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ORIGINAL ARTICLE

Influence of obesity on short- and long-term outcomes after laparoscopic distal gastrectomy for gastric cancer

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Summary

Purpose: *Despite the increasing prevalence of obesity and gastric diseases, the impact of obesity on short- and long-term outcomes of laparoscopic distal gastrectomy for gastric cancer still remains unclear.*

Methods: *Sixty-one consecutive obese patients with body mass index (BMI)≥30 kg/m², who underwent laparoscopic distal gastrectomy, were compared with 76 non-obese patients with BMI<30 kg/m². Short- and long-term outcomes were analyzed in both groups.*

Results: *Obesity was associated with a longer operative time and a greater estimated blood loss. The rate of conversion to open distal gastrectomy was similar between the two groups. There were no 30-day postoperative deaths in either group. There was no significant difference in the overall number or severity of 30-day postoperative complications between the two groups. Regarding long-term survival outcomes, there was no statistical difference in overall (OS) or disease-free survival (DFS) between the two groups. Multivariate analysis showed that BMI did not influence prognosis.*

Conclusion: *Laparoscopic distal gastrectomy appears to be a safe and reasonable option for selected obese patients with gastric cancer and results in short- and long-term outcomes similar to those in non-obese patients.*

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

Introduction

Obesity is a well-known and increasingly common problem in China [1]. In China, the number of obese (BMI ≥ 30 kg/m²) individuals continues to increase. Obesity is a well-known risk factor for health disorders, including type 2 diabetes mellitus, hypertension, and acute coronary syndrome, and is associated with worse surgical outcomes than those in normal-weight individuals (BMI, 18.5–24.9 kg/m²) [2]. Furthermore, obese individuals are at an increased risk of wound and cardiopulmonary complications, as well as technical difficulties during operative procedures, all of which potentially influence outcomes [3-5].

Compared with open distal gastrectomy, laparoscopic distal gastrectomy is considered to be associated with better short-term outcomes, such as less blood loss, less mortality and morbidity, and better cosmetic results [6-11]. These advantages have prompted the application of the laparoscopic approach to high-risk patients, including obese patients [12-18]. The impact of obesity on the outcomes of laparoscopic distal gastrectomy remains controversial. Some authors have shown that obese patients are at a greater risk for conversion to laparotomy and postoperative complications [6-10]. In contrast, other studies have

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reported equivalent postoperative outcomes and benefits [12-14]. In addition, with regard to long-term outcomes, to our knowledge, there is only one study with a relatively short follow-up period reporting on the survival outcomes of obese and non-obese patients who underwent laparoscopic gastrectomy for gastric carcinoma [19]. The present study aimed to evaluate the impact of obesity on short- and long-term outcomes of laparoscopic distal gastrectomy in obese patients with gastric cancer compared with a case-matched population of non-obese patients.

Methods

The medical records of patients who underwent laparoscopic distal gastrectomy with radical intent for gastric cancer from January 2007 through December 2015 were reviewed. The short-term outcomes, including demographic data, medical comorbidities, surgical data, and 30-day postoperative complications were reviewed from hospital and outpatient records. The long-term outcomes (i.e., OS and DFS) were gathered from the follow-up database. In accordance with the World Health Organization classification (BMI<30kg/m^2, non-obese; BMI≥30kg/m^2, obese), the patients were divided into two groups on the basis of their BMI at the time of surgery. Patients with BMI<18.5kg/m^2 were excluded from this study.

Sixty-one consecutive obese patients were matched to 61 non-obese patients for age, sex, clinical TNM stage, and American Society of Anesthesiologists (ASA) score [20,21]. The primary end points were short- and long-term outcomes. The details of the surgical procedures have been reported in a previous study [10]. After laparoscopic distal gastrectomy, patients were managed according to current guidelines for gastric cancer. Conversion to open distal gastrectomy was defined as an unplanned creation of a wound to facilitate dissection. The severity of 30-day postoperative complications was graded according to the Clavien–Dindo classification, as follows: grade 1=oral medication or bedside medical care required; grade 2= intravenous medical therapy required; grade 3= radiological, endoscopic, or operative intervention required; grade 4= chronic deficit or disability associated with the event; and grade 5= death related to surgical complications. Major complications were defined as grades 3, 4, and 5. Minor complications were classified as 1 and 2 [22-38].

