The Impact of Obesity on the Use of a Totally Laparoscopic Distal Gastrectomy in Patients with Gastric Cancer

Eiji Oki, Yoshihisa Sakaguchi1, Kippei Ohgaki1, Hiroshi Saeki, Yoshiki Chinen1, Kazuhito Minami1, Yasuo Sakamoto1, Yasushi Toh1, Testuya Kusumoto2, Takeshi Okamura1, and Yoshihiko Maehara

Department of Surgery and Science, Graduate School of Medical Sciences, Kyushu University, Fukuoka, 1Department of Gastroenterological Surgery, National Kyushu Cancer Center, Fukuoka, 2Department of Gastroenterological Surgery, National Beppu Medical Center, Beppu, Japan

Purpose: Since a patient's obesity can affect the mortality and morbidity of the surgery, less drastic surgeries may have a major benefit for obese individuals. This study evaluated the feasibility of performing a totally laparoscopic distal gastrectomy, with intracorporeal anastomosis, in obese patients suffering from gastric cancer.

Materials and Methods: This was a retrospective analysis of the 138 patients, who underwent a totally laparoscopic distal gastrectomy from April 2005 to March 2009, at the National Kyushu Cancer Center. The body mass index of 20 patients was ≥25, and in 118 patients, it was <25 kg/m².

Results: The mean values of body mass index in the 2 groups were 27.3±2.2 and 21.4±2.3. Hypertension was significantly more frequent in the obese patients than in the non-obese patients. The intraoperative blood loss, duration of surgery, post-operative complication rate, post-operative hospital stay, and a number of retrieved lymph nodes were not significantly different between the two groups.

Conclusions: Intracorporeal anastomosis seemed to have a benefit for obese individuals. Totally laparoscopic gastrectomy is, therefore, considered to be a safe and an effective modality for obese patients.

Key Words: Laparoscopy; Gastrectomy; Stomach neoplasms; Obesity; Body mass index

Introduction

In Japan, laparoscopy-assisted gastrectomy and lymph node dissection with curative intent have been recommended and practiced for the treatment of early gastric cancers since the first report in 1994 of a laparoscopy-assisted distal gastrectomy (LADG) with a Billroth I anastomosis for a patient with gastric cancer.1) Obesity is associated with the mortality and morbidity of a gastrectomy in open surgery.2~5) Obesity might increase the rate of intraoperative or post-operative complications. Therefore, less invasive surgery, such as an LADG, may have a greater impact in the obese patients by reducing the rate of complications, length of the hospital stay, and permitting a more rapid return to physical activities. There have been a few studies that have investigated the impact of obesity on laparoscopy-assisted distal gastrectomy.6~8) These reports have shown technical difficulties and a longer duration of surgery in the obese patients.

A totally laparoscopic distal gastrectomy (TLDG) is defined as a method used to perform both the resection and anastomosis intracorporeally with a laparoscopic technique. TLDG has several advantages over LADG including smaller wounds, less invasiveness, and a greater chance of a secure ablation.9) However, the introduction of TLDG for all people still remains controversial, since it is generally believed that the time required for a TLDG is longer and the surgical procedure is more difficult than for a LADG. This
study compared the factors associated with the outcome of a TLDG in obese patients and non-obese patients to elucidate the safety and advantages for the obese patients.

**Materials and Methods**

1. **Patients**

   One hundred thirty-eight patients underwent a TLDG for gastric cancer in the National Kyushu Cancer Center in Japan between April 2005 and March 2009. A TLDG was performed in patients with T1N0M and T2N0M0 gastric cancer regardless of their gender, age, body mass index (BMI) or comorbidities. The patients were divided into two groups, consisting of obese and non-obese patients, according to the obesity criteria recommended by the Japan Society of Obesity. The BMI in the non-obese group was < 25.0 (n=118); in the obese group, the BMI was ≥25.0 (n=20). The concurrent diseases, duration of surgery, blood loss, hospital stay and post-operative morbidity were compared in the two groups. Information was collected from the medical records and anesthesia records including age, gender, duration of surgery, estimated blood loss, blood test data, lung function tests, pathological findings and post-operative complications or parenteral nutritional support.

