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ORIGINAL ARTICLE

Laparoscopic gastrectomy in obese patients with gastric cancer

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Summary

Purpose: *The aim of this study was to assess the surgical and survival outcomes of laparoscopic gastrectomy in obese patients with gastric cancer.*

Methods: *All obese patients (body mass index/BMI ≥30 kg/m²) who underwent laparoscopic gastrectomy for gastric cancer with radical intent from January 2008 to September 2016 were compared with non-obese patients undergoing similar surgery. The patient short- and long-term outcomes (overall [OS] and disease-free survival [DFS]) were reviewed.*

Results: *Fifty-seven obese and 153 non-obese patients underwent laparoscopic gastrectomy for gastric cancer. Operating times were not significantly different. The conversion rate was higher in obese patients than in non-obese patients. Postoperative 30-day morbidity was greater in obese patients than in non-obese patients. The duration of postoperative hospital stay was similar for laparoscopically completed cases (9 days for obese patients vs 8 days for non-obese patients), but in the obese-converted group it was 13 days. Pathological data were equivalent between obese and non-obese patients. The 5-year OS and DFS was similar between the two groups.*

Conclusion*: Laparoscopic gastrectomy for gastric cancer in obese patients is technically feasible and oncologically safe. However, a higher postoperative 30-day morbidity and conversion rate was observed in obese patients.*

Key words: *body mass index, gastrectomy, gastric carcinoma, laparoscopic gastrectomy, obesity*

Introduction

Obesity substantially increases the risk of type 2 diabetes, coronary artery disease, hypertension, and ischemic stroke [1]. Obese patients are also at a higher risk of postoperative complications following a radical gastrectomy for gastric cancer, such as wound infection and cardiorespiratory and thromboembolic events [2-4]. Laparoscopic gastrectomy with a radical intent offers surgical benefits of reduced postoperative pain, early mobilization, fewer postoperative complications, and a reduced postoperative hospital stay [5-8]. Hence, laparoscopic gastrectomy may be particularly advantageous in obese patients. Recent studies have shown laparoscopic gastrectomy to be safe and beneficial in obese patients because it has a shorter postoperative recovery than open gastrectomy [2,4]. A number of studies have also shown that laparoscopic gastrectomy for gastric cancer can be performed to a standard that is comparable to open gastrectomy for gastric cancer without compromising the oncological outcomes (OS, DFS and disease recurrence) [9-17]. Laparoscopic gastrectomy for gastric cancer in obese patients is technically more challenging [2,4]. Because of the potential technical difficulties, there are concerns about the oncological safety of laparoscopic surgery in obese patients. Currently, there are no reports on long-term survival outcomes follow-

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ing laparoscopic gastrectomy for gastric cancer in obese patients. The aim of this study was to compare laparoscopic gastrectomies for gastric cancer in obese patients and non-obese patients. The specific aim was to investigate the impact of obesity on the quality of surgical resection and long-term survival outcomes.

Methods

A retrospective review of data from a prospectively maintained database of patients who underwent laparoscopic gastrectomy for gastric cancer from January 2008 to September 2016 was performed. All obese patients, defined as having BMI ≥30 kg/m^2, who underwent laparoscopic gastrectomy for gastric cancer were included. and were compared with non-obese patients who underwent a similar surgery. Data were obtained from in-hospital medical records and outpatient follow-up data. Data collected for the two groups included gender, age, American Society of Anesthesiologists (ASA) grade, BMI, clinical stage, comorbidity, surgical procedure, duration of surgery, blood loss, blood transfusion, time to recovery of gut function, postoperative hospital stay, postoperative 30-day morbidity and mortality, pathological data, and long-term survival outcomes. Pathological data included node harvest, resection margins, and pTNM staging. The TNM staging of gastric cancer followed the seventh edition of the Union for International Contre le Cancer, Japanese Gastric Cancer Association, and American Joint Committee on Cancer classification [18-21]. The staging of patients with surgery before 2009 was recalculated to match the more recent TNM classification. Postoperative 30-day morbidity was graded following the Clavien–Dindo classification. Major complications included grades 3, 4, and 5 and minor complications included grades 1 and 2. Details of the Clavien–Dindo classification have been reported elsewhere [22].

All operations were performed by one surgeon (S.Z). Conversion to an open surgical procedure was decided by the surgeon if the dissection could not be completed laparoscopically and it was deemed necessary to perform the dissection through a skin incision [23-25].

