



Clinical research of totally laparoscopic modified Roux-en-Y reconstruction

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Background: To evaluate the clinical efficacy of improved Roux-en-Y reconstruction after Totally laparoscopic total gastrectomy (LTG) for gastric cancer.

Methods: Clinical data of 36 patients who underwent totally laparoscopic total gastrectomy with intracorporeal Roux-en-Y reconstruction for gastric cancer with complete follow-up data between January 2014 and December 2014 in the Second Hospital of Jilin University. Patients were divided into modified Roux-en-Y group (MRY 20 cases), classic Roux-en-Y group (CRY 16 cases) according to reconstructive methods.

Results: All cases were successfully completed, without conversion to laparotomy. There were no significant differences in lymph nodes harvest, time to flatus, hospital stay and postoperative complications between the two groups. However, the MRY group had shorter mean operative time [(260.9±21.2) *vs.* (287.9±19.0) min, P=0.000], shorter mean reconstruction duration [(32.4±9.2) *vs.* (45.4±13.2) min, P=0.001] and less intraoperative bleeding [(50.9±23.5 *vs.* (67.0±20.5) mL, P=0.000]. The dissection of the mesentery of the jejunum and the jejunum resection were not needed in the MRY group.

Conclusions: The Modified Roux-en-Y reconstruction (MRY) is feasible and safe. It can short the mean operative time, simplify the surgical procedures.

Keywords: Totally laparoscopic surgery; intracorporeal anastomosis; gastric cancer

Received: 19 December 2016; Accepted: 08 February 2017; Published: 08 February 2017.

doi: 10.21037/jxym.2017.04.06

View this article at: <http://dx.doi.org/10.21037/jxym.2017.04.06>

Introduction

For more than 20 years, laparoscopic gastric cancer surgery progressed worldwide (1,2), which totally laparoscopic gastric surgery and gastrointestinal tract reconstruction is one of the most complex procedure. The operation team with a higher level of minimally invasive techniques should be needed. Types of laparoscopic gastrointestinal tract reconstruction after total gastrectomy are various, mainly includes the application of the circular anastomosis and the linear anastomosis (3). The

most common used for laparoscopic digestive tract reconstruction after total gastrectomy is Roux-en-Y anastomosis, which is nearly the same procedure as the open surgery to dissect a loop of intestine with blood arch. It's important to simplify this procedure because the small intestine mesentery dissected totally laparoscopically is inconvenient. Based on the traditional Roux-en-Y anastomosis modified, without small intestinal mesentery dissection, the Roux-en-Y anastomosis can be completely performed. Comparing the classic and modified Roux-en-Y anastomosis, a simple technique should be valued for

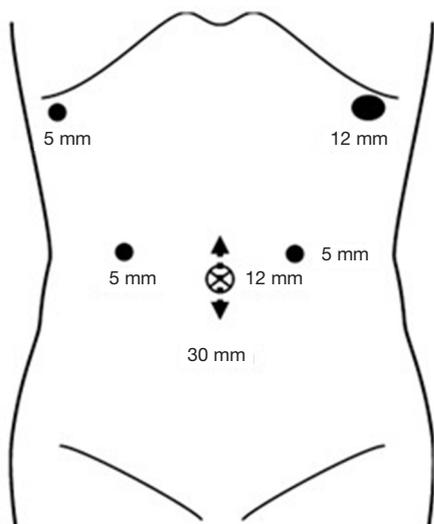


Figure 1 Location of the five trocars. The infraumbilical trocar is used for the insertion of a laparoscope. Two trocars are added to the right and left abdomen, respectively. The infraumbilical trocar is extended to 3–5 cm for the specimen retrieved.

the totally laparoscopic gastrointestinal tract reconstruction after total gastrectomy.

Methods

Patients

We retrospectively reviewed the medical records of 36 patients who underwent totally laparoscopic total gastrectomy (TLTG) with Roux-en-Y reconstruction in the second hospital of Jilin University between January 2014 and December 2014. There were 21 males and 15 females. The indication of TLTG included the patients with gastric adenocarcinoma located on the upper, upper to middle, or entire stomach, who were tested by endoscopy and abdominal CT scan. All operations were performed by one team of surgeon. All of the patients provided written informed consent to participate in the study. This study is also approved by the Ethics Committee of the Second Hospital of Jilin University.

Surgical technique

Under general anesthesia, the patient was placed in the supine position split with legs and the camera operator standing between. The chief surgeon was positioned on the left side of the patient and the first assistant on the right



Figure 2 Laparoscopic classic Roux-en-Y reconstruction, dissection of the small bowel mesentery.

side of the patient during stomach mobilization and lymph nodes dissection. Five trocars were inserted as showed in *Figure 1*. After stomach mobilization and lymph nodes dissection, the esophagus and duodenal should be transected with an endoscopic linear. The resected specimen were placed in a plastic specimen bag and retrieved through the umbilical trocar extended incision (*Figure 1*). Then the pneumoperitoneum was re-established by suturing the umbilical incision to the size of the trocar, the surgeon and the first assistant switched their positions for the later gastrointestinal tract reconstruction as needed.

