Comparison Surgical Outcomes between Laparoscopic and Conventional Distal Gastrectomy for Early Gastric Cancer in Obese Patients

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Purpose: In this study, we explored the safety of laparoscopic gastrectomy in obese gastric cancer patients compared with conventional open gastrectomy based on early surgical outcomes.

Methods: A total of 462 patients who underwent curative gastrectomy for early gastric adenocarcinoma from January 2000 to December 2014 were enrolled. Two obesity cohorts were defined according to a body mass index (BMI) of ≥ 25 kg/m² versus ≥ 30 kg/m². Those cohorts were further divided into the laparoscopic distal gastrectomy (LDG) and open distal gastrectomy (ODG) groups, and clinicopathologic characteristics were compared with early surgical results.

Results: There were no significant differences in clinicopathologic characteristics between the LDG and ODG groups in the BMI ≥ 25 or BMI ≥ 30 cohorts. For the overall complication rate, fewer complications were observed in the LDG than ODG group in both cohorts. Among the overall complications, significant differences were observed in the minor complication rates (Clavien-Dindo I or II), but no significant difference was observed in the rate of Clavien-Dindo III or higher complications. For risk factor analysis of postoperative complications, open distal gastrectomy, age > 60 years, and BMI ≥ 30 were independent risk factors for postoperative morbidity among all obese patients.

Conclusion: LDG may be a better procedure to improve surgical outcomes in patients with obesity undergoing surgery for early gastric cancer in terms of less excessive blood loss, shorter operation time, and lower complication rates.

Keywords: Stomach neoplasm, Laparoscopy, Complication, Obesity

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INTRODUCTION

Obesity is rapidly increasing on a global scale and is defined as excess fat accumulation, which can lead to health problems. The criteria for obesity is a body mass index (BMI) ≥ 30 kg/m² in Western countries and ≥ 25 kg/m² in Asian countries.¹ Globally, 39% and 13% of adults aged ≥ 18 years were overweight and obese, respectively, in 2014. According to the Ko-

rea National Health and Nutrition Examination Survey, the obesity rate in south Korea is increasing, from 25.8% in 1998 to 32.8% in 2012.² As obesity in the population increases, the proportion of obese patients with gastric cancer is also increasing.

Generally, gastric cancer surgeries in obese patients are technically demanding, showing limited oncologic safety. Large amounts of intra-abdominal fat can obscure vascular