Follow-up

Following discharge, patients were followed up as outpatients every 3 months for the first 2 years, then every 6 months for the next 3 years, and at 6 months or annually thereafter. At each visit, they underwent physical examinations and general blood tests. The 6-month follow-up alternated between thoracic and abdominal CT or abdominal ultrasonography and chest radiography. Disease recurrence was defined as a radiologically or pathologically confirmed locoregional or distant metastasis, and the time of diagnosis was determined by the interval between surgery and the last patient follow-up [26-29]. The last scheduled study follow-up was October 2016.

The study was approved by the institutional review board of our institution. The need for informed consent from patients was waived because this was a retrospective study.

Statistics

Data were analyzed depending on the intention to treat; therefore, the laparoscopic group also included data for those cases that were converted unless otherwise stated. All data are presented as mean ± SD (parametric data) or median and range (nonparametric data). Data were compared using the Student's t-test for paired variables, the Mann-Whitney *U* test for unpaired continuous variables, and the chi-square or Fisher's exact test for discrete variables. The survival rate was estimated by the Kaplan-Meier method, and the significance of differences was determined by the log-rank test. Univariate analyses were performed to identify prognostic variables related to OS and DFS, and those that were found to be significant at $p<0.10$ were selected for inclusion in a multivariate Cox proportional hazard regression model. Odds ratio (OR) and corresponding 95% confidence intervals (CIs) were calculated. The SPSS 13.0 statistical software package was used for analysis (SPSS Inc., Chicago, Illinois, USA). A p value < 0.05 was considered statistically significant.

Results

Fifty-seven obese patients with BMI ≥30 kg/m^2 underwent laparoscopic gastrectomy for gastric cancer with a radical intent. These patients were compared with 153 non-obese patients who underwent laparoscopic gastrectomy for gastric cancer. There were no differences with regard to age, sex, ASA score, or clinical stage. However, there were significantly more patients with type 2 diabetes mellitus, and hyperglycemia in the obese group than in the non-obese group ($p<0.05$). Table 1 shows the detailed baseline data of the two groups.

The median duration of surgery for laparoscopically completed cases was not significantly different between obese and non-obese groups (Table 2). There were 18 conversions to open surgery in the obese group and 13 conversions to open surgery in the non-obese group ($p<0.05$). The most common reason for conversion in obese patients was an inadequate view caused by fatty tissue, followed by bleeding and adhesions. In the non-obese group, the reasons for conversion were bleeding, adhesions, and locally advanced cancer. Fifteen obese patients required a blood transfusion compared with 17 non-obese patients ($p<0.05$).

Table 1. Baseline data of the two groups

Data	*Nonobese (n=153)*	*Obese (n=57)*	*p value*
Age (y) (range)	54 (49-75)	56 (45-74)	0.205
Gender (male: female)	97:56	39:18	0.498
Comorbidities			
Hyperglycemia	9	10	0.009
Hypertension	10	4	1.000
Chronic atrial fibrillation	3	1	1.000
Type 2 diabetes mellitus	3	7	0.006
Chronic renal insufficiency	1	1	1.000
Cirrhosis	1	1	1.000
ASA score			0.843
I	123	45	
II	26	11	
III	4	1	
Clinical TNM stage (7th UICC)			0.569
I	39	18	
II	98	35	
III	16	4	

Table 2. Operative data of the two groups

Data	*Laparoscopically completed cases (n=174)*		*p value**	*Converted cases (n=31)*		*p value***
	Nonobese (n=135)	*Obese (n=39)*		*Nonobese (n=18)*	*Obese (n=13)*	
Type of gastrectomy			0.479			0.981
Total gastrectomy	57	14		11	8	
Distal gastrectomy	78	25		7	5	
Operative time, min (range)	200 (150-250)	220 (160- 280)	0.128	170 (140- 280)	180 (150- 260)	0.098
Return of bowel function, days (range)	2 (1-5)	3 (2-5)	0.158	3 (2-6)	3 (2-5)	0.118
Postoperative hospital stay, days (range)	8 (6-21)	9 (7-22)	0.500	10 (9-28)	13 (7-25)	0.038

*Comparison of nonobese and obese patients who underwent completed laparoscopy,
**Comparison of nonobese and obese patients who underwent conversion

Table 3. Postoperative 30-day complications of the two groups

Complications	*Nonobese (n=153)*	*Obese (n=57)*	*p value*
Patients with complications	17 (11.1%)	13 (22.8%)	0.031
Patients with major complications	2	5	0.025
Pneumonia	1	4	0.022
Anastomosis leakage	4	2	1.000
Intra-abdominal bleeding	3	1	1.000
Intra-abdominal abscess	3	1	1.000
Wound infection	1	4	0.029
Ileus	5	3	0.790
Pancreatitis	3	1	1.000
Mortality			
30-day	0	0	-
90-day	0	0	-

Obese patients required parenteral analgesia for 4 days, while non-obese patients required parenteral analgesia for 3 days, but the difference was not statistically significant ($p>0.05$). The median time to return of bowel function was similar in obese and non-obese patients. The median length of hospital stay was also similar for laparoscopically completed cases. For converted cases, it was 13 days for obese patients and 10 days for non-obese patients ($p<0.05$).

