperative evaluations included endoscopy, chest X-ray, contrast-enhanced computed tomography, pathological examination of biopsy specimens, and basic blood tests. In the current literature, endoscopy only versus endoscopy plus endoscopic ultrasonography shows no difference in the accuracy of diagnosing T1a or T1b [9]. Therefore, we did not include endoscopic ultrasonography in our study. In our institution, ESD is conducted, based on the Japanese gastric cancer treatment guidelines: (1) the absolute indications (i.e., intramucosal tumor without ulcerative findings, differentiated type, and size ≤2 cm) and (2) the expanded indications (i.e., Criterion I: intramucosal tumor without ulcerative findings, differentiated type, and size >2 cm; Criterion II: intramucosal tumor with ulcerative findings, differentiated type, and size ≤3 cm; Criterion III: intramucosal tumor without ulcerative findings, undifferentiated type, and size <2 cm; and Criterion IV: sm1 >500 μm, differentiated type, and size ≤3 cm) [2]. In this study, the indications for additional surgery after ESD were sm1 >500 μm, lymphovascular invasion, undifferentiated histology, large tumor size, tumor-involved margin, and procedure failure, bleeding, or perforation during the ESD procedure.

As a rule, we followed the absolute indications. The expanded indications were applied according to a patient's individual situation. Among these patients, 199 patients received preoperative ESD and a subsequent surgery because of a noncurative resection. The absolute

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indications were relevant for 173 patients, and the expanded indications were applied to 26 patients. Forty-four patients with metachronous cancer or who had a recurrence after the curative ESD procedure on subsequent curative laparoscopic surgery were excluded from the analysis. The remaining 1,505 patients received curative laparoscopic gastrectomy as the initial treatment. We compared the clinicopathologic factors and short-term surgical outcomes between the 199 patients who underwent the preoperative ESD procedure and the 1,505 patients who did not. The type of operation was based on the tumor location. The indication for ESD in EGC was based on the criteria of the JGCA [2]. Specimens were reviewed by a specialized pathologist. Histological type was classified, based on the World Health Organization classification [10]. A tumor having the components of 2 histological types was classified according to the quantitative predominance [2]. All patients provided informed consent and the study was approved by Institutional Review Board of the Korean National Cancer Center (IRB No. NCC 2016-0252).

Definitions of complications

Postoperative complications were conditions that occurred during the first 30 postoperative days of any procedure (e.g., reoperation, need for antibiotics, percutaneous drain insertion, invasive procedure, medical treatment or prolonged hospital stay). Complications were graded, based on the Clavien-Dindo classification [11].

Statistical analysis

Statistical analysis was performed with IBM SPSS Statistics ver. 21 (IBM Co., Armonk, NY, USA). Potential risk factors were identified by comparing clinicopathologic factors of groups with and without a complication. The groups were compared for various clinical, pathological, and surgical factors. Univariate analysis of complications was conducted by the Student's t-test for continuous variables. A binary logistic regression model was used for multivariate analysis. The P-values were 2-sided. Statistical significance was defined as $P<0.05$.

RESULTS

Clinicopathologic characteristics

The details of the clinical and pathological features and surgical results of the 1,704 patients are shown in **Table 1**. Of the 1,704 patients, 199 patients received preoperative ESD. The mean age was 63 years in the ESD-surgery group and 57 years in the surgery-only group. The study participants consisted of more men than women (1,090 vs. 614). Most tumors were in the lower third of the stomach in both groups. The mean tumor size was 2.44 cm in the ESD-surgery group and 3.21 cm in the surgery-only group. Laparoscopy-assisted distal gastrectomy (LADG) was performed on 1,419 patients; laparoscopy-assisted total gastrectomy (LATG), 157 patients; laparoscopy-assisted pylorus preserving gastrectomy, 75 patients; and laparoscopy-assisted proximal gastrectomy (LAPG), 16 patients. A LN dissection of D2 was performed in 64.32% of the ESD-surgery group and in 78.27% of the surgery-only group. The mean interval from the ESD procedure to the operation was 43.03 days.

Noncurative factors of ESD are shown in **Table 2**. The most common cause of additional laparoscopic gastrectomy after noncurative resective ESD was sm1 >500 μm (68.84%). A tumor-involved margin was present in 24 patients (12.06%).