2. **Surgical procedures**

   The distal gastrectomy and lymph node dissection were performed according to the guideline of the Japanese Gastric Cancer Association.(10) The patient was placed under general anesthesia in the supine position. A 12-mm trocar was inserted in the umbilical region using a cut-down method. A laparoscope was inserted through the trocar and the liver was pulled up using a Penrose drain and a J-shaped retractor.(11) The detailed surgical procedure of the TLDG was reported previously.(9,11) The distal stomach

| Characteristic           | BMI≥25 (n=20) | BMI<25 (n=118) | P-value |
|--------------------------|--------------|----------------|---------|
| Mean age (yr)            | 63.5±11.1    | 63±11.2        | 0.845   |
| Gender                   | M            | 12 (60)        | 0.583   |
|                          | F            | 8 (40)         |         |
| BMI                      | 27.3±2.2     | 21.4±2.3       | <0.001  |
| VC                       | 3,223.2±865.2 | 3,310±825.4   | 0.729   |
| %FEV*                    | 75.1±9.6     | 76.0±9.6       | 0.918   |
| Hematological data       |              |                |         |
| Hemoglobin (g/dl)        | 13.8±1.9     | 13.5±1.5       | 0.431   |
| Protein (g/dl)           | 7.15±0.64    | 7.16±0.48      | 0.983   |
| Albumin (g/dl)           | 4.26±0.33    | 4.31±0.36      | 0.603   |
| ASA†                     |              |                |         |
| 1                        | 5 (25.0)     | 53 (44.9)      | 0.128   |
| 2                        | 14 (70.0)    | 54 (45.7)      |         |
| 3                        | 1 (5.0)      | 11 (9.3)       |         |
| Stage                    |              |                |         |
| Ia                       | 14 (70.0)    | 96 (81.3)      | 0.661   |
| Ib                       | 4 (20.0)     | 14 (11.9)      |         |
| II                       | 1 (5.0)      | 6 (5.1)        |         |
| IIIa                     | 1 (5.0)      | 2 (1.7)        |         |
| Extent of lymph node resection |          |                |         |
| D1+α, β                  | 16 (80.0)    | 83 (70.3)      | 0.374   |
| D2                       | 4 (20.0)     | 35 (29.7)      |         |
| Type of reconstruction   |              |                |         |
| Billroth I               | 16 (80.0)    | 98 (83.1)      | 0.743   |
| Roux-en Y                | 4 (20.0)     | 20 (16.9)      |         |
| Concurrent disease       |              |                |         |
| Hypertension             | 8 (40.0)     | 22 (18.6)      | 0.038   |
| Respiratory disease      | 2 (10.0)     | 14 (11.9)      | 0.809   |
| Cardiovascular disease   | 2 (10.0)     | 10 (8.5)       | 0.822   |
| Diabetes mellitus        | 4 (20.0)     | 13 (11.0)      | 0.258   |
| Liver disease            | 0            | 6 (5.1)        | 0.302   |
| Operation history        | 2 (10.0)     | 6 (5.1)        | 0.933   |

Values are presented as mean±standard deviation or n (%). BMI = body mass index; M = male; F = female; VC = vital capacity. *The ratio of the forced expiratory volume in one second. †American Society of Anesthesiologists physical status.
was removed and reconstructed using the Billroth I or Roux-en Y method. Billroth I reconstruction was performed with a delta-shaped anastomosis(12) and Roux-en Y reconstruction was also performed using a linear stapler.(13) Both anastomoses were completed intracorporeally.

3. Definitions of complications

Intraoperative complications were defined as conditions that required either an open conversion or additional procedures to the planned surgery for any reason. Post-operative minor complications were defined as any abdominal finding during the post-operative course not requiring medication or a systemic complication requiring pharmacologic treatment. Major post-operative complications were defined as any complication requiring surgical or radiological intervention.