Table 4. Pathological data of the two groups

Pathological data	*Nonobese (n=153)*	*Obese (n=57)*	*p value*
Lymph node harvest	18 (15- 28)	16 (16- 25)	0.209
Surgical margin	2 (1.3%)	1 (1.8%)	1.000
Pathological TNM stage (7th UICC)			0.877
I	16	5	
II	90	36	
III	47	16	

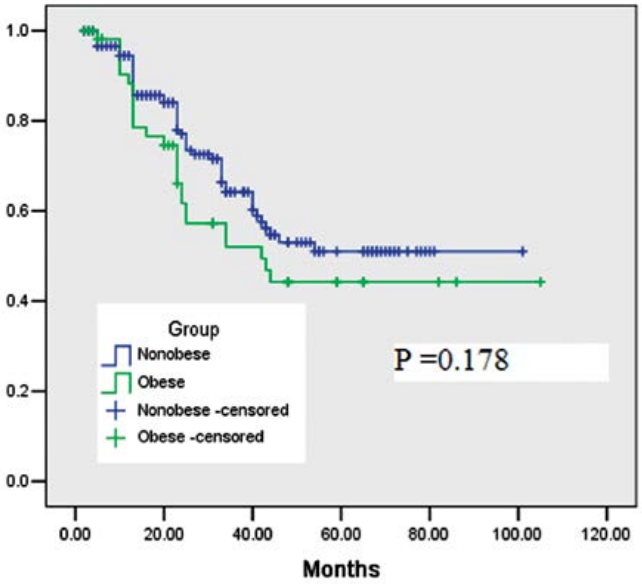

Figure 1. Disease-free survival of obese and non-obese groups that underwent laparoscopic gastrectomy for gastric cancer.

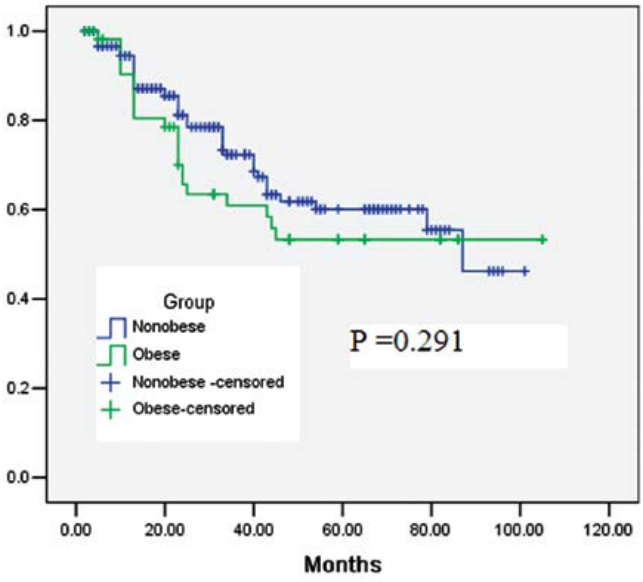

Figure 2. Overall survival of obese and non-obese groups that underwent laparoscopic gastrectomy for gastric cancer.

Table 5. Univariate and multivariate analyses for predictive factors of overall survival

	Univariate analysis		*Multivariate analysis*		
Factors	*Favorable vs unfavorable*	*p value*	*OR*	*95% CI*	*p value*
Age	< 70 vs ≥ 70years	0.042	1.235	0.507 – 1.658	0.096
Sex	Male vs female	0.128	-	-	-
Obesity	No vs yes	0.291	-	-	-
ASA score	I/II vs III	0.082	1.354	0.607 – 1.554	0.158
Major complication	No vs yes	0.109	-	-	-
Pathologic stage	I/II vs III	0.009	2.350	1.584 – 4.620	0.029

OR: odds ratio, 95% CI: 95% confidence interval

The postoperative 30-day complication rate was 16% for the obese group and 8% for the non-obese group (p<0.05). There were significant differences in wound infection and pneumonia; the severity of postoperative 30-day complications was significantly higher in the obese group (Table 3). No postoperative 30-day mortality was recorded.

The median lymph node harvest was not significantly different between the groups. The positive resection margin rates for obese and non-obese patients were 1.8 and 1.3% respectively (p>0.05). There was also no statistically significant difference in pTNM staging (p>0.05; Table 4).

