Technical note

“Tornado Roux-en-Y” anastomosis in laparoscopy-assisted distal gastrectomy

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Abstract

The use of laparoscopy-assisted distal gastrectomy has been gradually spreading and it has become one of the standard treatment options for early gastric cancer in Japan. But anastomotic problems are still frequent with this procedure, because of its technical difficulty. We have developed a simple, safe, and speedy Roux-en-Y anastomosis for use in laparoscopy-assisted distal gastrectomy. Here, we describe our technique and the short-term results.

Key words Laparoscopy-assisted distal gastrectomy · Roux-en-Y anastomosis · Early gastric cancer

Introduction

In Japan, the use of laparoscopy-assisted distal gastrectomy (LADG) is rapidly spreading and the procedure is often applied for patients with early gastric cancer. With improvements in technologies and the development of new instruments, the results of gastric resection with this technique have become almost comparable to those of conventional open laparotomy. According to a multicenter questionnaire survey carried out by the Japan Society for Endoscopic Surgery, however, complications during reconstruction, such as anastomotic problems, are frequently seen with this technique. This is probably because the standard reconstructive surgery used in Japan is the Billroth I (B-I) anastomosis, whose approach through a small incision is technically difficult. Moreover, the B-I approach through a small incision often causes tension at the anastomotic site.

In Europe and the United States, the standard method of reconstruction is the Roux-en-Y (RY) anastomosis, which is less likely to cause tension at the anastomotic

site and is thus recommended as a safe technique, although, because of its complicated procedure, surgical time may be prolonged. To solve this problem, we have employed a totally instrumental RY anastomosis, including jejunojejunostomy to gastrojejunostomy. We have been using the technique for 3 years, and each time we have achieved reconstruction safely in a short time. The details of the technique and the short-term results are described below.

Methods

Summary of the surgical technique

Our technique is summarized in the diagrams in Fig. 1A–C. It is characterized by no incision of the jejunal mesentery, no initial cut of the jejunum, and by gastrojejunostomy and jejunojejunostomy being performed through a common entry hole. With this technique, we have achieved significant time reduction by repeating the two simple anastomotic procedures. We named the technique “Tornado Roux-en-Y” because the jejunum is rotated during jejunojejunostomy.

Surgical procedure

1. The duodenum should be cut with the blue cartridge of a three-line end linear stapler (ELS). While B-I anastomosis requires the duodenum to be cut as closely to the stomach as possible to ensure an allowance for suture, RY anastomosis allows the duodenum to be cut at any point anal to the pyloric ring.
2. After completion of the resection, identify a site about 20 cm anal to the ligament of Treitz, and mark the site with dye, with the oral end positioned to the left of the patient and the anal end positioned to the right. This ensures that the jejunal end is positioned to the right with no kinks during the gastrojejunos-

Fig. 1A–C. Diagrams of our technique “Tornado Roux-en-Y”. **A** Jejunojejunostomy done with a 21-mm CS (A-A) and gastrojejunostomy done with a 25-mm CS (B-B). **B** Gastrojejunostomy via the antecolic route. **C** Completed “Tornado Roux-en-Y”

tomy. False identification of the jejunal direction can be prevented by holding the intestine with a forceps before making a small incision.

3. Then determine the resection line on the residual stomach. Make a small incision (about 4 cm) immediately below the epigastrium and pull the stomach out of the incision. To insert a 25-mm circular stapler (CS) anvil head into the stump of the greater curvature of the residual stomach, open a small hole in the stump and cut the stomach with a linear stapler (LS). The small hole ensures that the stomach is cut by a single stapling with a 75-mm or 80-mm LS. The stomach should be cut intraabdominally, by stapling twice with a 60-mm ELS, if the section line can be determined with the stomach remaining in the body or if the stomach is difficult to lift due to a thick abdominal wall. In this case, the small incision should be slightly caudal. Then attach a purse-string instrument (PSI) forceps to an area that includes the small hole in the greater curvature of the residual stomach, and put all layers in a purse-string suture using a 2-0 straight needle and monofilament nonabsorbable thread. Insert a 25-mm CS anvil head into the stump of the residual stomach and fix the CS anvil head in place and return into the abdominal cavity temporarily.
4. Prepare the jejunojejunostomy while the resected specimen is checked at the back table. Pull the planned gastrojejunostomy site, marked earlier, out of the incision, and cut off pieces (about 5-cm) of adjacent direct arteries/veins of the jejunum with an ultrasonic coagulator (USC), with peripheral arteries/veins left intact. Attach a PSI forceps to a site about 25 cm anal to the marked site in the longitudinal direction, and insert a 21-mm CS anvil head.
5. Open a small hole with a USC in the jejunum with direct arteries/veins processed earlier. Insert a 21-mm CS main body into the hole toward the oral end, and perform side-to-side anastomosis (Fig. 2). The jejunal stump should be treated with the ELS white cartridge, and only bleeding sites should be sutured to stop bleeding.
6. Then insert a 25-mm CS main body into the small hole toward the anal end, and anastomose with the residual stomach (Fig. 3). The anastomosis should be performed with the jejunal end positioned to the right of the patient to prevent kinking and to facilitate the postoperative flow. The jejunal stump should be treated in the same way as the jejunojejunostomy. We normally use the antecolic route, although there is no problem with the retrocolic route.