Laparoscopic classic Roux-en-Y reconstruction (CRY): 16 cases

First, the dissection of the mesentery was created (*Figure 2*), then the jejunum was transected 15–20 cm distal to the Treitz's ligament by using an endoscopic linear. The distal side of the jejunum (approximately 3–5 cm long) was usually removed avoiding excessive tension and lack of mesenteric blood supply. The side to side esophagojejunostomy was performed at the left side of esophagus by endoscopic linear in an ante-colic fashion (*Figure 2*). In case of false anastomosis, the fork of the linear stapler inserted into the hole of the esophagus was always guided by a nasogastric tube. The entry hole was created after a side-to-side esophagojejunostomy and closed by a continuous hand-sewn technique. At the lumen 40–50 cm distal from the esophagojejunostomy, a side-to-side jejun-jejunostomy was performed intracorporeally,

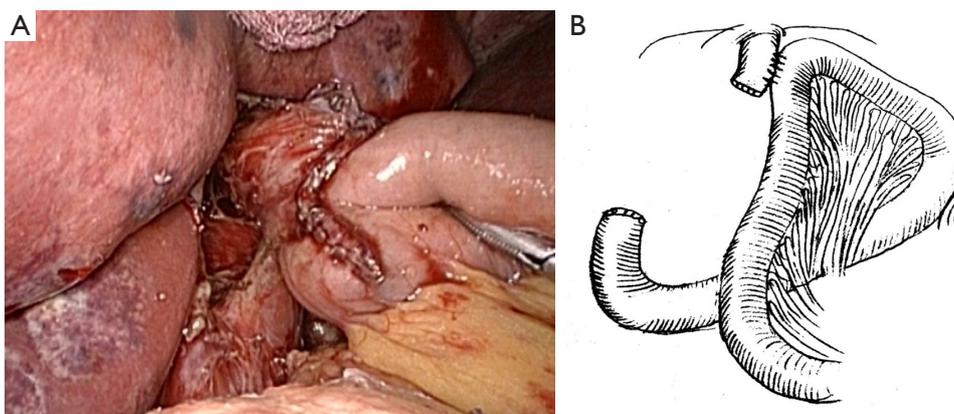


Figure 3 Laparoscopic modified Roux-en-Y reconstruction (MRY): esophagojejunostomy accomplishment. (A) Surgical image; (B) schematic diagram.

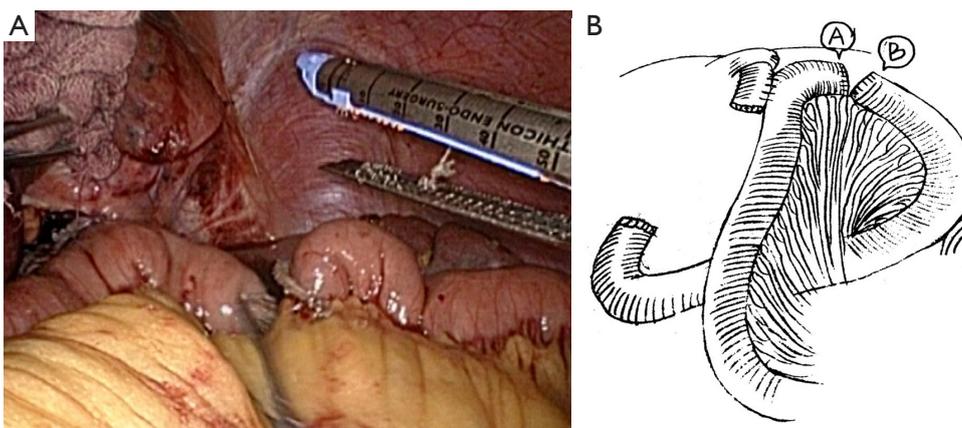


Figure 4 Laparoscopic modified Roux-en-Y reconstruction (MRY): the jejunum distal to the esophagojejunostomy 2–3 cm was intracorporeally transected, the mesentery dissection was not needed. (A) Surgical image; (B) schematic diagram.

and the entry hole was also closed by using a continuous hand-sewn technique.