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Table 1. Demographic characteristics of the patients

Characteristic	ESD-surgery group (n=199)	Surgery-only group (n=1,505)	P-value
Median age (yr)	62.66±10.48	57.44±12.00	<0.001*
Sex			<0.001*
Male	152 (76.38)	938 (62.33)	
Female	47 (23.62)	567 (37.67)	
Mean BMI (kg/m²)	24.13±3.17	23.84±3.05	0.211
Depth of tumor†			<0.001*
T1a	64 (32.16)	853 (56.68)	
T1b	129 (64.82)	632 (41.99)	
T2	4 (2.01)	17 (1.13)	
T3	2 (1.01)	3 (0.20)	
Tumor size (cm)	2.44±1.49	3.21±1.90	<0.001*
Location of tumor			<0.001*
Upper third	21 (10.55)	129 (8.57)	
Mid third	28 (14.07)	564 (37.48)	
Lower third	150 (75.38)	812 (53.95)	
Histology			<0.001*
Well-differentiated	96 (48.24)	329 (21.86)	
Moderately differentiated	77 (38.69)	392 (26.05)	
Poorly differentiated	9 (4.52)	351 (23.32)	
Signet ring cells	9 (4.52)	411 (27.31)	
Mucinous	1 (0.50)	15 (1.00)	
Undifferentiated	7 (3.52)	7 (0.47)	
Type of surgery			0.176
LADG	164 (82.41)	1,255 (83.39)	
LATG	16 (8.04)	141 (9.37)	
LAPPG	10 (5.03)	65 (4.32)	
LAPG	5 (2.51)	11 (0.73)	
ODG	1 (0.50)	20 (1.33)	
OTG	2 (1.01)	13 (0.86)	
OPG	1 (0.51)	0 (0.00)	
Resection margin (cm)			
Proximal	3.95±2.92	4.00±2.75	0.804
Distal	5.36±3.90	6.40±3.98	0.001*
LN metastasis‡			0.019*
pN0	186 (93.47)	1,360 (90.37)	
pN1	12 (6.03)	108 (7.18)	
pN2	1 (0.50)	35 (2.33)	
pN3	0 (0.00)	2 (0.13)	
Degree of LN dissection‡			<0.001*
D1+β	71 (35.68)	322 (21.40)	
D2	128 (64.32)	1,183 (78.60)	
Dissected LNs‡			<0.001*
D1+b	32.25±14.23	32.69±11.57	
D2	35.85±12.27	37.78±13.88	
Interval from ESD to operation (day)	43.03±36.79		<0.001*
Estimated blood loss (mL)	97.96±130.40	111.16±153.07	0.245
Open conversion	4 (2.01)	33 (2.19)	0.774
Operation time (min)	190.0±58.6	202.5±70.0	0.004*
Length of hospital stay (day)	8.47±10.44	8.02±5.75	0.490

Values are presented as mean±standard deviation or number (%).

ESD = endoscopic submucosal dissection; BMI = body mass index; LADG = laparoscopy-assisted distal gastrectomy; LATG = laparoscopy-assisted total gastrectomy; LAPPG = laparoscopy-assisted pylorus preserving gastrectomy; LAPG = laparoscopy-assisted proximal gastrectomy; ODG = open distal gastrectomy; OTG = open total gastrectomy; OPG = open proximal gastrectomy; LN = lymph node.

*Statistically significant data (P<0.05). †Classification according to the Japanese Gastric Cancer Association guideline. ‡Classification according to the American Joint Committee on Cancer 7th edition.

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Table 2. Noncurative factors in the endoscopic submucosal dissection surgery group

Noncurative factor	ESD surgery group (n=199)
Submucosal invasion >500 μm	137 (68.84)
Lymphovascular invasion	8 (4.02)
Undifferentiated histology	17 (8.54)
Large tumor	9 (4.52)
Tumor-involved margin	24 (12.06)
Bleeding	2 (1.01)
Perforation	1 (0.50)
Procedure failure	1 (0.50)

Values are presented as number (%).

ESD = endoscopic submucosal dissection.

