Clinical Science

Short-term outcomes of laparoscopic versus open total gastrectomy: a matched-cohort study

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Abstract

BACKGROUND: This study was designed to compare short-term laparoscopic total gastrectomy (LTG) with open total gastrectomy (OTG) outcomes in gastric cancer.

METHODS: Seventy patients who underwent total gastrectomy via LTG or OTG were included. All cases were matched for stage, age, and sex by means of statistically generated selection of all gastrectomies performed during the same period.

RESULTS: Although the operation time was not longer for LTG, the time required for esophagojejunostomy was significantly longer in LTG than in OTG (43 vs 14 min, \( P < .05 \)). The incidence of anastomotic complications was higher in the LTG group as well.

CONCLUSIONS: Postoperative complications such as anastomotic leakage and stenosis were observed more frequently in LTG. To improve the safety of esophagojejunostomy in LTG, technical innovations should be pursued.

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Gastric cancer is the second most common cause of cancer death worldwide and the leading primary malignancy in Korea.1,2 The proportion of early gastric cancer (EGC) cases is increasing because of the growing popularity of cancer screening policies. An EGC treatment modality that is coming into more widespread use in Korea is laparoscopic distal gastrectomy (LDG).3,4 Moreover, the feasibility and oncologic safety of LDG are proven5 in contrast to laparoscopic total gastrectomy (LTG), for which safety and effectiveness data remain insufficient.6 According to a nationwide survey administered in Korea in 2009, the total number of cases of laparoscopic gastrectomy for gastric cancer had markedly increased, but the proportion of LTG cases remained almost stagnant.7 Furthermore, LTG surgical outcomes have been analyzed only in a few studies.8-11

Of the many studies including comparisons of LDG, only one has focused on the technical aspects of LTG. Therefore, we undertook a case-control analysis of a statistically generated matched cohort to evaluate LTG versus open total gastrectomy (OTG) for surgically resectable adenocarcinoma.

Methods

Patients

Using a prospectively maintained gastric cancer database, all of the patients who had undergone a curative
resection for gastric adenocarcinoma at our hospital between January 2009 and June 2011 were identified. Of these, we compared 35 patients who underwent LTG (as performed by 1 surgeon [S.K.-Y.]) with 35 cases who underwent OTG during the same period. The 2 groups were matched for stage, age, and sex using an SAS program (SAS Institute Inc, Cary, NC). The matching procedure was performed as follows: (1) for each group (LTG and OTG), control cases were matched according to the major characteristics; (2) if more than 1 control matched a given group, 1 of those controls was randomly selected; and (3) the desired number of controls was randomly selected for each group. On the basis of respective chart reviews, the following clinical data were recorded for each of the patients: age, sex, body mass index, type of anastomosis, time required for Anastomosis, extent of lymph node dissection, operation time, length of postoperative hospital stay, and postoperative complications. This study was approved by the Institutional Review Board of Seoul St Mary’s Hospital, Seoul, Korea.

Postoperative complications

Postoperative complications were graded according to the Clavien-Dindo classification scheme and recorded. Early complication was defined as having occurred within 30 days of surgery; complications occurring more than 30 days after surgery were denoted as late complications. Symptoms of dysphagia were graded according to patient descriptions as follows: (1) grade 0, without symptoms; (2) grade 1, slight difficulty in swallowing and sensation of foreign body while on soft diet; (3) grade 2, difficulty swallowing on liquid diet; and (4) grade 3, inability to belch or difficulty in swallowing water or on a liquid diet. Esophagojejunostomy stenosis also was graded based on the endoscopic findings as follows: (1) grade 0, no stenosis; (2) grade 1, slight stenosis without difficulty of scope passage; and (3) grade 2, scope passage impossible.

Operative technique for laparoscopic total gastrectomy

General surgical procedures. LTG was performed under general anesthesia. The patient was placed on the table in a supine split leg position, with the surgeon operating from the right, the camera assistant in the middle, and the first assistant on the left.

Pneumoperitoneum was established via the open technique to attain an intra-abdominal pressure of 12 to 15 mm Hg. Access to the abdominal cavity was obtained by the use of two 5-mm laparoscopic trocars and two 12-mm trocars.

The liver was retracted upward using a previously described method. In order to allow access to the lesser sac, the gastrocolic ligament was divided using an ultrasonic scalpel (Ethicon Endo-Surgery Inc, Cincinnati, OH). Complete omental bursectomy was performed up to the left gastroepiploic vessels. Dissection was then continued toward the pylorus, including the infrapyloric nodes (group 6) and division of the right gastroepiploic artery at its origin off the gastroduodenal artery. The hepatoduodenal ligament also was dissected. The right gastric artery was identified and divided. The window opened at the hepatoduodenal ligament enabled the formation of a duodenal stump by means of the application of a 60-mm Endo-GIA staple (Covidien, Mansfield, MA). Dissection proceeded along the lesser omentum toward the gastroesophageal junction, skeletonizing the left gastric artery with dissection perigastric nodes (groups 1, 3, and 5). The left gastric vessels were identified and transected by double clipping. Dissection of the gastrocolic ligament continued toward the spleen. All of the patients underwent at least D1+ or D2 lymph node dissection as described in the Japanese classification of gastric carcinoma. After specimen removal, Roux-en-Y-type esophagojejunostomy was performed via the several intra-corporeal methods identified as follows.