The patients were seen in the outpatient department every 3 months for the first postoperative year, every 4–5 months for the next 2 years, and then annually. Tumor recurrence was diagnosed by history, physical examination, endoscopic evaluation, radiological investigations, or pathology when available. OS was calculated from the date of the radical resection to the date of the last follow-up or death from any cause. DFS was assessed from the date of radical resection until

Table 1. Baseline and clinicophathologic data

Data	*Nonobese (n=61) n*	*Obese (n= 61) n*	*p value*
Age (years), median (range)	59 (39-72)	61 (38-70)	0.398
Gender			0.700
Male	40	42	
Female	21	19	
Comorbidity			
Hyperlipidemia	1	8	0.038
Hypertension	1	8	0.038
Diabetes mellitus	2	3	1.000
Stable angina	2	2	1.000
Previous ischemic stroke	2	1	1.000
COPD	1	1	1.000
Clinical TNM stage (7th AJCC-UICC)			0.537
IB	13	15	
IIA	27	28	
IIB	21	18	
ASA score			0.169
I	52	46	
II	7	11	
III	2	4	
Pathological TNM stage (7th AJCC-UICC)			0.365
IB	8	11	
IIA	15	16	
IIB	11	12	
IIIA	18	14	
IIIB	9	8	
Retrieved lymph nodes, median (range)	18 (15-26)	17 (15-27)	0.250
Residual tumor (R0/R1/R2)	61/0/0	61/0/0	1.000

the date of cancer recurrence or death from any cause. The follow-up was closed in July 2016.

This study was carried out in accordance with the Declaration of Helsinki and was approved by the local ethics committee. Patient informed consent was waived because this was a retrospective study.

Statistics

Categorical data were presented as numbers and percentages, and continuous data were described by mean and standard deviation or median and range, according to the distribution. Non-parametric analysis, using the Wilcoxon test and Chi-square tests or the Fisher exact test when appropriate, was performed to compare the groups. Univariate OS and DFS curves' analysis was assessed using the Kaplan-Meier method with log rank test. Parameters with a p value of <0.10 entered into a multivariate Cox proportional hazards model. All statistical tests were two-sided with the threshold of significance set at p<0.05. Statistical analysis was performed using SPSS 13.0 software (SPSS Inc., Chicago, IL, USA).

Results

Among patients who underwent colectomy from January 2007 to December 2015, 61 obese patients (BMI ≥ 30 kg/m^2) were identified and included in this study, along with 61 case-matched, non-obese patients (BMI < 30 kg/m^2). The baseline and clinicopathological data of the two groups are presented in Table 1. A greater number of patients in the obese group had hypertension and hyperlipidemia than that in the non-obese group (p=0.038 and 0.038, respectively); no significant difference was seen between the two groups in any other type of medical comorbidity. There was no significant difference between the two groups for age, sex, ASA class, clinical TNM stage, pathological TNM stage, or lymph nodes (Table 1).

With regard to short-term surgical outcomes, surgical time was longer in the obese group than that in the non-obese group (p=0.018, Table 2). The obese group had a greater estimated blood loss than that in the non-obese group (p=0.025, Table 2). The rate of conversion was not significantly different between the two groups (p=0.563, Table 2).

There were no 30-day postoperative deaths in either group. The overall number and severity of 30-day postoperative complications were not significantly different between the two groups (Table

Table 2. Short-term outcomes

Outcomes	*Nonobese (n=61)*	*Obese (n= 61)*	*p value*
Operative time (min), median (range)	170 (140-220)	190 (160-240)	0.018
Estimated blood loss (ml), median (range)	210 (120-300)	230 (180-490)	0.025
Conversion, n (%)	5 (8.2)	7 (11.5)	0.563
Patients with postoperative 30-day complication, n	11	17	0.196
Patients with major complication, n	3	5	0.715
Postoperative hospital stay (days), median (range)	9 (7-21)	11 (9-32)	0.094

