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The Influences of Obesity in Laparoscopic and Open Distal Gastrectomy for Patients with Early Gastric Cancer

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Background: A recent increase in the number of surgeries performed on obese patents has raised several issues. In this study, we examined the effects of obesity on laparoscopic and open distal gastrectomy.

Methods: A total of 262 patients with gastric cancer (cStage I) who underwent distal gastrectomy were classified into open distal gastrectomy (ODG) (145 patients) and laparoscopic distal gastrectomy (LDG) (117 patients) groups. According to their body mass index (BMI), they were subdivided into obese (BMI $\geq$ 25) and non-obese patients (BMI < 25) to examine the duration of surgery, blood loss, the number of lymph node dissections, postoperative hospital stay, and incidence of postoperative complications.

Results: The duration of surgery was longer and blood loss was higher for obese patients than for non-obese patients in both groups. The results for these two endpoints were significantly reduced in the LDG group than in the ODG group both in obese and non-obese patients. Furthermore, the number of lymph nodes dissected tended to be higher in the LDG group than in the ODG group in obese patients. Postoperative hospital stay was not significantly different between obese and non-obese patients in both groups, but was significantly shorter in the LDG group than in the ODG group regardless of the body weight. The incidence of postoperative complications was significantly higher in obese patients than in non-obese patients, although the difference between the groups was not significant.

Conclusions: These findings indicate that LDG may be useful for obese patients with cStage I gastric cancer. (J Nippon Med Sch 2022; 89: 215–221)

Key words: obesity, gastric cancer, laparoscopic surgery

Introduction

In Japan, the number of obese patients has been increasing every year owing to Westernization of dietary habit, stable food supply, and popularization of fast food[1]. Patients with gastric cancer generally experience emaciation; however, the number of obese patients who develop gastric cancer has recently been increasing[1]. During surgery, maintaining the visual field is difficult and bleeding easily occurs. Laparoscopic distal gastrectomy (LDG) is becoming the standard surgical procedure for cStage I gastric cancer. However, laparoscopically assisted surgery is quite challenging in obese patients. In the present article, we examined the effects of obesity on LDG and open distal gastrectomy (ODG).

Materials and Methods

Patients

We included 262 patients with gastric cancer (cStage I) who underwent distal gastrectomy between January 1996 and June 2014 and classified them into the ODG (145 patients) and LDG (117 patients) groups (ODG and LDG have been initiated since 1996 and 2005, respectively).

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Table 1 Patient background of LDG cases

		Obese n = 25	Non-obese n = 92	p value
BMI		26.7±1.4	21.5±2.4	<0.01
Age		67.9±10.1	67.5±10.3	0.88
Sex	Male	21	57	0.03
	Female	4	35	
Depth	T1	25	89	0.23
	T2	0	3	
Lymph node metastasis	N0	24	91	0.17
	N1	1	0	
	N2	0	1	
Lymph node dissection	D1	17	44	0.17
	D1+	8	47	
	D2	0	1	
pStage	IA	24	88	0.55
	IB	1	2	
	II	0	2	
Comorbidity	Diabetes	6/25	7/92	0.03
	Hypertension	15/25	33/92	0.03
	Heart disease	6/25	9/92	0.08
	Lung disease	0/25	2/92	0.32

According to their body mass index (BMI), they were subdivided into obese (BMI ≥ 25) and non-obese (BMI < 25) groups to examine the duration of surgery, blood loss, number of lymph nodes dissected, postoperative hospital stay, and incidence of postoperative complications. Since these endpoints were evaluated using patient data obtained >20 years ago, pStage was classified based on the Japanese Classification of Gastric Carcinoma (13th edition) to maintain consistency and accuracy.

Statistical Analysis

All statistical analyses were analyzed with the JMP statistical software program (SAS, Cary, NC, USA). For group comparison, χ^2 test was used. Also we used the Wilcoxon rank sum test to analyze continuous variables. P values of <0.05 were determined to be statistically significant.

Informed Consent

All patients were informed about their treatment options. No treatment has been given without prior informed consent. The research protocol complied with the ethical guidelines established by the Declaration of Helsinki and was approved by the institutional review board of Hasuda Hospital.

Results

Patient characteristics of the LDG and ODG groups are shown in **Table 1** and **Table 2**, respectively. Each item was compared between the obese and non-obese patients. BMI significantly differed between the obese and non-obese patients both in the LDG and ODG groups. In the LDG group, the number of men and the prevalence of diabetes and hypertension were significantly higher in the obese patients than in the non-obese patients. In the ODG group, only BMI showed a significant difference.