Table 1. Clinicopathologic characteristics of the patients

Variables	BMI ≥ 25 (kg/m ²) (n=426)			BMI ≥ 30 (kg/m ²) (n=41)		
	LDG (%) (n=260)	ODG (%) (n=166)	p value [†]	LDG (%) (n=24)	ODG (%) (n=17)	p value [†]
Age (year)	58.9 $\pm$ 11.2*	59.8 $\pm$ 9.9*	0.422	57.8 $\pm$ 10.1*	61.2 $\pm$ 9.9*	0.299
Sex			0.662			1.000
Male	182 (70.0)	120 (72.3)		16 (66.7)	11 (64.7)	
Female	78 (30.0)	46 (27.7)		8 (33.3)	6 (35.3)	
BMI (kg/m ²)	27.3 $\pm$ 2.2*	27.3 $\pm$ 1.9*	0.918	32.7 $\pm$ 2.6*	31.5 $\pm$ 1.6*	0.093
ECOG PS			0.736			0.115
0	184 (70.8)	120 (72.3)		19 (79.2)	9 (52.9)	
1	68 (26.2)	39 (23.5)		5 (20.8)	7 (41.2)	
2	7 (2.7)	7 (4.2)		0 (0)	1 (5.9)	
3	1 (0.4)	0 (0)		0 (0)	0 (0)	
Number of comorbidities			0.470			0.780
0	107 (41.2)	64 (38.6)		10 (41.7)	4 (23.5)	
1	111 (42.7)	76 (45.8)		10 (41.7)	9 (52.9)	
2	30 (11.5)	14 (8.4)		1 (4.2)	1 (5.9)	
≥ 3	12 (4.6)	12 (7.2)		3 (12.5)	3 (17.6)	
Smoking history			0.713			0.233
Non-smoker	150 (57.7)	94 (56.6)		13 (54.2)	8 (47.1)	
Ex-smoker	60 (23.1)	35 (21.1)		6 (25.0)	8 (47.1)	
Current smoker	50 (19.2)	37 (22.3)		5 (20.8)	1 (5.9)	
Alcohol history			0.545			0.176
Non-drinker	145 (55.8)	91 (54.8)		13 (54.2)	7 (41.2)	
Social drinker	92 (35.4)	55 (33.1)		8 (33.3)	10 (58.8)	
Heavy drinker	23 (8.8)	20 (12.0)		3 (12.5)	0 (0)	
Previous abdominal operation history			0.803			0.499
Absent	210 (80.8)	132 (79.5)		15 (62.5)	13 (76.5)	
Present	50 (19.2)	34 (20.5)		9 (37.5)	4 (23.5)	
Tumor location			0.116			0.285
Upper	5 (2.0)	6 (3.6)		0 (0)	2 (11.8)	
Middle	30 (11.5)	29 (17.5)		3 (12.5)	2 (11.8)	
Lower	225 (86.5)	131 (78.9)		21 (87.5)	13 (76.5)	
Tumor size (mm)	2.6 $\pm$ 1.5*	3.9 $\pm$ 2.4*	< 0.001	2.6 $\pm$ 1.7*	4.8 $\pm$ 3.2*	0.005
Differentiation			0.058			0.760
Differentiated	153 (58.8)	82 (49.4)		14 (58.3)	6 (52.9)	
Undifferentiated	107 (41.2)	84 (50.6)		10 (41.7)	8 (47.1)	
N stage			0.648			0.247
N0	229 (88.1)	142 (85.5)		21 (87.4)	12 (70.6)	
N1	20 (7.7)	13 (7.8)		1 (4.2)	4 (23.5)	
N2	6 (2.3)	8 (4.8)		1 (4.2)	1 (5.8)	
N3	5 (1.9)	3 (1.8)		1 (4.2)	0 (0)	

BMI = Body Mass Index; ECOG = Eastern Cooperative Oncology Group. *Standard deviation. [†]Indicates χ^2 test.

structures and normal surgical planes during surgery. Preoperative BMI is a risk factor for postoperative complications.³ Moreover, complete lymph node dissection is challenging during surgery in obese patients. These issues are equally challenging during laparoscopic surgery. In the past, laparoscopic surgery was not attempted in obese patients due to the above-mentioned problems. However, technical advancements have overcome these limitations. At this time, laparoscopic gastrectomy has advantages over open gastrectomy regarding postoperative outcomes and quality of life.⁴⁻⁶ In the recently published KLASS-01 trial morbidity and mortality report, laparoscopic gastrectomy showed advantages in terms of estimated blood loss, length of hospital stay, and overall complication rate, especially for wound complication.⁷ However, laparoscopic gastrectomy requires a longer operation time than that of open gastrectomy. Recently, the discrepancy in operation time has decreased due to technical improvements.⁸ However, the advantages of laparoscopic gastrectomy in obese patients remain controversial. In this study, we explored the safety of laparoscopic gastrectomy in terms of early surgical outcomes in obese gastric cancer patients.

MATERIALS AND METHODS

From January 2000 to December 2014, 4,272 patients with gastric adenocarcinoma underwent gastrectomy at the Depart-

ment of Surgery, Seoul, St. Mary's Hospital. Eligible criteria were curative resection, distal gastrectomy, pathologically confirmed early gastric cancer, and range of lymph node dissection D1+ or greater. Patients who underwent palliative or non-curative resection or combined resection were excluded. The data were collected retrospectively from a prospectively collected database. Obesity and morbid obesity were defined as BMI ≥ 25 and BMI ≥ 30 , respectively, according to Asian-Pacific guidelines. Among the 4,274 patients, two cohorts were defined: patients with BMI ≥ 25 and those with BMI ≥ 30 . A total of 462 patients were included in the former cohort and 41 patients in the latter cohort. Those cohorts were further divided into the laparoscopic distal gastrectomy (LDG) and open distal gastrectomy (ODG) groups. Clinicopathologic characteristics and surgical results included the range of lymph node dissection, early surgical results including postoperative complications, and length of hospital stay. Comparisons of continuous variables were performed using Student's *t*-test and categorical variables were assessed using Pearson's χ^2 test or a linear-by-linear association χ^2 test. Postoperative complications were graded based on the Clavien-Dindo classification.⁹ In addition, univariate and multivariate analyses were performed to identify risk factors for the development of postoperative complications. This study followed the 7th UICC TNM staging system (according to the American Joint Committee on Cancer [AJCC] 7th edition).¹⁰