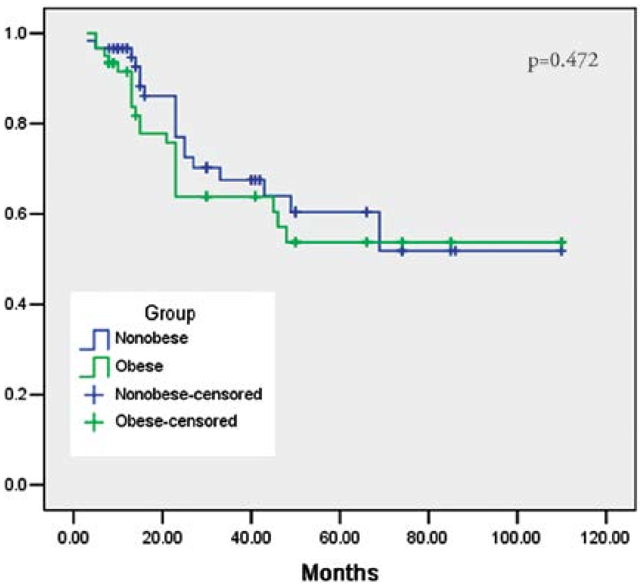

Figure 1. Overall survival classified by obesity status.

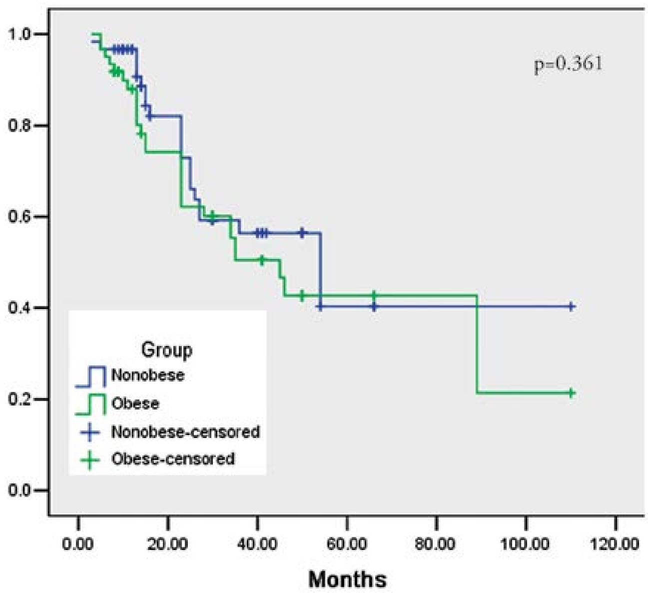

Figure 2. Disease-free survival classified by obesity status.

2). The median postoperative hospital stay was not significantly different between the two groups (p=0.094).

The median follow-up period for all patients was 41 months. No significant difference was seen in the median follow-up period between the two groups (p= 0.656). OS rate was similar between the obese and non-obese patients (5-year OS rate: 56 vs 60%, respectively; p=0.472; Figure 1). Univariate and multivariate analyses identified pathological T stage and pathological N stage as the factors with independent effects on OS (Tables 3 and 4). BMI did not influence OS.

There was no statistically significant difference in 5-year DFS between the obese and non-obese patients (43 vs 40%, respectively; p=0.361; Figure 2). In univariate and multivariate analysis, pathological T stage and pathological N stage had independent effects on DFS (Tables 5 and 6). BMI did not influence DFS.

Discussion

In the present study, the operative time and blood loss were significantly greater in the obese group than that in the non-obese group. However, the conversion rate, postoperative hospital stay, and 30-day postoperative morbidity and mortality were not significantly different between the two groups. Of note, regarding long-term survival outcomes, there was no significant difference in OS and DFS rates between the two groups.

Obesity is often accompanied by increased metabolic-related medical comorbidities, longer operative times, increased blood loss, and increased conversion rates [39,40]. Although our study did not show a significant difference in conversion rates between the two groups, our finding is consistent with the results of previous study in terms of short-term outcomes [39,40]. The rate of postoperative complications did not differ between the two groups, which is again consistent with previous study [39,40].

The importance of the present study is that it provides evidence to support the use of laparoscopic distal gastrectomy in obese patients so that they may derive the potential benefits provided by a laparoscopic approach. Furthermore, the laparoscopic approach in obese patients with gastric cancer has been supported by a comparative investigation analyzing 77 patients with BMI >30 kg/m^2 who underwent laparoscopic or open distal gastrectomy [19]. The authors of that study reported better short-term outcomes in the laparoscopic group [19].

