



Intracorporeal esophagojejunostomy with Roux-en-Y reconstruction after laparoscopic total gastrectomy

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Laparoscopic gastrectomy has been established as a minimally invasive treatment. Laparoscopic total gastrectomy or laparoscopy-assisted total gastrectomy (LTG) is being more frequently performed, but requires a more complex surgical procedure (1). Anastomotic leakage of the esophagojejunostomy after LTG can negatively affect the quality of life of patients by prolonging the postoperative hospital stay and increasing the risk of reoperation and even mortality. In our previous meta-analysis, LTG had slightly higher incidences of anastomotic complications such as leakage and stenosis than did open total gastrectomy (3.0% vs 2.1%) (2). According to the Japanese National Clinical Database, the incidence of anastomotic leakage was 4.4% among more than 20,000 patients who underwent total gastrectomy, including both open and laparoscopic approaches in 2011 (3). Various procedures for intracorporeal esophagojejunostomy have frequently been reported, because an intracorporeal approach provides a better view of the anastomosis than an extracorporeal approach (4-10). A new device (OrViil™, Covidien, Mansfield, MA, USA) using a transorally inserted anvil and a circular stapler was developed to perform intracorporeal esophagojejunostomy (11). However, the incidences of anastomotic leakage were similar for intracorporeal procedures (1.1-3.2%) and extracorporeal procedures (2.1%) in our previous review (2). The best procedure should reduce the risk of postoperative complications in patients and be easily performed by all surgeons, although which procedure is best remains unclear.

Hong *et al.* recently described a modified procedure for totally intracorporeal Roux-en-Y reconstruction after

LTG, referred to as the self-pulling and latter transection (SPLT) technique (12). Their procedure is based on construction of a functional end-to-end anastomosis (FEEA) with the use of linear staplers. One distinctive feature of the SPLT procedure is ligation of the cardia using a hemp rope before making the entry hall. This step can prevent the implantation of tumor cells and pollution of the peritoneal cavity by gastric contents. Another feature is synchronized closure of the entry hall with removal of stomach. The SPLT procedure is reasonable and was not associated with anastomotic leakage or stenosis in 40 patients. However, the SPLT procedure seems to have several critical problems similar to esophagojejunostomy constructed by FEEA. First, the lower esophagus must be adequately mobilized to the mediastinum. Second, the procedure is difficult to perform after resection of esophagogastric junction cancer, in which anastomosis should be performed in the mediastinum, because closure of the entry hall by a stapler is technically difficult in the narrow space of mediastinum. In addition, preceding transection of esophagus sometimes makes it easy to dissect lymph nodes along the left inferior phrenic artery, short gastric artery, or splenic artery. In the study by Hong *et al.*, the SPLT procedure was applied even for tumors with serosal invasion (12). However, the tumor specimen was moved without protection during reconstruction, which may have increased the risk of scattering tumor cells from tumors with serosal invasion. Therefore, the procedure might not be feasible in patients with far advanced tumors.

The procedure for intracorporeal esophagojejunostomy can be performed by using either linear staplers or circular staplers. In a review of esophagojejunostomy after LTG by Umemura *et al.*, the use of circular staplers was significantly associated with higher incidences of both anastomotic leakage (4.7%) and stenosis (8.3%) as compared with the use of linear staplers (1.1% and 1.8%, respectively) (13). Moreover, the procedures for intracorporeal esophagojejunostomy were classified into five types in detail, although the incidence of anastomotic leakage was similar among those types (2). On the other hand, the incidence of anastomotic stenosis was higher in the procedures that used an OrVil™ transoral anvil delivery system (8.8%) than in the other procedures (1.0–3.6%) (2). Use of a smaller OrVil™ anvil increased the incidence of anastomotic stenosis (14). In a retrospective comparative study, the risk of anastomotic stenosis of the intracorporeal esophagojejunostomy was significantly lower with the overlap procedure performed using a linear stapler than with the use of an OrVil™ anvil (15). Another Japanese multicenter study also showed that FEEA significantly reduced anastomotic leakage of esophagojejunostomy than the use of a circular stapler (16). The use of a linear stapler can secure a large delta-shaped anastomosis as compared with the use of a circular stapler, thus reducing the risk of anastomotic stenosis. The use of a circular stapler has some difficulties associated with insertion of the anvil head into the esophagus, while ischemia, which is cause of anastomotic leakage, is an important concern at the double or hemi-double stapled margin after the use of an OrVil™ anvil. Indeed, the use of an OrVil™ anvil tended to increase anastomotic leakage in the study as compared with the use of linear staplers (15). The anastomotic procedures performed using linear staplers are classified into two types: overlap procedure and FEEA. The overlap procedure is isoperistaltic anastomosis, and the entry hall for inserting a stapler is closed by hand-sewing or a linear stapler. An inverse T-shaped anastomosis is classified as an overlap procedure (17). The FEEA is an antiperistaltic anastomosis, and the entry hall is usually closed with the use of a linear stapler. Anastomotic leakage and stenosis did not differ between the overlap procedure and FEEA in our previous review (overlap, 2.9% and 1.0%; FEEA, 1.1% and 2.2%; respectively) (2). The use of a linear stapler is also associated with

several problems; for example, longer dissection of the esophagus is sometimes required for insertion of a linear stapler. The FEEA is more difficult to complete in patients in whom the anastomosis has to be performed in the mediastinum because of poor operability (16). In addition, ischemia of the double-stapled margin is a concern with FEEA. Overlap procedure also requires skilled technique to close of the entry hall in the mediastinum.

Less experience of surgeons was significantly associated with the incidence of postoperative local complications in a study of laparoscopic distal gastrectomy (18). The incidence of anastomotic leakage was higher during the early introduction phase of LTG in a retrospective study. However, an independent risk factor for anastomotic leakage was the prognostic nutritional index in that study (19). In a single-institutional retrospective study of LTG, postoperative complications did not differ among three periods classified according to the esophagojejunostomy procedures performed. Various procedures decided by the surgeon were used during the first period. An OrVil™ delivery system was used during the second period, and FEEA was used during the third period (20). Experience performing LTG in approximately 45 or 100 patients was required to master the procedure according to studies of the learning curve associated with LTG (21,22). A prospective phase II study of LTG and laparoscopic proximal gastrectomy is ongoing in Japan, with anastomotic leakage as the primary endpoint, and that study is expected to provide conclusive evidence on anastomotic problems of esophagojejunostomy after laparoscopic gastrectomy (23).

The best procedure for esophagojejunostomy probably differs according to the surgeon, and a standardized procedure for esophagojejunostomy may be the key to successful esophagojejunostomy. Much experience and improved procedures can reduce the risk of anastomotic problems after LTG.

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