Influence of Excess Body Weight on the Surgical Outcomes of Total Gastrectomy

DAISUKE NOBUOKA, NAOTO GOTOHDA, YUICHIRO KATO, SHINICHIRO TAKAHASHI, MASARU KONISHI, and Taira Kinoshita

Department of Surgery, National Cancer Center Hospital East, 6-5-1 Kashiwanoha, Kashiwa, Chiba 277-8577, Japan

Abstract

Purpose. We conducted this retrospective study to identify the influence of excess body weight on the surgical outcome of total gastrectomy (TG) and to evaluate recent advances in this operation.

Methods. The subjects were 644 consecutive gastric cancer patients who underwent TG between 1992 and 2008. Patients with a body mass index (BMI) of 25.0 kg/m² or greater were defined as overweight (overweight group) and those with a BMI less than 25.0 kg/m² as not overweight (non-overweight group).

Results. The operating times were longer (P = 0.005) and intraoperative blood loss was greater (P < 0.001) in the overweight group. The incidence of overall postoperative complications (P = 0.012) and of pancreatic fistula (P < 0.001) were significantly higher in the overweight group. In recent years, we achieved a reduction in operating time (P < 0.001), intraoperative blood loss (P = 0.033), and incidence of pancreatic fistula (P = 0.005), while maintaining curability, in the overweight group.

Conclusions. Although TG for gastric cancer is technically more difficult in overweight patients, they should not be denied this operation. Conversely, we should make a greater effort to improve the surgical outcomes of overweight patients.

Key words Gastric cancer · Total gastrectomy · Overweight · Surgical outcome · Body mass index

Introduction

The proportion of obese and overweight people is increasing steadily over the world. Once considered a problem only in high-income countries, it is now obviously rising in low- and middle-income countries. The World Health Organization (WHO) highlights this nutritional topic as one of the worldwide health crises. Although the prevalence of obesity in Japanese adults has been low compared with that in Western countries, reports using data from the National Nutrition Surveys of Japan show evidence of increasing numbers of overweight adults in Japan. This tendency will certainly continue considering the growing excess fat intake and lack of physical activity. Therefore, Japanese surgeons are more and more often required to operate on overweight patients.

Chemotherapy can prolong the survival of patients with advanced disease, but surgical resection remains the most effective treatment for curable gastric cancer. Based on previous reports that extensive lymph node dissection improved patient survival, gastrectomy plus extended systematic lymphadenectomy (D2 resection) has long been the standard treatment in Japan. Despite a recent report indicating that sentinel node navigation surgery may justify limited lymphadenectomy for early disease, removal of metastatic lymph nodes is critically important. However, complete removal of retroperitoneal lymph nodes is technically difficult and not always without risk in overweight patients. Indeed, European studies have shown unfavorable surgical outcomes, partly because of a significantly higher prevalence of overweight patients.

Many investigators have found that overweight patients are at risk of a poor outcome after intraabdominal surgery. On the other hand, there have been remarkable advances in surgical techniques in recent years. The purposes of this study were to identify the influence of an overweight state on surgical outcomes and to evaluate recent surgical advances in total gastrectomy (TG).
Patients and Methods

Between August 1992 and December 2008, 905 consecutive patients with gastric neoplasm underwent TG at the National Cancer Center Hospital East, Chiba, Japan. Among these 905 patients, 892 had gastric cancer, 12 had malignant lymphoma, and 1 had a gastrointestinal stromal tumor. Patients with gastric neoplasms other than gastric cancer and those who underwent resection for residual gastric cancer or palliative resection were excluded from the analysis. Those who underwent other procedures simultaneously, such as hepatectomy, colectomy, portal vein resection, thoracotomy, or intraperitoneal chemotherapy, were also excluded (with the exception of distal pancreateicosplenectomy or splenectomy for gastric cancer and cholecystectomy). The remaining 644 patients were grouped according to time periods (1992–1999 and 2000–2008) for analysis (Fig. 1).