Table 2. Postoperative and surgical outcomes

Variables	BMI ≥ 25 (kg/m ²) (n=426)			BMI ≥ 30 (kg/m ²) (n=41)		
	LDG (%) (n=260)	ODG (%) (n=166)	<i>p</i> value [†]	LDG (%) (n=24)	ODG (%) (n=17)	<i>p</i> value [†]
Reconstruction type			< 0.001			0.110
B-I	45 (17.3)	15 (9.0)		3 (12.5)	4 (23.5)	
B-II	166 (63.8)	147 (88.6)		13 (54.2)	12 (70.6)	
R-Y	49 (18.8)	4 (2.4)		8 (33.3)	1 (5.9)	
LND			< 0.001			0.012
D1 + β	173 (66.5)	55 (33.1)		17 (70.8)	5 (29.4)	
$\geq$ D2	87 (33.5)	111 (66.9)		7 (29.2)	12 (70.6)	
Retrieved LNs	39.5 $\pm$ 15.2*	39.8 $\pm$ 15.2*	0.834	41.1 $\pm$ 14.5*	39.7 $\pm$ 15.2*	0.754
Combine resection			1.000			1.000
Yes	4 (1.5)	2 (1.2)		23 (95.8)	17 (100)	
No	256 (98.5)	164 (98.8)		1 (4.2)	0 (0)	
Operation time (min)	190.7 $\pm$ 49.7*	200.5 $\pm$ 41.1*	0.033	190.0 $\pm$ 64.4*	206.8 $\pm$ 50.1*	0.375
EBL (ml)	155.2 $\pm$ 124.9*	192.4 $\pm$ 162.1*	0.008	151.9 $\pm$ 100.2*	187.9 $\pm$ 119.3*	0.300
First flatus (day)	3.2 $\pm$ 1.7*	3.1 $\pm$ 1.0*	0.549	3.1 $\pm$ 0.6*	3.4 $\pm$ 0.5*	0.212
Postoperative hospital stay (days)	8.2 $\pm$ 4.7*	8.0 $\pm$ 2.8*	0.629	9.6 $\pm$ 5.8*	7.9 $\pm$ 1.4*	0.231

LND = Lymph Node Dissection; EBL = Excessive Blood Loss. *Standard deviation. [†]Indicates χ^2 test.

RESULTS

Clinicopathological characteristics

In the BMI ≥ 25 cohort, no significant differences in patient characteristics including age, sex, ECOG, number of comorbidities, social history, or previous operation history were observed between the LDG and ODG groups. Tumor location, degree of differentiation, and N stage also showed no significant differences between the two groups. In the BMI ≥ 30 cohort, similar results were observed between the two groups (excluding mean tumor size). Tumor size in the LDG group was 2.6 ± 1.5 cm, which was smaller than that (3.9 ± 2.4 cm) in the ODG group (Table 1).

Postoperative and surgical results

In terms of surgical outcomes, there were differences in the type of reconstruction and extent of lymph node dissection

between the groups in the BMI ≥ 25 cohort and in the extent of lymph node dissection in the BMI ≥ 30 cohort. Billroth-II anastomosis was performed more commonly in the LDG than in the ODG group. In addition, more D2 lymph node dissections were performed in the ODG than in the LDG (Table 2).