The duration of surgery was longer in the obese patients (LDG, 260.8 minutes; ODG, 267.6 minutes) than in the non-obese patients (LDG, 230.0 minutes; ODG, 228.0 minutes) ($p < 0.05$) (**Fig. 1**). In the LDG group, blood loss was greater for the obese patients (134.0 g) than for the non-obese patients (77.7 g) ($p < 0.05$), and a similar tendency was observed in the ODG group (obese group [592.0 g] vs. non-obese [446.5 g]) ($p < 0.01$) (**Fig. 2**). Blood loss was significantly reduced in the LDG group than in the ODG group regardless of body weight ($p < 0.01$). Regarding the number of lymph nodes dissected, no significant difference was observed between the obese (26.5) and non-obese (28.2) patients in the LDG group, but it was significantly lower in the obese patients (13.0) than in the non-obese patients (30.5) in the ODG group ($p < 0.05$) (**Fig. 3**). Regarding the number of lymph nodes dissected, obese patients was higher in the LDG group than in the ODG group ($p = 0.08$). The length of hospital stay was not significantly different in the LDG group (obese [17.2 days] and non-obese [13.5 days] patients) and in the ODG group (obese [21.4 days] and non-obese [22.3 days] patients) (**Fig. 4**) but was significantly shorter in the LDG

Table 2 Patient background of ODG cases

		Obese n = 23	Non-obese n = 122	p value
BMI		27.2±1.7	21.2±2.2	<0.01
Age		64.1±11.1	64.6±13.7	0.72
Sex	Male	17	81	0.47
	Female	6	41	
Depth	T1	23	122	Untestable
	T2	0	0	
Lymph node metastasis	N0	22	117	0.96
	N1	1	5	
	N2	0	0	
Lymph node dissection	D1	15	51	0.06
	D1+	7	50	
	D2	1	21	
pStage	IA	22	115	0.78
	IB	1	7	
	II	0	0	
Comorbidity	Diabetes	2/23	14/122	0.69
	Hypertension	7/23	32/122	0.68
	Heart disease	4/23	11/122	0.26
	Lung disease	0/23	1/122	0.56

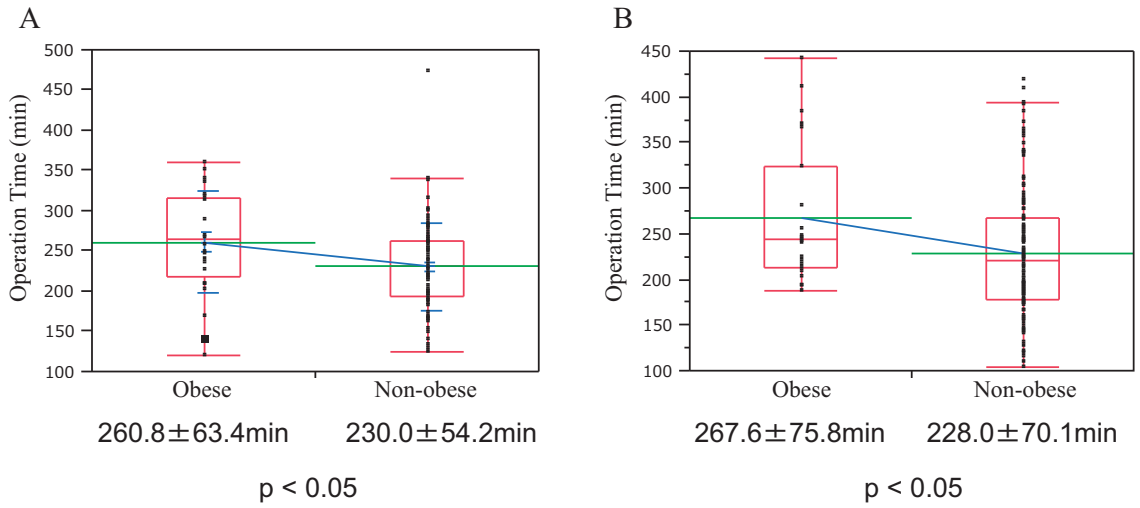

Fig. 1 Duration of surgery in obese and non-obese patients by laparoscopic distal gastrectomy (LDG) (A) and open distal gastrectomy (ODG) (B). The median values are depicted by the horizontal line, and the lower and upper edges of the boxes depict the 25 and 75 percentiles, respectively.
The duration of surgery was longer in the obese patients (LDG, 260.8 minutes; ODG, 267.6 minutes) than in the non-obese patients (LDG, 230.0 minutes; ODG, 228.0 minutes) ($p < 0.05$).