Each patient's height and body weight was measured preoperatively. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters (kg/m²), and categorized according to the WHO cutoff points as follows: underweight, <18.5 kg/m²; normal range, 18.5–24.9 kg/m²; preobese, 25.0–29.9 kg/m²; obese class I, 30.0–34.9 kg/m²; obese class II, 35.0–39.9 kg/m²; and obese class III, 40.0 kg/m² or greater. We defined the non-overweight group as underweight and normal range, and the overweight group as preobese and obese classes I, II, and III. We then compared the two groups.

All patients underwent open TG, performed or supervised by one of our staff surgeons with extensive experience in gastric surgery. We performed TG with splenectomy (pancreas-preserving method), Japanese-style D2 lymph node dissection, and reconstruction with Roux-en-Y esophagojunostomy as the standard surgical procedure for advanced gastric cancer located in the upper third of the stomach; TG without splenectomy for early gastric cancer; and TG with pancreateicosplenectomy for patients with direct invasion to the pancreas or evident macroscopic lymph node metastasis along the splenic artery.

All specimens were routinely sectioned, stained, and checked for cancer progression by experienced pathologists. Pathological stage was assigned according to the Japanese classification of gastric carcinoma, second English edition. Some patients with stage II or more advanced disease received chemotherapeutic drugs as adjuvant therapy, with or without inclusion in clinical trials. When tumor recurrence was discovered, the patients were referred to clinical oncologists and usually received chemotherapy.

Surgical outcomes included operating time, intraoperative blood loss, postoperative complications, postoperative hospital death, duration of hospital stay, and survival time after surgery. Postoperative pancreatic fistula was diagnosed when there was purulent discharge containing necrotic debris from the drainage tube. We included intra-abdominal abscess that might have occurred from pancreatic juice leakage. Anastomotic leakage was diagnosed by radiological examination using orally administered contrast medium. Postoperative hospital death was defined as death from any cause within 30 days after surgery, or death within the same hospital admission.

We used the chi-squared test or Mann–Whitney U-test to evaluate differences in patient demographics. Overall and cancer-specific survival curves were obtained by the Kaplan–Meier method and compared by the log-rank test. For all statistical tests, differences with a P value of less than 0.05 were considered significant. Data were analyzed with the statistical package, Dr. SPSS II for Windows (SPSS Japan, Tokyo, Japan).

Results

Among the 644 patients, 65 (10.1%) were underweight, 480 (74.5%) were in the normal range, 95 (14.8%) were preobese, and 4 (0.6%) were in obese class I. No patient was in obese class II or III. Thus, 545 patients (84.6%) were in the non-overweight group and 99 (15.4%) were in the overweight group. The patient characteristics of the two groups are shown in Table 1. The number of patients with earlier stages of disease was significantly higher in the overweight group than in the non-overweight group (P = 0.040). The incidence of diabetes

---

**Table 1.** Characteristics of the two groups

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Non-overweight (n=545)</th>
<th>Overweight (n=99)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Median (IQR)</td>
<td>Median (IQR)</td>
</tr>
<tr>
<td>Stage distribution</td>
<td>25.0% (II)</td>
<td>25.0% (II)</td>
</tr>
<tr>
<td>Gender distribution</td>
<td>Male: 52.5%</td>
<td>Male: 52.5%</td>
</tr>
<tr>
<td>Preoperative chemotherapy</td>
<td>Yes: 65.0%</td>
<td>Yes: 65.0%</td>
</tr>
<tr>
<td>Postoperative chemotherapy</td>
<td>Yes: 55.2%</td>
<td>Yes: 55.2%</td>
</tr>
</tbody>
</table>

**Fig. 1.** Schematic flowchart of the enrolled patients. *Hepatectomy, colectomy, portal vein resection, thoracotomy, and intraperitoneal chemotherapy. GIST, gastrointestinal stromal tumor.