Short-term surgical outcomes

Estimated blood loss was 97.96±130.40 ml in the ESD-surgery group and 111.16±153.07 ml in the surgery-only group (P=0.245). Open conversion was performed in 4 patients (2.01%) in the ESD-surgery group and 33 patients (2.19%) in the surgery-only group (P=0.774). The mean operation time was 190.0 minutes in the ESD-surgery group and 202.5 minutes in the surgery-only group (P=0.004). The length of hospital stay was 8.47 days in the ESD-surgery group and 8.02 days in the surgery-only group (P=0.490). Postoperative complications until postoperative day 30 are summarized in **Table 3**. Total complications were experienced by 23 patients (11.56%) in the ESD-surgery group and 189 patients (12.56%) in the surgery-only group (P=0.688). There was 1 mortality (0.50%) in the ESD-surgery group and 2 mortalities (0.13%) in the surgery-only group (P=0.470). Postoperative complications were not significantly different between the ESD-surgery group and surgery-only group. In the ESD-surgery group, ileus (2.51%) was the most common complication. The next common complications were abdominal fluid collection (1.51%), wound problems (1.51%), stricture (1.01%), and pulmonary problems (1.01%). In the surgery-only

Table 3. Postoperative complications

Complication	ESD-surgery group (n=199)	Surgery-only group (n=1,505)	P-value
Total complication	23 (11.56)	189 (12.56)	0.688
The Clavien-Dindo classification			
Grade I	8 (4.02)	77 (5.12)	0.505
Grade II	7 (3.52)	43 (2.86)	0.604
Grade IIIa	6 (3.02)	52 (3.46)	0.748
Grade IIIb	1 (0.50)	14 (0.93)	0.544
Grade IV	0 (0.00)	1 (0.07)	0.716
Grade V	1 (0.50)	2 (0.13)	0.470
Major complication			0.548
Bleeding	1 (0.50)	12 (0.80)	
Anastomosis leakage	2 (1.01)	24 (1.59)	
Intra-abdominal abscess	1 (0.50)	4 (0.27)	
Abdominal fluid collection	3 (1.51)	19 (1.26)	
Ileus	5 (2.51)	43 (2.86)	
Delayed gastric emptying	1 (0.50)	9 (0.60)	
Stricture	2 (1.01)	18 (1.20)	
Bowel ischemia	0 (0.00)	3 (0.20)	
Pulmonary	2 (1.01)	19 (1.26)	
Minor complication			0.691
Wound problem	3 (1.51)	19 (1.26)	
Reflux	1 (0.50)	3 (0.20)	
Splenic infarction	0 (0.00)	3 (0.20)	
Biliary stone	0 (0.00)	2 (0.13)	
Other GI tract problem	1 (0.50)	9 (0.60)	
Urinary retention	1 (0.50)	2 (0.13)	

Values are presented as number (%).

ESD = endoscopic submucosal dissection; GI = gastrointestinal.

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group, the most common complication was ileus (2.86%), which is similar to the ESD-surgery group. The next common complications were anastomosis leakage (1.59%), wound problem (1.26%), pulmonary problem (1.26%), and abdominal fluid collection (1.26%).

Risk factors for complications

Risk factors were analyzed relative to surgical complications. Univariate analysis showed that male sex (P=0.003), tumor location (P=0.003), and type of operation (P<0.001) were significantly associated with complications (**Table 4**). However, a history of having undergone ESD was not significantly associated with postoperative complications (P=0.688). Multivariate analysis showed that only male sex and LATG and LAPG were independently associated with postoperative complications (P=0.008; odds ratio [OR]=0.640; and 95% confidence interval [CI]=0.461–0.888 vs. P=0.000; OR=2.398; and 95% CI=1.654–3.477) (**Table 5**).

