

Functional end to end esophagojejunostomy without previous resection of esophagus and jejunum by linear stapler in the totally laparoscopic gastrectomy: Experience in 106 patients

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Abstract

Introduction: We aimed to evaluate the outcomes of the technique of functional end-to-end esophagojejunostomy by linear stapler without previous resection of the esophagus and jejunum in the totally laparoscopic total gastrectomy (TLTG) and report experience in 106 patients.

Patients and methods: A prospective observational study on patients received technique of functional end-to-end esophagojejunostomy by linear stapler without previous resection of esophagus and jejunum in TLTG between July 2017 and July 2022.

Results: We included 106 patients with a mean age of 63.2 ± 11.7 (26 – 88). 10.4% of patients having tumors in the upper third of the stomach and 88.7% of patients having tumors in the middle of the stomach. There were 4.7% of cases having incidents during the surgery and 3.6% of cases having complications after the surgery. There were 2 (1.8%) cases of technical errors in making functional end to end esophagojejunostomy during surgery. No anastomotic leakage or death was observed after the surgery. The operation time was 201.5 ± 29.0 (145 - 270) minutes. The mean hospital stay was 7.56 ± 2.23 (5 - 15) days. 04 (3.6%) cases of reflux esophagitis, and 03 (2.7%) mild stenosis of the anastomosis after surgery, and 1 (0.9%) recurrence at the anastomosis after surgery.

Conclusion: The technique of functional end-to-end esophagojejunostomy by linear stapler without previous resection of esophagus and jejunum was safe and effective in TLTG.

Keywords: Esophagojejunostomy in laparoscopy, The technique of functional end-to-end.

Introduction

Esophagojejunostomy after total gastrectomy is a difficult and complicated technique in gastrointestinal anastomosis. Currently, there are more than 25 techniques of esophagojejunostomy in over the world [1], of which there are more than 5 techniques in laparoscopic surgery such as OrVil, Overlap, Functional ... [2]. Each technique has different advantages and disadvantages.

In 1968, Steichen was the first person to report the technique of functional gastrointestinal anastomosis by linear stapler [3]. In 2005, Okabe H was the first one to apply the technique of functional end-to-end esophagojejunostomy after total gastrectomy using laparoscopic linear staplers, and since 2006, he has performed procedures using laparoscopic functional end-to-end anastomosis for esophagojejunostomy [4]. In 2009, Shinohara submitted a report on the postoperative anastomotic leakage rate of the functional anastomosis for esophagojejunostomy after total gastrectomy using linear staplers in 55 patients, and this rate was estimated at 4% [5]. In 2013, Ebihara Yuma reported performing procedures using functional end-to-end anastomosis for esophagojejunostomy after total gastrectomy using laparoscopic linear staplers in 65 patients, there were no cases of esophagojejunostomy leakage, there were 3 cases of esophagojejunostomy stenosis and 3 cases of technical errors in esophagojejunostomy operations comprising incorrect bowel loops, clamping the stapler to the gastric feeding tube and jamming the stapler [6]. In 2017, Nguyen Van Huong, Dinh Van Chien, and their colleagues performed procedures using functional end-to-end esophagojejunostomy without resection of the esophagus and anterior jejunum by linear stapler in total gastrectomy, and by 2020, it was reported on successful implementation in 70 cases with this particular technique, there were no cases of anastomosis complications [2]. Up to now, this technique has been widely applied in totally laparoscopic total gastrectomy and it has brought high efficiency to patients as a result [4],[5],[6].

However, esophagojejunostomy after totally laparoscopic total gastrectomy is a difficult technique, which consists of many manipulations, long-time operation and a lot of staplers. And intraoperative complications and postoperative anastomotic leakage are likely to happen. Therefore, the aim of our study is to report on: *"Experience in 106 cases of functional end to end esophagojejunostomy without previous resection of the esophagus and jejunum by linear stapler in totally laparoscopic total gastrectomy"*.