Types of esophagojejunostomy

Four different esophagojejunostomy procedures were used.

1. Type A: esophagojejunostomy by a conventional anvil head (Fig. 1). After inserting an anvil head into the esophageal stump, a hand-sewn purse-string suture was performed.

2. Type B: esophagojejunostomy by OrVil (Coviden, Mansfield, MA) (Fig. 2). The commercially available OrVil system is a ready-to-use anvil delivery device designed to transorally insert an anvil into the abdominal esophagus. The orogastric tube is connected to the center rod of the anvil and is removed by cutting the connecting thread. The device, after successful introduction of the anvil into the abdominal esophagus, facilitates esophagojejunostomy simply by untwisting the pretwisted head automatically.

3. Type C: hemi-double stapling technique with an anvil head (Fig. 3). In this procedure, the surgeon inserts the anvil head through a gastrotomy site 2 to 3 cm below the esophagogastric junction and creates an esophageal stump by applying Endo-GIA stapler. After inserting the anvil into the esophageal stump and performing a purse-string suture as indicated in types A through C, an end-to-side-type esophagojejunostomy is performed using a 25-mm EEA stapler (Covidien, Mansfield, MA).

4. Type D: side-to-side esophagojejunostomy (Fig. 4). After creating an esophageal stump and Roux limb with an Endo-GIA stapler, small enterotomies are made on the Roux limb and esophageal stump preparatory to the insertion of a GIA fork. By firing the stapler, the side-to-side esophagojejunostomy is completed upon which the enterostomy site is closed with an intra-corporeal continuous suture.
Currently, there are no guidelines or consensus on the preferred method for esophagojejunostomy in LTG. We used type A or B for tumors located near the Z-line, such as Siewert type III gastric cancer. We used type C or D for tumors located at least 2 to 3 cm below the Z-line so that we could guarantee that the stapled line did not enclose the tumor.

**Open total gastrectomy**

OTG was performed in the usual manner through an upper-midline incision from the xiphoid process to the umbilicus with the patient in a supine position. Total omentectomy in most cases was performed. The extent of lymph node dissection was basically the same with either laparoscopic procedure (D1+ or D2 dissection). Reconstruction was performed using the Roux-en-Y-type by hand sewing.

**Statistical analysis**

Matched open cases were randomly selected from the entire group of curative-intent total gastrectomies performed at our institution during the same period as the laparoscopic group using SAS version 9. Case-control analysis was then performed to compare surgical outcomes such as operative time, anastomosis time, length of postoperative hospital stay, and early (up to 30 days) and late (30 days to 3 months) complication rates as well as tumor characteristics, stages, and lymph node retrieval.
Comparisons of baseline characteristics were conducted using the Mann–Whitney \(U\) test for continuous variables and the Fisher exact test for categoric variables. The parameters relating to the operative outcomes and complications between the groups were analyzed using the Student \(t\) test; \(P < .05\) was considered significant.

**Results**

**Operative and pathologic characteristics**

The operation time did not significantly differ between the 2 groups (230.4 vs 212.7 min, \(P > .05\)). However, the mean reconstruction time for the LTG group was longer than that for the OTG group (42.7 vs 13.9 min, \(P < .05\)).

According to the 6th American Joint Committee on Cancer’s classification scheme, most of the patients (88.6%) were in stage I, and there was no statistical difference between the groups. Likewise, there were no statistical differences in tumor size, total number of retrieved nodes, extent of lymph node dissection, or proximal cut margin.

**Postoperative complications**

Early complications were observed in 8 (22.8%) and 7 (20%) patients in the LTG and OTG groups, respectively. Most of the complications were grade I or II, and, for the LTG group, they were managed conservatively; there were 4 anastomosis leakages as well. Two patients required reoperation because of postoperative bleeding and a mesenteric leak.
herniation with afferent loop syndrome, respectively. In the OTG group, there were 3 grade IIIa complications, including an esophagojejunostomy leakage (n = 1) and pleural effusion (n = 2). Overall, the IIa complication rate did not statistically differ between the LTG and OTG groups although the anastomotic leakage rate in the LTG group was significantly higher than in the OTG group (P < .01). In terms of late complications, the incidence of esophagojejunostomy stenosis was significantly higher in the LTG group than in the OTG group (9 vs 1, P < .05). We represented the stenosis according to the patient’s symptom scale and endoscopic findings (Table 1). Esophagojejunostomy leakage occurred in 4 patients and was managed nonoperatively using endoscopic stent insertion and percutaneous drainage. Nine patients complained of stenosis, and 7 required endoscopic balloon dilatation.