In the LDG group, 87 patients (33.5%) underwent $>D2$ lymph node dissection, and 173 patients (66.5%) underwent D1+ lymph node dissection. In the ODG group, 111 patients (66.9%) underwent $>D2$ lymph node dissection and 55 patients (33.1%) D1+ lymph node dissection. Nevertheless, the number of retrieved lymph nodes showed no significant difference between the two groups (LDG vs. ODG: 39.5 ± 15.2 vs. 39.8 ± 15.2). An extended operation time was required in the ODG group compared with the LDG group in the BMI ≥ 25 cohort. However, the difference was minimal, and there was no significant difference in the BMI ≥ 30 cohort. Less blood loss was observed in the LDG group (155.2 ± 124.9 ml) than in the ODG group (192.4 ± 162.1 ml) in the BMI ≥ 25 cohort. The postoperative clinical course showed no significant differences between the

Table 3. Postoperative morbidities within 30 postoperative days

Variables	BMI ≥ 25 (kg/m ²) (n=426)			BMI ≥ 30 (kg/m ²) (n=41)		
	LDG (%) (n=260)	ODG (%) (n=166)	p value [†]	LDG (%) (n=24)	ODG (%) (n=17)	p value [†]
Total number of postoperative morbidity	49 (18.8)	60 (36.1)	<0.001	5 (20.8)	11 (64.7)	0.009
Grade I, II	39 (15)	50 (30.1)		4 (16.7)	11 (64.7)	
Grade III, IV	10 (3.8)	10 (6.0)		1 (4.2)	0 (0)	
Grade I	14 (5.4)	21 (12.7)	0.011	0 (0)	4 (23.5)	0.024
Grade II	25 (9.6)	29 (17.5)	0.024	4 (16.7)	7 (41.2)	0.151
Grade IIIa	8 (3.1)	10 (6.0)	0.216	1 (4.2)	0 (0)	1.000
Grade IIIb	1 (0.4)	0 (0)	1.000	0 (0)	0 (0)	1.000
Grade IVa	1 (0.4)	0 (0)	1.000	0 (0)	0 (0)	1.000
Medical						
Pulmonary	7 (2.7)	17 (10.2)		0 (0)	4 (23.5)	
Cardiovascular	0 (0)	2 (1.2)		0 (0)	0 (0)	
Hepatic	1 (0.4)	2 (1.2)		0 (0)	1 (5.8)	
Urinary	3 (1.2)	1 (0.6)		0 (0)	0 (0)	
Intra-abdominal						
Abscess	0 (0)	1 (0.6)		0 (0)	0 (0)	
Anastomosis bleeding	1 (0.4)	0 (0)		0 (0)	0 (0)	
Anastomosis leakage	5 (1.9)	3 (1.8)		1 (4.2)	1 (5.8)	
Anastomosis stenosis	3 (1.2)	1 (0.6)		0 (0)	0 (0)	
Bleeding	8 (3.1)	2 (1.2)		0 (0)	0 (0)	
Ileus	14 (5.4)	10 (6.0)		2 (8.3)	0 (0)	
Pancreatitis	1 (0.4)	3 (0.8)		1 (4.2)	0 (0)	
Wound complications	3 (1.2)	18 (10.8)		0 (0)	5 (29.4)	
Others	3 (1.2)	0 (0)		1 (4.2)	0 (0)	

[†]Indicates χ^2 test.

two groups in terms of flatus day or length of hospital stay.

Postoperative complications

There were more overall complications in the ODG than in the LDG group in both cohorts. Among the complications,