group than in the ODG group regardless of body weight ($p < 0.01$). The incidence of postoperative complications (i.e., those with Clavien-Dindo ≥Grade 2) was higher in the obese patients (16.0%) than in the non-obese patients (4.3%) in the LDG group ($p < 0.05$). Such a tendency was observed in the ODG group (obese group [21.7%] vs. non-obese group [10.7%]) ($p = 0.17$)(**Table 3**). There were no cases of reoperation due to postoperative complications. No surgery-related deaths were observed.

Discussion

In Japan, an increase in the proportion of obese patients has been associated with an increased number of surgeries for these patients. Such a tendency is also observed in the field of gastric cancer surgery in which advancements in diagnostic technologies have enabled early detection. Surgery for obese patients poses several issues, such as difficulty in surgical manipulation and the onset of postoperative complications. Our literature search was per-

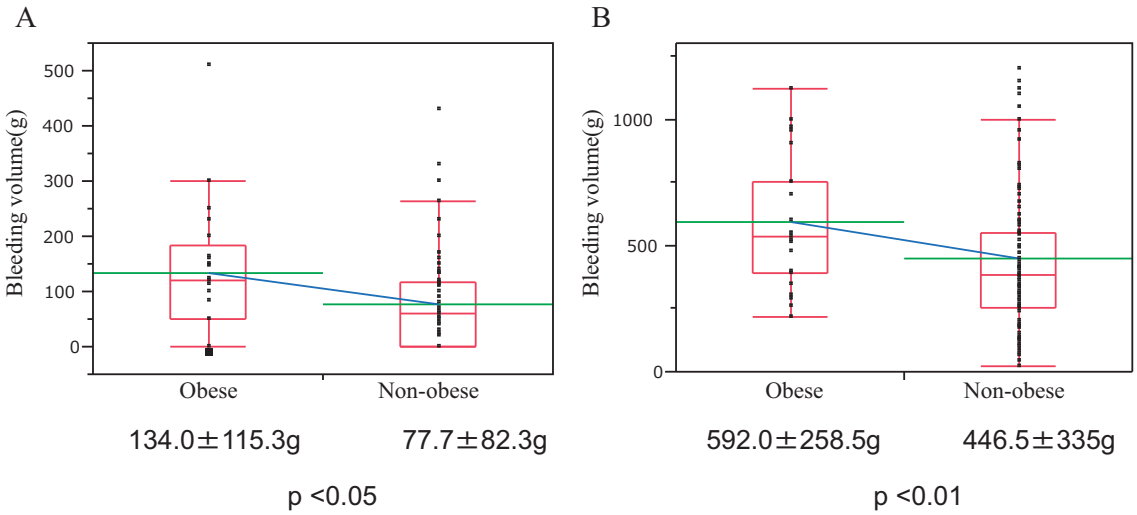

Fig. 2 Blood loss in obese and non-obese patients by laparoscopic distal gastrectomy (LDG) (A) and open distal gastrectomy (ODG) (B). The median values are depicted by the horizontal line, and the lower and upper edges of the boxes depict the 25 and 75 percentiles, respectively.
In the LDG and ODG groups, blood loss was greater for the obese patients (134.0 g and 592.0 g, respectively) than for the non-obese patients (77.7 g and 446.5 g, respectively) ($p < 0.05$ and $p < 0.01$ respectively).