Materials and methods

Subjects

We included 106 patients who were operated with functional end-to-end esophagojejunostomy without previous resection of the esophagus and jejunum by linear stapler in totally laparoscopic total gastrectomy for gastric carcinoma at Nghe An Friendship General Hospital.

Research methods

Our study is a prospective observational study, all patients who underwent functional end-to-end esophagojejunostomy without previous resection of the esophagus and jejunum by linear stapler in totally laparoscopic total gastrectomy between July 2017 and July 2022.

Variables:

Patients characteristics: age, gender, ASA, BMI, gastric lesion location.

Surgical results: surgical method, intraoperative blood loss, surgery time, incidents during the surgery.

Early results: Time to defecate, time to gastric tubes removal, time to feed after surgery, postoperative complications, hospital stay after surgery.

Distant results: anastomosis stenosis, the recurrence at the anastomosis, reflux.

Anastomotic Technique: The patient was placed in the supine split-leg position, the surgeon stood on the left side and the number of trocar placement was 5, and then gastric dissection was performed

to remove the D2 lymph node. Performing esophagojejunostomy according to the following steps:

Step 1: Dissect the cardia and the esophagus to the esophageal hiatus, about 8-10cm length to ensure cutting area and be adequate to make the anastomosis with a linear stapler. Then, open a small hole above the Z-line about 1-2 cm on the left side of the esophagus, and perform biopsy at the resection line.

Step 2: Preparing a loop of jejunum about 40-60cm from the Treitz ligament. Dissect and release about 3cm of the mesentery of the jejunum along the mesenteric border, and be alert not to enlarge

the mesentery. After that, open a small hole in the free margin of the jejunum to place the anastomotic devices.

Step 3: Use the first stapler to conduct esophagojejunostomy and inspect the hemostasis from anastomotic site if hemorrhage occurs.

Step 4: Use the second stapler and insert it through the opening of the mesentery of the jejunum to cut esophageal jejunum and tightly close the anastomosis (Figure 1). And then inflate the stomach or filling it with water to inspect the digestive tract flow at the anastomotic site. After that, performing end-to-side roux-en-Y anastomosis via linear stapler.

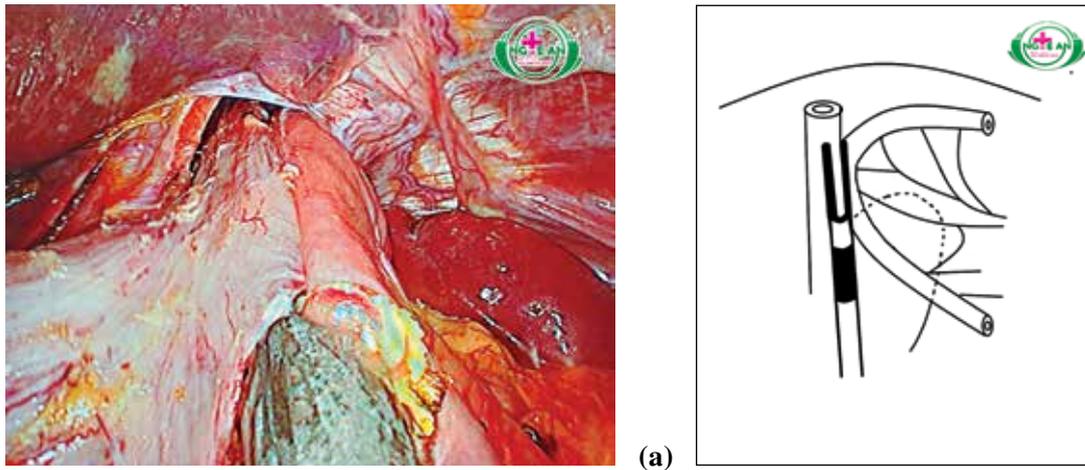


Figure 1: end-to-end esophagojejunostomy without previous resection of the esophagus and jejunum via linear stapler