Table 4. Risk factors for postoperative morbidity

Variables	Univariate analysis			Multivariate analysis	
	Number of patients (n = 426)	Morbidities (%)	<i>p</i> value [‡]	Odds ratio	<i>p</i> value [‡]
Operative approach			< 0.001		< 0.001
Open	166	60 (36.1)		1	
Laparoscopy	260	49 (18.8)		0.431 (0.273 ~ 0.683)	
Age (years)			0.004		0.004
<60	213	41 (19.2)		1	
≥60	213	68 (31.9)		1.987 (1.252 ~ 3.153)	
Sex			0.038		0.057
Male	302	86 (28.5)		1	
Female	124	12 (18.5)		0.592 (0.344 ~ 1.020)	
BMI			0.041		0.039
<30	385	93 (24.2)		1	
≥30	41	16 (39.0)		2.106 (1.039 ~ 4.269)	
ECOG PS			0.547		
0, 1	411	104 (25.3)			
2, 3	15	5 (33.3)			
Comorbidities			1.000		
Absent	420	170 (25.5)			
Present	6	2 (33.3)			
History of abdominal surgery			0.488		
Absent	342	85 (24.9)			
Present	84	24 (28.6)			
Reconstruction type			0.100		
B-I	60	18 (30.0)			
B-II	313	72 (23.0)			
R-Y	53	19 (35.8)			
LND			1.000		
D1+β	228	58 (25.4)			
D2	198	51 (25.8)			
Operation time (min)			0.045		0.158
<200	228	49 (21.5)		1	
≥200	198	60 (30.3)		1.396 (0.879 ~ 2.216)	
EBL (ml)			0.094		
<150	195	42 (21.5)			
≥150	231	67 (29.0)			
pN stage			1.000		
N0	371	95 (25.6)			
N1 ~ 3	55	14 (25.5)			

Significant values are indicated in bold. BMI = Body Mass Index; ECOG = Eastern Cooperative Oncology Group. [‡]Binary logistic regression.

significant differences were observed in the rates of Clavien–Dindo I and II complications (Table 3), but not Clavien–Dindo III and IV complications, between the two groups in both cohorts.

The most common complications observed in the LDG group were ileus and bleeding, pulmonary complications, and anastomosis leakage. Pulmonary and wound complications were more common in the ODG group than in the LDG group and represented the main differences in terms of complications between the two groups. Based on risk factor evaluation, open distal gastrectomy, age >60 years, and BMI ≥ 30 were independent risk factors for postoperative morbidity among obese patients (Table 4).

DISCUSSION

Major advancements in laparoscopic surgery for gastric cancer have been achieved since Kitano et al. first introduced laparoscopy–assisted distal gastrectomy in 1994.¹¹ Subsequently, several retrospective and prospective studies have explored the surgical and oncologic safety of this technique. A meta-analysis of seven randomized controlled trials concluded that laparoscopic assisted gastrectomy significantly reduced blood loss and postoperative complications compared with open distal gastrectomy.¹²

Obese patients undergoing surgery have been examined in several reports. The postoperative complication rate varies among studies. Some studies have suggested that obesity does not affect postoperative morbidity or mortality.^{13,14} However, a longer operation time has been noted in obese patients.⁷

This study evaluated the postoperative complication rate after laparoscopic distal gastrectomy and the safety of laparoscopic distal gastrectomy in patients with a high BMI. The overall complication rate was higher in the ODG than in the LDG group in both cohorts. Specifically, the major complication rates did not differ between the two groups. However, minor complications, especially pulmonary and wound complications, were more common in the ODG group. Although more patients underwent lymph node dissection of >D2 in the ODG group compared with the LDG group, the number of retrieved lymph nodes did not differ between the two groups. In the BMI ≥ 25 cohort, the ODG group required a longer operation time. However, in the BMI ≥ 30 cohort, no significant difference in operation time was observed between the groups. Estimated blood loss was lower in the LDG group, but the postoperative clinical course showed no significant difference.

Kim W et al. reported that the wound complication rate of the LDG group was significantly lower than that in the ODG group.⁷ In our study, wound complications were more common in the ODG group. In obese patients, the risk of wound infec-

tions is likely to increase due to abundant subcutaneous fat.

In this study, pulmonary complications were significantly less common in the laparoscopic surgery group. Although objective measurements of postoperative pain were not performed, less pain in the LDG group allowed for early ambulation and prevented pulmonary complications.

In general, surgery in obese patients is associated with technical difficulties and a high complication rate. Especially in surgeries for cancer, in which sufficient lymph node dissection is important for curative resection, a large amount of intra-abdominal fat may obscure anatomical structures and hamper lymph node dissection. Laparoscopic gastrectomy for stomach cancer in patients with a high BMI is technically challenging; thus, the safety of this approach should be explored.