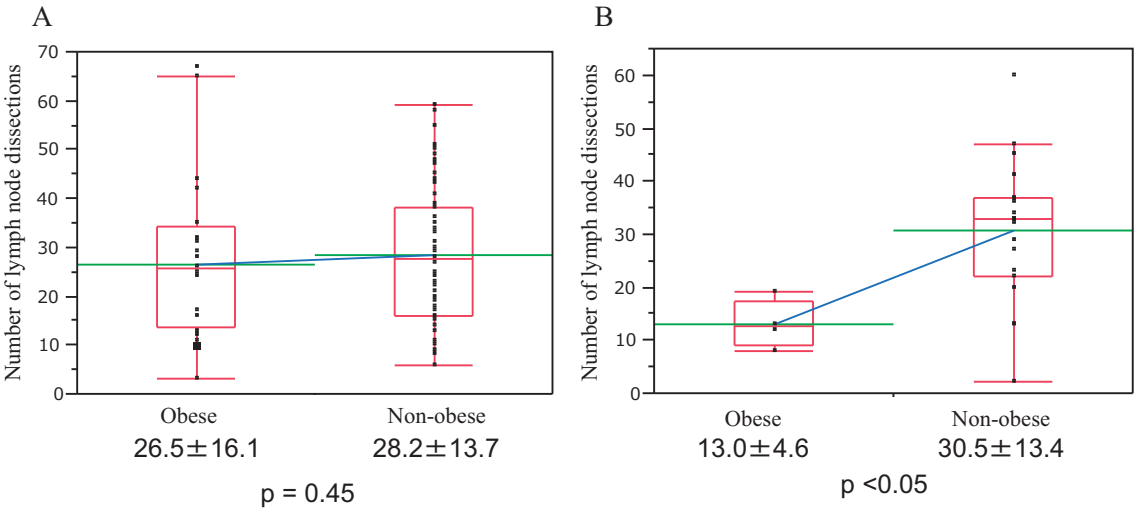

Fig. 3 The number of lymph nodes dissected in obese and non-obese patients by laparoscopic distal gastrectomy (LDG) (A) and open distal gastrectomy (ODG) (B). The median values are depicted by the horizontal line, and the lower and upper edges of the boxes depict the 25 and 75 percentiles, respectively.
The number of lymph nodes dissected was not significantly different between the obese (26.5) and non-obese (28.2) patients in the LDG group. However, it was lower for the obese patients (13.0) than for the non-obese patients (30.5) in the ODG group ($p < 0.05$), but higher for obese patients in the LDG group than in the ODG group.

formed in Pubmed using the keywords "gastric cancer surgery" and "obesity." Studies relevant to our research and similar variables were few. Among the obese patients, visceral fat obesity is more closely associated with glucose tolerance, lipid metabolism abnormality, hypertension, and arteriosclerosis than subcutaneous fat obesity[2]. Therefore, if these diseases are not identified preoperatively, adequate caution should be exercised, particularly in patients with visceral fat obesity. The recent advancements in diagnostic technologies have enabled the detection of early-stage cancer, thereby increasing the likelihood of surgery in obese gastric cancer patients with excess visceral fat. The effects of obesity on surgery for gastric cancer patients have been evaluated, indicat-

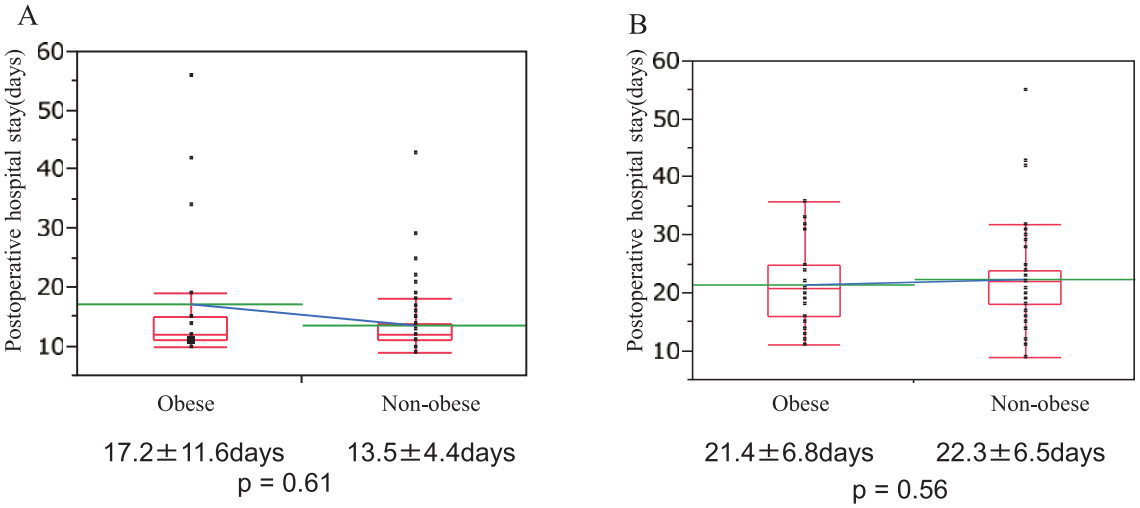

Fig. 4 Postoperative hospital stay for obese and non-obese patients after laparoscopic distal gastrectomy (LDG) (A) and open distal gastrectomy (ODG) (B). The median values are depicted by the horizontal line, and the lower and upper edges of the boxes depict the 25 and 75 percentiles, respectively.
No significant difference was observed in postoperative hospital stay between the obese (LDG, 17.2 days; ODG, 21.4 days) and non-obese (LDG, 13.5 days; ODG, 22.3 days) patients. However, it was significantly shorter in the LDG group than in the ODG group regardless of body weight.