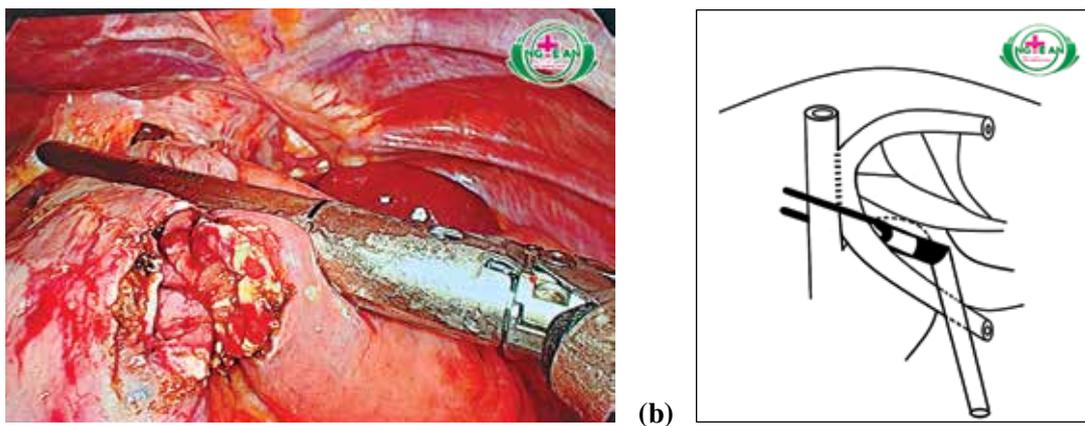


Figure 2: (a) Esophagojejunostomy (b) Cutting esophageal jejunum and tightly close the anastomosis

Statistical analyses: Data was collected and analyzed using SPSS V 26.0

Research results

From July 2017 to July 2022, we included 106 patients with the results obtained

Table 3.1. Patients Characteristics

Age (yr)	63,2 ± 11,7 (26 – 88)	
BMI (kg/m ²)	20,2 ± 2,2 (13,3 - 25)	
Gender	Male	74 (69,8%)
	Female	32 (30,2%)
ASA	ASA1	47 (44,3%)
	ASA2	44 (41,5%)
	ASA3	15 (14,2%)
Location of lesion	The upper third	11 (10,4%)
	The middle third	94 (88,7%)
	Totally	01 (0,9%)

The lowest age in the study group was 26 years old and the highest was 88 years old, the lowest BMI was 13.3 kg/m² and the highest was 25 kg/m² in contrast. The male/female ratio is 2.3/1. Preoperative health status was mainly ASA1 and ASA2. The location of gastric lesions in the study group was mainly in the middle third.

Table 3.2. Surgical Outcomes

Intraoperative Complications	05 (4,7%)
Technical errors of esophagojejunal anastomosis	02 (1,8%)
Operative time	201,5 ± 29,0 (145 - 270) mins
Intraoperative blood loss	32,59 ± 19,3 (15 - 200) ml
Distance from lesion margin to the proximal resection line	4,58 ± 1,04 (2 – 7) cm
The pathology of the negative margin of upper resection	106 (100%)

All patients underwent the technique of functional end-to-end esophagojejunostomy without previous resection of the esophagus and jejunum by linear stapler in totally laparoscopic total gastrectomy. There were 4.7% of patients having mild complications during the surgery. Among all of these, our research showed one patient (0.9%) having left hepatic capsule injury, 02 of cases (1.9%) having the spleen capsule injury. One case (0.9%) having a volume of 200ml blood loss due to upper splenic pole's vessels injury. Another case suffered from the serosal laceration of the small intestine. There were 2 cases of technical errors in making an esophageal jejunal anastomosis which were the process of splicing and nasogastric tube. The shortest distance from the upper injury margin to the proximal resection line was 2cm and the longest was 7cm. All cases showed no tumor cells residual at the proximal and distal resection lines.