4. Statistical analysis

The statistical analysis was performed using the JMP 7 software package (SAS Institute Inc., Cary, NC, USA). All values are expressed as the means±standard deviation. The Chi-square test and Fisher’s exact test were used for the statistical analysis.

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**Table 2. Surgical outcomes of totally laparoscopic distal gastrectomy**

| Characteristic                | BMI≥25 (n=20) | BMI<25 (n=118) | P-value |
|------------------------------|---------------|----------------|---------|
| Operation time (min)         | 321.9±61.6    | 322.0±74.7     | 0.79    |
| Estimated blood loss (g)     | 146.5±189.7   | 114.6±130.6    | 0.60    |
| Time to resumed oral intake (d) | 3.55±1.09    | 3.42±0.94      | 0.92    |
| Retrieved lymph nodes        | 30.8±16.2     | 32.7±15.0      | 0.43    |
| CRP (mg/dl)*                 | 4.01±3.50     | 3.50±4.18      | 0.21    |
| Post-operative hospital stay (d) | 14.4±4.8     | 16.6±16.4      | 0.88    |

Values are presented as mean±standard deviation. BMI = body mass index; CRP = C-reactive protein. *7 days after operation.

**Table 3. Intra-operative complications**

| Characteristic       | BMI≥25 (n=20) | BMI<25 (n=118) | P-value |
|----------------------|---------------|----------------|---------|
| Open conversion      | 1 (5.0)       | 1 (0.8)        |         |
| Bleeding             | 1 (5.0)       | 7 (5.9)        |         |
| Re-anastomosis       | 0             | 1 (0.8)        |         |
| Total                | 1 (5.0)       | 8 (6.8)        | 0.767   |

Values are presented as n (%). BMI = body mass index.

**Table 4. Post-operative complications**

| Characteristic                          | BMI≥25 (n=20) | BMI<25 (n=118) | P-value |
|-----------------------------------------|---------------|----------------|---------|
| Minor complication                      |               |                |         |
| Wound infection                         | 1 (5.0)       | 10 (8.5)       | 0.574   |
| Cholecystitis                           | 0             | 1 (0.8)        | 0.575   |
| Leakage of lymph                        | 0             | 1 (0.8)        | 0.575   |
| Arrhythmia                              | 0             | 1 (0.8)        | 0.575   |
| Delirium                                | 1 (5.0)       | 0              | 0.048   |
| Total                                   | 2 (10.0)      | 13* (11.0)     | 0.892   |
| Major complication                      |               |                |         |
| Leakage or intra-abdominal fluid collection | 0            | 3 (2.5)        | 0.329   |
| Leakage of pancreatic juice             | 0             | 3 (2.5)        | 0.329   |
| Liver infarction                        | 0             | 1 (0.8)        | 0.575   |
| Colon injury                            | 0             | 1 (0.8)        | 0.575   |
| Anastomosis bleeding                    | 0             | 1 (0.8)        | 0.575   |
| Ileus                                   | 0             | 3 (2.5)        | 0.329   |
| Total                                   | 0             | 12* (10.2)     | 0.135   |

Values are presented as n (%). BMI = body mass index. *Duplicated cases were included.

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**Results**

1. Clinicopathological findings

The characteristics of the 138 patients are summarized in Table 1. The mean values of BMI in the 2 groups were 27.3±2.2 and 21.4±2.3, respectively, for obese and non-obese patients. The gender and age, stage of gastric cancer, extent of lymph node dissection and type of reconstruction were not significantly different between the two groups. In addition, the vital capacity and the ratio of the forced expiratory volume in one second, the hemoglobin and the albumin levels were not significantly different in two groups. A severe comorbidity (American Society of Anesthesiologists class 3) was present in 11 patients in the non-obese group and one patient in the obese group. Table 1 shows the pre-operative concurrent diseases in both groups. The most frequent concurrent disease in both groups was hypertension, and the incidence of hypertension was significantly more frequent in the obese patients than in the non-obese patients.