Fig. 2. Insert a 21-mm CS main body into the hole toward the oral end, and perform side-to-side anastomosis

Fig. 3. Insert a 25-mm CS main body into the small hole toward the anal end and anastomose with the residual stomach

7. After the completion of anastomosis, we make it a rule to check for any kinking or bleeding at the anastomotic site.

Surgical results

So far, this technique has been used in laparoscopic surgery for 34 patients with gastric cancer. No suture leakage has occurred, suggesting the safety of the anastomotic procedures. Neither suture leakage from the duodenal stump nor bleeding from the gastrojejuno anastomotic site has occurred, while late membranous stenosis at the anastomotic site was observed in 1 patient. This patient was treated with endoscopic balloon expansion and the stenosis was removed.

Table 1. Short-term results of our technique “Tornado Roux-en-Y”

Anastomotic leakage	0/34 (0%)
Anastomotic stenosis	1/34 (2.9%)
Anastomotic bleeding	0/34 (0%)
R-Y stasis	2/34 (5.9%)

Stasis is known as a complication specific to the RY method. We have experienced apparent RY stasis syndrome in only 2 of our 34 patients (5.9%; Table1).

A disadvantage of our technique is that the diameter of the gastrojejunostomy is restricted by the jejunal diameter, and a 25-mm CS is used in most of the patients. However, as the anastomotic site exists in the stump of the greater curvature, postoperative fluoroscopy demonstrates favorable passage; thus, the restricted diameter of the anastomosis does not matter.

Discussion

In regard to reports on laparoscopic surgery for gastric cancer, Kitano et al. [1] performed laparoscopic distal gastrectomy for early gastric cancer in 1994. Recently, with instrumental development and technical improvement, laparoscopic surgery has been performed at many institutions as a low-invasive, radical technique for gastric cancer [2–4]. On the other hand, the seventh questionnaire survey by the Japan Society for Endoscopic Surgery [5] reported many cases of complications caused by anastomosis. One of the possible causes of these complications is that the creation of an anastomosis in a limited space requires sophisticated manipulations from a small incision. Anastomosis from a small incision, particularly with the B-I method, is likely to produce tension at the anastomotic site, and often causes suture leakage. Surgeons have to adjust to the rapid change from an endoscopic visual field to a field through a small incision and the performance of an anastomosis after a stressful resection. To reduce these burdens on surgeons, a speedy and safe technique for anastomosis is desired. In contrast, intraabdominal anastomosis is unlikely to produce tension at the anastomotic site, and it is practicable under complete endoscopic guidance; thus, there is no visual change, and it is an ideal technique for anastomosis. However, regardless of the various improvements reported recently [6, 7], this technique (i.e., intraabdominal anastomosis) requires time to learn, as well as higher costs; thus, it is expected that it will take some time before the technique is commonly used.

The current standard for reconstruction is instrumental anastomosis from a small incision, and we

should find a way to perform this technique in a stress-free manner, as with normal laparotomy, as well as in a tension-free manner, as with intraabdominal anastomosis.