Table 3.3. Treatment outcomes and surgical follow-up

Postoperative Complications	Pneumonia	1 (0,9%)
	Residual Abscesses	1 (0,9%)
	Surgical Site Infections	1 (0,9%)
	Esophagojejunal anastomotic fistula	0 (0,0%)
	Urinary tract infections	1 (0,9%)
Time of gastric tubes removal (hours)	17,9 ± 24,2 (0 - 96)	
Time to drain removal (hours)	2,96 ± 1,2 (2 - 7)	
Time of oral feeding (days)	3,4 ± 1,4 (2 - 7)	
Hospital stay (days)	7,56 ± 2,23 (5 - 15)	
GERD	04 (3,6%)	
Postoperative anastomotic stenosis	03 (2,7%)	
Anastomotic recurrence	01 (0,9%)	

There were 3.8% of patients having postoperative complications, were well internally treated. No case was noticed having anastomotic fistula and no death was observed during and after surgery. Our research indicated 59 of cases (55.7%) do not require postoperative nasojejunal tube, 49 of cases (46.2%) having all the drain removal and 44 patients (41.5%) was allowed to eat in the second day after surgery. There were eight patients (7.5%) being discharged in the fifth day, 32 (30.2%) in the sixth day and 31 (29.2%) in the seventh day after surgery.

In our study group, there were 3.6% of patients suffering from symptoms of GERD, which often occurred after eating at the follow-up examination at six months. There were 03 (2.7%) patients with signs of dysphagia when eating dry, endoscopic image showed a slight narrowing without endoscopic dilation or surgical treatment as well. One of cases (0.9%) had tumor recurrence at the anastomosis was reported during the observation period.

Discussion

The mean age in the study was 63.2 ± 11.7 in which the youngest was 26 and the oldest was 88. The percentage of male gender in our study group was 69.8% and that of female gender was 30.2%. The male/female ratio was 2.3/1. According to some authors, gastric cancer occurs mainly in patients of 62.7- 64.8 years old in Japan, 63.6-73 years old in Europe and USA [4],[5],[6]. Preoperative health status was mainly ASA classification I accounting for 44.3% and ASA classification II accounting for 41.5%. Mean BMI was 20.2 ± 2.2 kg/m², the lowest number was 13.3 and the highest one was 25 kg/m². We chose total gastrectomy for patients having tumors in the cardia, fundus, or having gastric cancer with ulceration. Other cases were patients who had the distance from the tumor margin to the cardia <6 cm, which aimed to ensure to remove the tumor cells entirely. The results showed that 10.4% of patients having the tumor located at the one-third upper of the stomach, 88.7% of patients having the tumor located in the middle of the stomach, and

0.9% of patients having tumors with ulceration. The shortest distance from the upper injury margin to the proximal resection line was 2 cm and the longest was 7 cm. To prevent the tumor recurrence at the anastomosis, some Japanese authors suggested that this kind of distance should be at least 5 cm and this particular distance should be at least 1 cm if the lesion position was in the cardia [2],[4],[7].

For the technique of restoration of gastrointestinal continuity, we performed the esophagojejunostomy anastomosis using the technique functional end-to-end with linear staplers without previous resection of esophagus and jejunum in the totally laparoscopic total gastrectomy with Roux En Y reconstruction. We noticed that the suture in the totally laparoscopy was more beneficial than the suture in the assisted-laparoscopy or open surgery. These advantages included wide surgical area, easy manipulations, small scar, and better postoperative recovery. On the other hand, we did not conduct the resection of the esophagus and jejunum before anastomosis but did them simultaneously while closing the anastomosis. This helped to decrease the number of manipulations, ease the procedure, reduce the operation time and the number of staplers leading to the reductions of operation cost.