Comments

Recently, laparoscopic distal gastrectomy (LDG) has been increasingly used to manage early or even advanced gastric cancer in Korea and Japan,3–5 where it is a standard treatment option. Because the first LTG for gastric cancer was performed by Huscher et al in 1992,15 several groups have reported that it is safe and feasible.16–18 However, LTG is still regarded as a difficult procedure; it has been performed only by experienced laparoscopic surgeons in just a few centers. We believe that there are several technical points relevant to safe and complication-free LTG that need to be discussed. The higher level of difficulty of lymph node dissection, especially in the splenic hilum, is the main problem. In the cases of esophageal and left upper-quadrant dissection, the bulky stomach often blocks the surgeon’s field of view. The special difficulty of lymph node dissection in this circumstance has been overcome by “trial and error” and “cumulative experience” although the learning curve is longer than for LDG. We believe that the most significant obstacle to LTG is the difficulty of reconstruction.

Originally, extracorporeal anastomosis by minilaparotomy was used to facilitate esophagojejunostomy as with LDG. However, this type of anastomosis is frequently impossible or complication fraught, especially when the patient is obese. For this reason, several different types of intracorporeal anastomosis have been developed for easy reconstruction. For safe intracorporeal end-to-side esophagojejunostomy, a secure purse-string suture of the esophageal stump is critical. Unfortunately, there is no consensus as to the most useful and safest way of making a purse-string suture. The conventional type of purse-string suture performed by hand sewing is technically difficult because it is usually performed in a very narrow and deep space and requires complex suturing skills. Although the OrVil system has been used for effective insertion of the anvil into the esophageal stump, there remains the risk of esophageal tearing. Some surgeons have reported uses of the side-side-type jejunoojejunostomy in a limited number of cases although the results have not been encouraging.

The literature on LTG outcomes is limited and somewhat controversial. Lee et al11 performed 67 LTG procedures and compared the outcomes with those of LDG. Although the extents of lymph node dissection, the numbers of retrieved lymph nodes, and the conversion rates did not differ, the operation time and the complication rate were significantly higher with LTG. The main post-LTG problem was anastomosis stenosis. The rate of postoperative stricture at esphagojejunostomy was 9% and 1% for LTG and OTG, respectively. Furthermore, in the report of Mochiki et al,9 LTG required a longer postoperative hospital stay than OTG. In our study, the factors relating to postoperative outcomes, such as operation time, bowel recovery, postoperative hospital stay, extent of lymph node dissection, and number of lymph nodes dissected, did not differ between the 2 groups. The total number of postoperative complications, including those of grade III or greater, were not significantly different.

Table 1 Incidences of esophagojejunostomy stenosis for OTG and LTG grades

<table>
<thead>
<tr>
<th>Symptom</th>
<th>OTG</th>
<th>LTG</th>
<th>P value</th>
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<tr>
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<tr>
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<td>Balloon dilatation</td>
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</tbody>
</table>

*Symptoms of dysphagia. Grade 0: No dysphagia. Grade 1: Difficulty in swallowing and foreign body sensation on soft diet. Grade 2: Difficulty in swallowing on liquid diet. Grade 3: Inability to belch or difficulty in swallowing water.

†Endoscopic (EGD) grading. Grade 0: No stenosis. Grade 1: Slight stenosis without difficulty of scope passage. Grade 2: Inability to scope passage.
However, according to the results of an assessment of the problem of reconstruction, regardless of type, the reconstruction duration was significantly longer, and the incidence of postoperative anastomosis stricture was higher in the LTG group. Our results are consistent with those of Lee et al.\textsuperscript{11} Surgeons face severe stress whenever they perform post-LTG anastomosis, unlike the case with LDG or OTG. This remains a concern even as newer methods and instruments are being developed for safe anastomosis.

Most assessments of the benefits of LTG have been retrospective comparative studies regarding which significant selection bias is a concern. Therefore, before we can draw any firm conclusions on the benefits related to short-term outcomes (if any), we must await prospective studies. However, the benefits of a minimally invasive approach, such as less pain, earlier bowel recovery, and oncologic proficiency in terms of the number of lymph nodes dissected, are at least the same as with LDG. The most important goal remains the development of a safe and easy universal method for performing esophagojejunostomy. Another means of improving outcomes would be a tumor location–based approach. Certainly, a well-designed controlled study is called for to determine the best method of post-LTG reconstruction.

**Conclusions**

In conclusion, the oncologic principles and short-term outcomes of LTG resection are comparable with those of OTG. However, postoperative complications, for instance anastomotic leakage and stenosis, are observed more frequently with LTG than with OTG. Therefore, to enhance the safety of post-LTG reconstruction, technical innovation should be pursued.

**References**