At a median follow-up of 41 months, there was no statistically significant difference in DFS for obese and non-obese patients who underwent laparoscopic surgery (p=0.178, Figure 1). OS of obese and non-obese groups that underwent laparoscopic surgery showed no significant difference (p=0.291, Figure 2). The cancer stage was found to be independently associated with OS and DFS (Tables 5 and 6). Obesity was not found to be independently associated with the risk of decreased OS or DFS.

Table 6. Univariate and multivariate analyses for predictive factors of disease-free survival

	Univariate analysis		*Multivariate analysis*		
Factors	*Favorable vs unfavorable*	*p value*	*OR*	*95% CI*	*p value*
Age	<80 vs ≥ 80 years	0.057	1.216	0.801 – 1.546	0.258
Sex	Male vs female	0.350	-	-	-
Obesity	No vs yes	0.178	-	-	-
ASA score	I/II vs III	0.078	1.2902	0.520 – 1.878	0.320
Major complication	No vs yes	0.058	1.125	0.754 – 1.685	0.202
Pathologic stage	I/II vs III	0.001	2.100	1.540 – 3.980	0.032

OR: odds ratio, 95% CI: 95% confidence interval

Discussion

Obese patients with gastric cancer are increasingly encountered in surgical practice. They are at a greater risk of postoperative morbidity and mortality from a radical gastrectomy [2-4]. Laparoscopic gastrectomy with a radical intent offers short-term benefits of a quicker return of gut function and a reduced risk of postoperative morbidity [5-8]. The results of this study demonstrate the feasibility and oncological safety of laparoscopic gastrectomy for gastric cancer in obese patients. Operating times were similar in the two groups. These results are similar to those published in the literature [4].

Although intra-operative complications were not increased by obesity, there was a greater conversion rate in the obese group. Obesity has been reported as an independent risk factor for conversion [4]. Nearly 70% of the conversions in obese patients were due to obesity-related factors. As shown in our study, and although technically more demanding, a laparoscopic approach for gastric cancer surgery was as safe both in obese and in non-obese patients.

Reports on postoperative morbidity following laparoscopic gastrectomy have shown conflicting results, with some studies reporting no significant difference [5,6], while others reporting a higher trend in postoperative morbidity [7,8]. We found a significantly higher rate of postoperative 30-day morbidity in obese patients, caused almost entirely by wound infection and pneumonia. The blood transfusion rate was significantly greater in obese patients, but there was no statistically significant difference in cardiovascular complications. A previous study found that obesity was a risk factor for wound infection, wound dehiscence, and stomal complications [3]. An association with anastomotic leakage has also been reported. Previous reports found a higher rate of wound infection and pneumonia in obese patients than in non-obese patients who underwent radical surgery for gastric cancer [2-4]. Diabetes mellitus, which is related to wound infection and pneumonia, was more frequent in obese patients, and this was confirmed by our data. However, many wound infections occurred in patients without diabetes and were probably directly related to increased fat.

Higher postoperative 30-day morbidity did not affect the median length of postoperative hospital stay, which was similar in the two groups. However, in obese patients who underwent a conversion to open gastrectomy it was 2-fold higher than the length of stay for the converted non-obese patients. This difference was statistically significant, indicating a slower recovery following conversion to open gastrectomy in obese patients. Furthermore, it is noteworthy that the median duration of parenteral analgesia required in the converted group was 1 day longer, suggesting an advantage of the laparoscopic approach in obese patients. These data are consistent with previous studies [5-10].

Large sample size studies have shown comparable long-term outcomes (OS, DFS and cancer recurrence) after laparoscopic and open gastrectomy for gastric cancer [9-17]. Previous reports of laparoscopic surgery in obese patients have included various conditions [30-33], few of which were gastric cancer. To the best of our knowledge, no previous study has specifically studied the long-term survival outcomes of laparoscopic gastrectomy in obese patients. The nodal status was similar between the groups, and the positivity rate of the surgical margin was also similar. These observations were in line with similar 5-year DFS rates in obese and non-obese patients.

This study has limitations, including its non-randomized design, retrospective nature, and small sample size, which may have led to an unpowered conclusion. However, the effect of obesity on short- and long-term outcomes has rarely been analyzed, and we believe that the study is valuable even though the sample size was not sufficiently large. Therefore, a large-scale, multicenter, randomized controlled trial should be con-

ducted in the future.

Conclusion

In conclusion, laparoscopic gastrectomy for gastric cancer in obese patients is technically feasible and oncologically safe. However, higher postoperative 30-day morbidity and conversion rate was observed in obese patients.

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Conflict of interests

The authors declare no confict of interests.

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