Table 3 Number of Postoperative complications (ratio)

	Obese LDG n = 25	Non-obese LDG n = 92	Obese ODG n = 23	Non-obese ODG n = 122
Surgical site infection	1	0	3	3
Anastomotic leakage	1	1	0	0
Anastomotic stenosis	1	0	0	0
Pancreatic fistula	1	0	0	0
Pancreatitis	0	0	1	1
Pneumonia	0	2	0	0
Ileus	0	0	0	1
Postoperative bleeding	0	0	0	1
Others	0	1	1	7
Total	4 (16.0)	4 (4.3)	5 (21.7)	13 (10.7)

ing that the obese patients face several disadvantages when compared with the non-obese patient. Longer duration of surgery, greater volume of blood loss, and higher incidence of postoperative complications, such as pancreatic fistula, intraabdominal infection, and suture failure are some of the issues faced by obese patients[3–8].

Recently, several studies have also evaluated whether laparoscopically assisted gastrectomy is useful for obese patients. Shin et al. reported that although such a procedure can be safely performed on these patients, because of the technical difficulties in lymph node dissection, it should be reserved for early-stage cancers[9]. BMI is commonly used as an index of obesity because it can be easily calculated based on height and body weight. However, the correlation between BMI and physique differs in some cases; thus, BMI does not accurately reflect obesity risk[10]. Diagnostic criteria for obesity proposed by the Japan Society for the Study of Obesity include visceral fat area (VFA) in addition to BMI. VFA is determined by abdominal computed tomography at the umbilical level, and patients with ≥100 cm^2 of VFA are categorized as having visceral fat obesity. Several studies have evaluated surgical risk using BMI and VFA. Yoshikawa et al. documented that VFA was more favorable than BMI to predict blood loss during LDG and postoperative complications[11]. In addition, Tanaka et al. described that VFA was more favorable than BMI to predict the onset of pancreatic fistula after total gastrectomy[12]. The subsequent study revealed that it was uncertain as to whether VFA measurements determined by abdominal computed to-

mography outperform BMI in predicting the surgery risk for obese patients with gastric cancer[1]. Based on these reports, BMI, which can be easily calculated at any medical institution, may currently be more reliable than VFA.

Endoscopic surgery has seen rapid advancements owing to improvements in surgical techniques, formulation of surgical modality, and development of surgical instruments. In terms of surgery for gastric cancer, Kitano et al. first reported LDG in 1994[13]. Since, then, the number of patients receiving LDG has steadily increased, and the superiority of this procedure over open surgery has been established[14–32]. The 2014 guidelines for endoscopic surgery have classified LDG under level B (i.e., it is recommended) for gastric cancer patients with cStage I[33]. According to the 12th nationwide survey of endoscopic surgery in Japan, gastric surgery was laparoscopically performed on 9,168 patients in 2013, accounting for 34.0% of all gastric surgeries. With the number of laparoscopically assisted gastric surgery procedures increasing every year[34], this type of surgery has been standardized. Currently, a clinical trial uses this procedure and has achieved favorable short-term results (i.e., noninferiority to open surgery) in patients with advanced gastric cancer. Thus, it is likely that indications for laparoscopically assisted gastric surgery will be expanded in the future[35].

The duration of surgery was longer and blood loss was greater in the obese patients than in the non-obese patients; however, the blood loss may be reduced through the use of LDG in the obese patients.

The number of lymph nodes dissected was lower in the obese patients in the ODG group. The use of LDG may increase such numbers in the obese patients.

Postoperative hospital stay was similar between the obese and non-obese patients; however, it was significantly shorter in the LDG group than in the ODG group.

The incidence of postoperative complications was higher in the obese patients than in the non-obese patients. However, in this study, although there was no statistically significant difference, obese cases tended to have slightly lower lymph node dissection than non-obese cases. It is necessary to consider how this will affect long-term results in the future.

In conclusion, LDG may be useful for obese patients with cStage I gastric cancer for short-term results.

Conflict of Interest: All authors declare that they have no conflicts of interest.

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