Based on our results, laparoscopic surgery can be more difficult during lymph node dissection for obese patients than for non-obese patients. However, laparoscopic surgery is not inferior to open surgery in obese patients.

This study has several limitations. First, it was designed as a single-institutional retrospective study with a focus on early gastric cancer. Further randomized controlled trials conducted in large cohorts are required to confirm the results of this study. Second, we enrolled patients from 2000 to 2014. In early 2000, the majority of surgeons preferred open gastrectomy over laparoscopic gastrectomy. Over time, as laparoscopic instruments became more developed and surgeons' experiences increased, the preference shifted to laparoscopy. Patients who underwent laparoscopic gastrectomy at an earlier date may have had higher complication rates. In addition, the surgeon's preference may lead to selection bias. Third, to ensure the safety of laparoscopic gastrectomy in obese patients, a comparison between obese patients and normal- or low-weight patients is required. In addition, future studies should explore the long-term safety, including cancer recurrence and disease-free survival rates, of laparoscopic gastrectomy in obese patients with gastric cancer.

In conclusion, LDG may improve surgical outcomes in obese patients undergoing surgery for early gastric cancer in terms of less excessive blood loss, shorter operation times, and lower complication rates. The conventional open gastrectomy approach, older age, and higher BMI are associated with postoperative morbidity in obese patients with early gastric cancer.

REFERENCES

- 1) Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999–2004. *Jama* 2006;295:1549–1555.
- 2) Ministry of Health and Welfare, Korea Centers for Disease Control and Prevention. Korea Health Statistics 2015: Korea National

- Health and Nutrition Examination Survey (KNHANES VI-3). Sejong: Ministry of Health and Welfare; 2016.
- 3) Kim MG, Yook JH, Kim KC, et al. Influence of obesity on early surgical outcomes of laparoscopic-assisted gastrectomy in gastric cancer. *Surg Laparosc Endosc Percutan Tech* 2011;21:151-154.
 - 4) Hayashi H, Ochiai T, Shimada H, Gunji Y. Prospective randomized study of open versus laparoscopy-assisted distal gastrectomy with extraperigastric lymph node dissection for early gastric cancer. *Surg Endosc* 2005;19:1172-1176.
 - 5) Kim YW, Baik YH, Yun YH, et al. Improved quality of life outcomes after laparoscopy-assisted distal gastrectomy for early gastric cancer: results of a prospective randomized clinical trial. *Ann Surg* 2008;248:721-727.
 - 6) Lee JH, Han HS, Lee JH. A prospective randomized study comparing open vs laparoscopy-assisted distal gastrectomy in early gastric cancer: early results. *Surg Endosc* 2005;19:168-173.
 - 7) Kim W, Kim HH, Han SU, et al. 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.
 - 8) Mochiki E, Kamiyama Y, Aihara R, Nakabayashi T, Asao T, Kuwano H. Laparoscopic assisted distal gastrectomy for early gastric cancer: Five years' experience. *Surgery* 2005;137:317-322.
 - 9) 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;240:205-213.
 - 10) Washington K. 7th edition of the AJCC cancer staging manual: stomach. *Ann Surg Oncol* 2010;17:3077-3079.
 - 11) Kitano S, Iso Y, Moriyama M, Sugimachi K. Laparoscopy-assisted Billroth I gastrectomy. *Surg Laparosc Endosc* 1994;4:146-148.
 - 12) Deng Y, Zhang Y, Guo TK. Laparoscopy-assisted versus open distal gastrectomy for early gastric cancer: A meta-analysis based on seven randomized controlled trials. *Surg Oncol* 2015;24:71-77.
 - 13) Yamada H, Kojima K, Inokuchi M, Kawano T, Sugihara K. Effect of obesity on technical feasibility and postoperative outcomes of laparoscopy-assisted distal gastrectomy--comparison with open distal gastrectomy. *J Gastrointest Surg* 2008;12:997-1004.
 - 14) Yasuda K, Inomata M, Shiraishi N, Izumi K, Ishikawa K, Kitano S. Laparoscopy-assisted distal gastrectomy for early gastric cancer in obese and nonobese patients. *Surg Endosc* 2004;18:1253-1256.