Table 3. Univariate analysis of overall survival

Variables	*5-year overall survival (%)*	*p value*
Age (years)		0.102
<65	65	
≥65	54	
Gender		0.360
Male	59	
Female	55	
ASA score		0.155
I-II	61	
III	53	
Comorbidity		0.128
No	62	
Yes	49	
Pathological T stage		0.001
T1-T2	72	
T3-T4	43	
Pathological N stage		0.008
N0-N1	75	
N2-N3	52	
Major complication		0.098
No	63	
Yes	48	
Adjuvant chemotherapy		0.150
Yes	67	
No	55	

Table 4. Cox proportional hazards model for overall survival

Variables	*Hazard ratio (95% CI)*	*p value*
T1-T2 versus T3-T4	2.320 (1.258-5.879)	0.010
N0-N1 versus N2-N3	3.001 (1.887-4.550)	0.028
Major complication No versus Yes	1.887 (0.589-2.088)	0.125

From the perspective of operative technique, the median number of dissected lymph nodes was not affected by the obesity status, and this is consistent with the results of previous studies [6-15]. Furthermore, we did not observe increased rates of conversion to an open procedure, which has been previously reported to lead to shorter long-term survival outcomes [6-12].

No previous findings have examined the association between BMI and long-term survival outcomes in patients undergoing laparoscopic gastrectomy with radical intent for gastric cancer. To the best of our knowledge, our study is the first series investigating BMI and prognosis for patients undergoing laparoscopic gastrectomy for gastric cancer. We found that obesity is not associated with negative OS and DFS outcomes when gastrectomy is performed by laparoscopy. We analyzed both DFS and OS given the fact that obesity is a risk factor for numerous medical conditions that can adversely affect both

Table 5. Univariate analysis of disease-free survival

Variables	*5-year disease-free survival (%)*	*p value*
Age, years		0.271
<65	46	
≥65	38	
Gender		0.211
Male	45	
Female	41	
ASA score		0.155
I-II	50	
III	41	
Comorbidity		0.150
No	49	
Yes	37	
Pathological T stage		0.006
T1-T2	54	
T3-T4	31	
Pathological N stage		0.001
N0-N1	60	
N2-N3	38	
Major complication		0.210
No	46	
Yes	36	
Adjuvant chemotherapy		0.098
Yes	51	
No	37	

Table 6. Cox proportional hazards model for disease-free survival

Variables	*Hazard ratio (95% CI)*	*p value*
T1-T2 versus T3-T4	1.885 (1.320-3.302)	0.020
N0-N1 versus N2-N3	2.558 (1.889-3.025)	0.030
Adjuvant chemotherapy Yes versus No	1.650 (0.785-1.885)	0.110

operative and long-term outcomes, in addition to oncological aspects.

One possible explanation for the lack of significant differences in OS and DFS between the two groups could be that the "metabolic profile" of the two groups in our study was relatively similar (apart from the greater prevalence of hypertension and hyperlipidemia in the obese patients). Indeed, there is increasing evidence that excess BMI alone does not necessarily translate to increased mortality; patients who were obese based on BMI alone but otherwise metabolically healthy have been shown not to be at an increased risk of cardiovascular disease and all-cause mortality over 7 years [41].

The limitations of this study obviously include its retrospective design, which may have caused selection bias; i.e., the selection of patients for laparoscopic surgery may have been dependent on the surgeon's perception of the likelihood of successful outcomes, and, therefore, also dependent on the patients' BMI. Further analysis in a large cohort prospective study is needed to validate these results. Another limitation of this study was the small patient sample size. One recommendation for future studies is to increase patient sample number, which will also increase the power of the findings.

In summary, our findings are of clinical interest because they concur with the growing body of evidence that excess weight in the absence of clinically serious metabolic morbidity does not adversely affect the surgical and survival outcomes of laparoscopic distal gastrectomy for gastric cancer. We believe these findings also support the safety of laparoscopic distal gastrectomy for obese patients with gastric cancer.

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Conflict of interests

The authors declare no confict of interests.

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