Laparoscopic modified Roux-en-Y reconstruction (MRY): 20 cases

The side-to-side esophagojejunostomy was performed directly by one fork of the endoscopic stapler inserted into the jejunum 15–20 cm distal to the Treitz's ligament, another fork inserted carefully into the hole of the esophagus guided by nasogastric tube (*Figure 3*). After firing of the stapler converted the two openings into a single entry hole. The entry hole was closed by a continuous hand-sewn technique. The jejunum distal to the esophagojejunostomy 2–3 cm was intracorporeally transected and the mesenteric

dissection was not needed (*Figure 4*). A side to side jejunojunctionostomy was performed as described above (*Figure 5*).

Clinicopathological findings

All the patients information, including gender, age, body mass index (BMI), operative duration, blood loss, number of lymph nodes dissection, pathological findings, and perioperative complications was collected. All values are expressed as means \pm standard deviation.

Results

All 36 patients were successfully completed totally laparoscopically, there was no conversion from laparoscopic

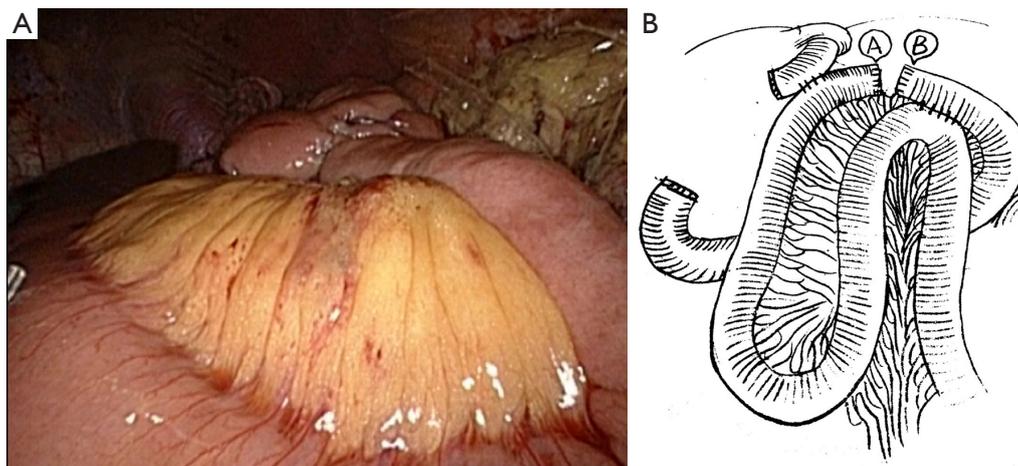


Figure 5 Laparoscopic modified Roux-en-Y reconstruction (MRY) accomplishment. (A) Surgical image; (B) schematic diagram.

Table 1 Clinicopathologic findings of patients with gastrectomy

Characteristic	MRY (n=20)	CRY (n=16)	P value
Age (years)	57.4±10.3	56.7±11.9	0.851
Male/female	10/10	10/6	0.517
BMI (kg/m ²)	22.2±2.3	21.9±4.5	0.797
History of abdominal surgery (n)	5 (25.0%)	3 (18.8%)	0.654
Tumor size (cm)	5.2±1.3	4.9±0.7	0.413
TNM stage (n)			0.189
I	2 (10.0%)	1 (6.2%)	
II	6 (30.0%)	4 (25.0%)	
III	12 (60.0%)	11 (68.8%)	

MRY, modified Roux-en-Y reconstruction; CRY, classic Roux-en-Y reconstruction.

surgery to open surgery. *Table 1* shows the clinicopathologic characteristics of the study groups. The age, sex ratio, BMI, history of abdominal surgery, tumor diameter and TNM staging did not differ between the CRY group (20 cases) and MRY group (16 cases).

The perioperative data were summarized in *Table 2*. The operative time was 260.9±21.2 mins in the MRY group and 287.9±19.0 min in the CRY group, and the blood loss was less than the CRY group (50.9±23.5 vs. 67.0±20.5 mL; P=0.01). The number of dissected lymph nodes did not differ between the study groups. The Roux-

en-Y reconstruction time was 32.4±9.2 min in the MRY group and 45.4±13.2 min in the CRY group. The length of the mesenteric dissection and the removed intestine were 11.6±4.5 and 3.6±2.3 cm in the CRY group. The time to flatus, postoperative hospitalization and the complications did not differ between the study groups.

Discussion

Laparoscopic surgery is widely used for gastric cancer due to its minimal invasiveness. The related technique is always mastered by the experienced surgeons. Totally laparoscopic gastrectomy (TLG), however, is not widely accepted because of its technical difficulty in comparison with laparoscopic assisted gastrectomy (LAG). In particular, the intracorporeal gastrointestinal tract reconstruction after total gastrectomy for gastric cancer is thought to be particularly difficult (4,5). Currently, various methods of intracorporeal gastrointestinal tract reconstruction are normally used and the Roux-en-Y reconstruction accepted widely, which is a method of side-to-side EJ (esophagojejunal) anastomosis using a linear stapler. To overcome the difficulties of intracorporeal esophagojejunostomy and simplify the process, we tried to develop a novel method described here. In this study, the short-time effect did not differ between the MRY group and CRT group.