2. Surgical and peri-operative outcomes and post-operative complications

No significant differences were observed regarding the operation time, estimated blood loss, number of retrieved lymph nodes,
the value of C-reactive protein 7 days after the operation and post-
operative hospital stay (Table 2) between the two groups. Table 3
and 4 summarize the peri-operative complications in univariate
analysis. Each group had one conversion case from a laparoscopic
gastrectomy to an open gastrectomy. Unexpected bleeding oc-
curred in 8 cases. Post-operative complications were categorized
into minor or major complications. No significant differences were
noted between the two groups in the incidence of major complica-
tions such as anastomotic leakage, anastomotic bleeding and colon
injury. Six major factors associated with peri- or post-operative
complications were selected for the multivariate analysis. None of
the factors significantly increased in the high BMI cases (Table 5).

**Discussion**

A laparoscopic distal gastrectomy (LDG) is generally used for
the treatment of gastric cancer, since this type of surgery has dem-
onstrated benefits over open surgery.(1,14) Many surgeons expected
that the laparoscopic approach for gastric surgery would improve
the morbidity and mortality for high risk patients in comparison to
open surgery. However, the advantages for high risk patients, such
as the obese, elderly and patients with low respiratory function are
still controversial. Some previous studies have suggested that there
is no difference in the post-operative morbidity and mortality be-
tween obese and non-obese patients associated with LDG for gas-
tric cancer.(6-8,15,16) However, a longer duration of surgery and
more difficult operations have been reported for obese patients.(7,8)

Recently, a TLDG has been used for the treatment of gastric
cancer.(9,17,18) TLDG is a method in which both the resection
and anastomosis are performed intracorporeally using laparoscopic
procedures. Previous studies have shown favorable results with
TLDG and demonstrated this approach with lymph node dissection
to be technically feasible, and it is thus considered to be an effective
surgical modality for gastric cancer without a high morbidity rate.
In this report, we retrospectively compared the factors associated
with the outcome of a TLDG in obese patients and non-obese pa-
tients to elucidate the safety and advantages for the obese patients.
We found no significant differences between the two groups in terms of the duration of surgery, bleeding and post-operative com-
plications.

The most important problem resulting from the laparoscopic
surgery for obese patient was anastomosis. The anastomosis is per-
formed in the abdominal cavity in TLDG, and excessive torsion is
not applied to the remnant stomach and duodenum. Therefore, no
extension of the wound or minilaparotomy is usually necessary.
This made the anastomois simple and easy. Therefore, anastomo-
sis-related complications are rarely observed. Wound infections
may be more frequent in obese patients.(19,20) The risk for wound
infection also decreases following the TLDG procedure because of
the smaller wound.

In open surgery, it has been reported that the number of retrieved
lymph nodes for gastrectomy with D2 resection was not affected by
obesity.(21) On the other hand, another report showed that the num-
ber of examined lymph nodes was affected by obesity.(22) Laparo-
scopic surgery has advantages for minute surgical procedures, such
as lymph node dissection, however it is controversial whether the
number of retrieved lymph nodes is influenced by obesity or not
when using this procedure.(6,15) In our investigation, the duration
of surgery and the number of retrieved lymph nodes was not dif-
ferent between obese and non-obese patients. The average number
of retrieved lymph nodes in obese patients was 30.8±16.2 and that
in non obese patients were 32.7±15.0. Laparoscopic surgery there-
fore seems to be more suitable for lymph node dissection because
of the magnification of the field of vision, even for obese patients.

In conclusion, the TLDG is therefore considered to be a safe
and effective procedure for obese patients since there were no dif-
fences in the duration of surgery, estimated blood loss, and rate of
complications, in spite of the difference in the patients’ background.
This method can therefore be recommended as a standard treat-
ment for obese patients.

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