Table 4. Univariate analysis of the risk factors for complications

Characteristic	Without complications (n=1,492)	With complications (n=212)	P-value
Age (yr)	58.14±11.73	57.41±13.42	0.455
Sex			0.003*
Male	936 (62.73)	154 (72.64)	
Female	556 (37.27)	58 (27.36)	
BMI (kg/m^2)	23.84±3.00	24.05±3.51	0.423
Depth of tumor†			0.097
T1a	816 (54.69)	101 (47.64)	
T1b	652 (43.70)	109 (51.42)	
T2	20 (1.34)	1 (0.47)	
T3	4 (0.27)	1 (0.47)	
Tumor size (cm)	3.10±1.85	3.31±2.02	0.127
Location of tumor			0.003*
Upper	117 (7.84)	33 (15.57)	
Mid	518 (34.72)	74 (34.91)	
Lower	857 (57.44)	105 (49.53)	
Histology			0.711
Well-differentiated	375 (25.13)	50 (23.58)	
Moderately differentiated	406 (27.21)	63 (29.72)	
Poorly differentiated	313 (20.98)	47 (22.17)	
Signet ring cell	370 (24.80)	50 (23.58)	
Mucinous	15 (1.01)	1 (0.47)	
Undifferentiated	13 (0.87)	1 (0.47)	
Type of surgery			<0.001*
LADG, LAPPG	1,333 (89.34)	161 (75.94)	
LATG, LAPG	133 (8.91)	40 (18.87)	
ODG	16 (1.07)	5 (2.36)	
OTG, OPG	10 (0.67)	6 (2.83)	
Degree of LN dissection‡			0.847
D1+β	343 (22.99)	50 (23.58)	
D2	1,149 (77.01)	162 (76.42)	
LN metastasis‡			0.309
pN0	1,356 (90.88)	190 (89.62)	
pN1	106 (7.10)	14 (6.60)	
pN2	29 (1.94)	7 (3.30)	
pN3a	1 (0.07)	1 (0.47)	
Operation method			0.688
ESD-surgery	176 (11.80)	23 (10.85)	
Surgery-only	1,316 (88.20)	189 (89.15)	

Values are presented as mean±standard deviation or number (%).

BMI = body mass index; LADG = laparoscopy-assisted distal gastrectomy; LAPPG = laparoscopy-assisted pylorus preserving gastrectomy; LATG = laparoscopy-assisted total gastrectomy; LAPG = laparoscopy-assisted proximal gastrectomy; ODG = open distal gastrectomy; OTG = open total gastrectomy; OPG = open proximal gastrectomy; LN = lymph node; ESD = endoscopic submucosal dissection.

*Statistically significant data (P<0.05). †Classification according to the American Joint Committee on Cancer 7th edition. ‡Classification according to the Japanese Gastric Cancer Association guideline.

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Table 5. Multivariate analysis of the risk factors for complications

Risk factor	OR	95% CI	P-value
Sex (male vs. female)	0.640*	0.461–0.888*	0.008*
Location of tumor (upper vs. mid and lower)	1.025	0.482–2.183	0.948
Type of surgery (LADG, LAPPG vs. LATG, LAPG)	2.398*	1.654–3.477*	0.000*
Operation method (ESD-surgery vs. surgery-only)	1.202	0.749–1.927	0.446

OR = odds ratio; CI = confidence interval; LADG = laparoscopy-assisted distal gastrectomy; LAPPG = laparoscopy-assisted pylorus preserving gastrectomy; LATG = laparoscopy-assisted total gastrectomy; LAPG = laparoscopy-assisted proximal gastrectomy; ESD = endoscopic submucosal dissection.

*Statistically significant data (P<0.05).

DISCUSSION

In this study, we compared short-term surgical outcomes of patients who did and did not undergo ESD. We found that ESD did not affect short-term surgical outcomes such as estimated blood loss, open conversion, and hospital day. Complications in laparoscopic gastrectomy, even the baseline clinical factors, were slightly different between the 2 groups. Based on our finding of operative safety after ESD, the ESD indication may be expanded. However, the indication for ESD should be decided considering the safety of additional surgery and the long-term oncologic outcomes [7].

Contrary to expectations, ESD was not associated with postoperative complications during or after an additional laparoscopic surgery in patients who underwent noncurative resective ESD. There may be several reasons for this finding such as the developments in laparoscopic surgical techniques and energy device such as ultrasonic shear and advanced bipolar device.

Based on the JGCA guidelines, an additional gastrectomy after ESD for EGC is conducted when pathology confirms LN metastasis or margin involvement [2,3]. In such patients, the preference for laparoscopic gastrectomy has increased in the current era of minimally invasive surgery. However, the surgical complications of laparoscopic gastrectomy after ESD have not been well documented, despite the expected deleterious effect of ESD on surgery. Suzuki et al. [12] reported minor anastomotic leakage and pancreatic fistulas in patients who underwent LADG-ESD (16%), whereas no significant differences in blood loss or the time of surgery existed between patients who underwent LADG-ESD and who underwent LADG-standard. Akagi et al. [8] reported that artificial ulceration after ESD caused severe intra-abdominal adhesions. And pathologic reports also showed the presence of inflammatory cell invasion and fibrosis formation. Intra-abdominal adhesions are associated with healing of the artificial ulceration [8].