In 1999, Uyama *et al.* (6) first reported laparoscopic side-to-side anastomosis by the endo linear cutters. As most surgeon preformed, however, the jejunum and the esophagus were transected, the mesentery was dissected

Table 2 perioperative data

Characteristic	MRY (n=20)	CRY (n=20)	P value
Operative time (min)	260.9±21.2	287.9±19.0	0.000
Blood loss (mL)	50.9±23.5	67.0±20.5	0.000
Reconstruction time (min)	32.4±9.2	45.4±13.2	0.001
No. of dissected lymph nodes	33.4±6.5	34.3±8.2	0.715
Length of mesentery dissection (cm)	0	11.6±4.5	0.000
Length of removed intestine (cm)	0	3.6±2.3	0.000
Flatus time (days)	2.8±1.5	3.0±0.9	0.642
Postoperative hospital stay (days)	7.3±4.5	8.1±6.5	0.666
Postoperative complications (n)	3 (15.0)	4 (28.6)	0.783
Ileus	1	1	
Anastomotic leakage	0	1	
Gastrointestinal bleeding	1	1	
Duodenal fistula	0	0	
Incision infection	0	1	
Alkaline reflux gastritis	1	0	

MRY, modified Roux-en-Y reconstruction; CRY, classic Roux-en-Y reconstruction

before the esophagojejunal anastomosis. In recent years, with the development of the laparoscopic instruments and skills, various of the gastrointestinal tract reconstruction after laparoscopic total gastrectomy performed by the experienced surgeons. Noh *et al.* (7) reported a laparoscopic purse-string suture in the distal esophagus and inserting an anvil, but laparoscopic endo linear anastomosis accepted more widely, such as Billoth I delta anastomosis and Roux-en-Y uncut anastomosis (3,8,9). Roux-en-Y anastomosis is usually used after total gastrectomy, various of modified Roux-en-Y anastomosis appeared in the recent year. At the beginning, the mini-incision was prepared by the surgeon for the reconstruction, but it was complicated as the larger incision, blur surgical vision and more blood for the fat patients, so the recent studies suggested that intracorporeal anastomosis is more benefit than extracorporeal anastomosis. In 2009, Okabe *et al.* (10) reported a new technique to fulfill the intracorporeal

linear-stapled esophagojejunal anastomosis, which can be performed safely and easily. The entire procedure was performed totally under laparoscopy, the method could be applied easily to obese patients. They also made some improvement: linear stapled esophagojejunostomy in the left side cause of sufficient free work space, insertion of an endoscopic linear fork into the true lumen of the esophagus guided by nasogastric tube. Inaba *et al.* (11) also previously reported the intracorporeal esophagojejunostomy by functional end-to-end anastomosis using an endoscopic linear stapler. In 2013, Shim and his teammates (12) summarized various types of anastomosis after LTG and evaluated the postoperative surgical outcomes according to their four types of anastomosis. Each study described the mesentery should be dissected and the jejunum should be transected for the Roux-en Y anastomosis (13). As far as we know, this is the first report that mesenteric does not need to be dissected for the Roux-en Y anastomosis after LTG.

At the beginning of the study, we performed this modified Roux-en Y anastomosis for the open surgery after the total gastrectomy. We started to perform the intracorporeal anastomosis after the learning curve completed and the laparoscopic techniques developed. This modified Roux-en Y anastomosis has several advantages: (I) shorten the reconstruction time to shorten the operation time; (II) the dissection of the mesentery of the jejunum and the jejunum resection were not needed; (III) no stitches were made to close the dissected mesentery. As compared with the classic Rou-en-Y anastomosis, the modified group is associated with the same short-term clinical outcomes. With all these modifications, our new procedure could become one of the simple, economic, feasible and safe procedures for intracorporeal gastrointestinal tract reconstruction after LTG.

However, further clinical and randomized controlled trials are needed to evaluate its long-term effects. This study was limited by its small patient population. To launch this new method, an experienced laparoscopic work team should be necessary.

Acknowledgments

Funding: None.

Footnote

Conflicts of Interest: All authors have completed the ICMJE

uniform disclosure form (available at <http://dx.doi.org/10.21037/jxym.2017.04.06>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). All of the patients provided written informed consent to participate in the study. This study is also approved by the Ethics Committee of the Second Hospital of Jilin University.

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doi: 10.21037/jxym.2017.04.06

Cite this article as: Liu T, Ma Z, Fang X, Zhu J. Clinical research of totally laparoscopic modified Roux-en-Y reconstruction. *J Xiangya Med* 2017;2:8.