For reconstruction in distal gastrectomy, B-I anastomosis, the simplest and most physiological technique, is commonly used in Japan. However, the B-I method is not indicated for some patients, including those with a small residual stomach, those with a tumor infiltrating into the duodenum, and those complicated by esophageal hiatus hernia; for these patients, a method such as Billroth II or RY is recommended. As reported recently, RY anastomosis, as a reconstructive method in distal gastrectomy, shows suture leakage less frequently than other types of anastomoses, and rarely causes gastritis in the residual stomach, or reflux esophagitis [8, 9]. However, the RY method has not yet become popular because of its complexity, as two anastomotic sites are required. With the RY method, reconstruction is usually performed after the jejunum is temporarily cut off. We omit this process and perform gastrojejunostomy and jejunojejunostomy at once, with the help of the CS, thus simplifying the anastomosis and saving time. The point is that the small hole in the jejunum serves as a common access for the two anastomotic procedures and the intestine is no longer cut twice, which enables efficient and speedy anastomosis. Our technique is based on a simple idea, and the surgeon can complete the anastomosis safely in a very short time, if the surgical procedure is performed in the proper direction. We named the technique "Tornado Roux-en-Y", because, during jejunojejunostomy, the CS main body inserted toward the oral end is rotated to combine with the anvil head inserted toward the anal end. Once a surgeon acquires this skill, our technique requires only about 15 min, promising a stress-free operation.

When applied to distal gastrectomy, our reconstructive technique basically does not differ from its original application to total gastrectomy, except for the presence of the residual stomach. In terms of the time required for reconstruction, our technique also does not differ from laparotomy.

In our procedure, we usually use the antecolic route. Whether to use the antecolic route or the retrocolic route is still controversial, but in some studies it has been reported that the laparoscopic antecolic gastric RY bypass leads to fewer internal hernias than the retrocolic approach [10, 11]. We also use the antecolic route in open surgery, and have had no experience of ileus due to this approach.

With our technique, the diameter of the gastrojejunostomy is restricted by the jejunal diameter and is slightly smaller (25 mm) than that achieved by hand-stitching or using LS. However, no difficulty with the passage of food has occurred in our patients. Transient

food stasis was observed in one patient with a large residual stomach, but no problem was found at the anastomotic site. Thus, the food stasis in this patient was considered to be attributable to the decreased mobility of the residual stomach rather than to the area of the anastomotic site. In another patient, membranous stenosis, possibly specific to the CS, was observed and was relieved by conservative treatment with endoscopic balloon expansion. During the creation of a gastrojejunostomy, it is also necessary to be careful there is no kinking at the anastomotic site. For this purpose, the jejunal end should always be positioned to the right of the patient at the stage of determining the anastomotic site.

Inserting a 29-mm CS main body into the jejunum is possible in certain patients. However, forcible insertion of a thick CS may cause mucosal damage, a possible cause of anastomotic stenosis. Thus, we are now using the 25-mm CS uniformly.

Instruments used in our technique are two CSs, one LS, and three ELSs (or five ELSs with no LS for intraabdominal resection of the stomach). Although there are problems with the cost of these instruments, our technique can also be performed in the same manner with open distal gastrectomy as well as total gastrectomy, as noted earlier, and is applicable to various situations. Performing anastomoses with the same instruments and the same technique repeatedly is expected to further enhance the safety of the technique.

RY anastomosis often causes a specific complication called RY stasis syndrome, which may be intractable [12]. RY stasis syndrome was first reported in 1985 by Mathias et al. [13] as a pathological condition observed in patients who had had an RY reconstruction following distal gastrectomy; the condition was characterized by persistent abdominal pain, nausea, and vomiting after meals, with no organic abnormality. The etiologic mechanism is considered to be that cutting the small intestine breaks the continuity of neurotransmission between the duodenum and the lifted jejunum, and allows heterotopic pacemakers to appear in the lifted jejunum and produce antiperistalsis toward the residual stomach [14]. As an effective countermeasure, an uncut Roux procedure prevents ectopic jejunal pacemakers and gastric stasis [15]. With our procedure, the mesentery should not be cut, to preserve its integrity and protect the continuity of neurotransmission; we had only two cases (5.9%) of apparent RY stasis syndrome, which did not require much time to be cured.

While the top priority in surgery for gastric cancer is no doubt radical treatment, the feature that directly affects the patient's postoperative quality of life and determines the duration of the hospital stay is the quality of the anastomosis. Our technique, "Tornado Roux-en-Y," can achieve anastomosis safely in a short

period of time, and is thus recommended for reconstruction in LADG.

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