In our study, intraoperative results such as blood loss were similar between groups, but the ESD-surgery group had a shorter operation time. The difference believes that the difference reflects the range of LN dissection. Compared to the surgery-only group, the ESD-surgery group had a lower degree of D2 dissection (78.27% vs. 64.32%; P<0.001) and lower harvest of LNs (37.78 vs. 35.85; P<0.001).

Two interesting results in this study were (1) the percentage of T1b was significantly higher in the ESD-surgery group than in the surgery-only group (64.82% vs. 41.99%, P<0.001) and (2) tumors were highly distributed in the lower third of the stomach in the ESD-surgery group than in the surgery-only group (75.38% vs. 53.95%, P<0.001). ESD was conducted using the most absolute indication. Most patients with T1a tumors did not have surgery, and most patients with T1b tumors underwent surgery conversion. Therefore, the most common

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cause of additional laparoscopic gastrectomy after noncurative resective ESD was T1b tumors (68.84%). An absolute indication for ESD is a differentiated tumor. The tumor is generally in the distal stomach, compared to tumors with an undifferentiated histology [13,14]. These factors are the reasons for the differences between the 2 groups.

The histological type was significantly different between the 2 groups (P<0.001). The percentage of well-differentiated and moderately differentiated tumors was higher in the ESD-surgery than in the surgery-only group (86.93% vs. 47.91%). However, the percentage of poorly differentiated and signet ring cells was higher in the surgery-only group than in the ESD-surgery group (50.63% vs. 9.04%). These results occurred because the ESD procedure was primarily performed on patients with absolute indications, whereas the expanded indication was rarely adopted.

Patients underwent laparoscopic gastrectomy within 1–2 months post-ESD [15]. Another study [12] reported an average interval of 42.4 days from ESD to surgery. In our study, the mean interval from ESD to laparoscopic gastrectomy was 43.03 days, which was similar to previous studies. Thus, the time from ESD to curative laparoscopic surgery does not influence the postoperative course in usual practice.

Sex and the type of operation were identified as the most important risk factors of postoperative complications. In this study, the incidence of postoperative complications was less among women than among men, possibly because of the higher amount of visceral fat in men. Inagawa et al. [16] reported that obese patients have increased postoperative complications (body mass index [BMI] of ≤20, 3.3%; BMI of 20–25, 5.6%; BMI of ≥25, 22.0%). The postoperative complication rate in patients with a BMI of ≥25 was similar to that reported in a European study [17].

Esophageal anastomosis after LATG and LAPG significantly increased postoperative complications in patients with gastric cancer. The techniques of esophagojejunostomy and esophagogastrostomy are difficult and associated with postoperative complications in laparoscopic gastrectomy. Lee et al. [18] showed that the incidence of complications after LATG was 26.9% and after LADG was 8.0% (P<0.001). The most common complication of LATG was anastomotic stricture [18]. Kim et al. [19] reported laparoscopic proximal gastrectomy was associated with postoperative complications (OR=4.062; 95% CI=1.691–9.752; P=0.002). Jeong et al. [20] demonstrated that the independent risk factors of laparoscopic total gastrectomy were male sex (OR=4.01; 95% CI=1.18–14.16), D2 lymphadenectomy (OR=5.12; 95% CI=1.66–15.87), and intraoperative blood loss (200 mL; OR=3.33; 95% CI=1.14–9.70). Most published series had similar results as in our study.

Our study had a few limitations, despite having a relatively higher number of patients with ESD compared to previously published studies [12,15]. This study was a single-center retrospective study, and the number of individuals in the ESD-surgery group was relatively smaller than in the surgery-only group. A multicenter study is needed to provide more information on the surgical outcomes after ESD.

In conclusion, ESD did not influence short-term surgical outcomes and was not risk factor of postoperative complications in laparoscopic gastrectomy. Therefore, surgeons do not have to worry about performing laparoscopic gastrectomy in patients who have undergone ESD.

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