There were 4.7% of cases in our study having intraoperative complications. Our results showed 01 (0.9%) of cases having hepatic injury during the manipulation of the liver leading to the left hepatic hemorrhage, 02 (1.9%) of cases having the bleeding spleen while dissecting the gastrosplenic ligament and lymph nodes stations 4sa, 10. One case (0.9%) had the serosal laceration of the small intestine when suturing the digestive tract. Another case (0.9%) having a volume of 200ml blood loss due to upper splenic pole's vessels injury. All were treated with electrosurgery in laparoscopy, hemostasis clips and suturing with vicryl 4.0 X-shaped stitches to repair serosal injury. There were 2 (1.8%) cases of technical errors in making an oesophageal jejunal anastomosis during surgery, which were splicing to the gastric feeding tube. We made a cross-

section of the catheter right in the upper apex of the anastomosis, and those patients recovered stably and was discharged later. After 1 month, it was demonstrated that there was no remaining catheter part by using endoscopic to inspect the anastomosis. No patients needed to undergo open surgery and no death was observed during operation. Ebehara Y, the ratio of having intraoperative incidents was 7.7%. Of these, 2 of cases had to be converted to open surgery due to technical errors when connecting the wrong loops and clamping stapler to the nasogastric tube. The rate of complications of the authors in over the world ranged from 0.9% to 7.4%.

There were 3.6% of patients having complications after the surgery. For the complications, there was one of cases having a residual abscess in the left liver. We conducted purulent aspiration under ultrasound guidance and this patient was well treated and discharged on day 13. There was also 01 of cases having pneumonia on day 4 after the surgery, then was conservatively treated and recovered, left the hospital on day 15. There was 01 of cases with surgical site infections. To manage this complication, the wound needed to be opened by removing the sutures and change bandages on a regular basis until the infection was controlled then closed the wound and the patient was discharged on day 15. Another patient was reported suffering from urinary tract infections, and then was well internally treated and discharged on day 9. There was no reports on anastomosis fistula and no death case after the surgery. According to Ebehara Y, overall complication rate was 15% and 1.5% of fatality. According to Kim EY, the proportion of complications in totally laparoscopic versus laparoscopic-assisted were 18.5% and 17.2% consecutively. Overall complication rate in reports in Western and America ranged from 21 to 26% [2],[7].

The recorded mean blood loss was 32.59 ± 19.3 (15 - 200) ml; the average surgical time was 201.5 ± 29.0 (145 - 270) minutes; the average nasogastric tube time was 17.9 ± 24.2 (0 - 96) hours,

59 (55.7%) patients did not have a nasojejunal tube after surgery; the mean time of abdominal drain removal was 2.96 ± 1.2 (2 - 7) days, 49 (46.2%) patients had all drain removed on the 2nd day after surgery; the average time to start oral feeding was 3.4 ± 1.4 (2 - 7) days, 44 (41.5%) patients were fed on the 2nd day after surgery; The average hospital stay was 7.56 ± 2.23 (5-15) days, 08 (7.5%) patients were discharged on the 5th day after surgery, 32 (30.2%) patients were discharged on the 6th day, and 31 (29.2%) patients were discharged on the 7th day after surgery. According to Ebihara Y, the average blood loss during surgery was 85.2 ml; the average surgical time was 271.5 minutes; The mean postoperative hospital stay was 21.4 days, the mean time to start feeding was 4.6 days [6]. According to Kim EY, the results between totally and assisted laparoscopy are as follows: the average surgical time is 228.9 minutes and 230 minutes, the average intraoperative blood loss is 90.9 ml and 106.3 ml; the mean time of enteral feeding was 4.6 days and 5.0 days; mean length of hospital stay was 9.7 days and 13.6 days [8].

In postoperative follow-up, we found that 3.6% of the patients had symptoms of reflux esophagitis, which often occurred after eating when follow-up at 6 months. The symptoms improved after we advised the patient to have an appropriate diet. 2.7% of patients showed signs of dysphagia when eating dry food, endoscopy showed a slight narrowing without the need for dilation or surgery to redo the anastomosis. There was 1 (0.9%) patient with gastric cardia carcinoma who had a recurrence at the anastomosis, we made a 2cm-above-the-Z-line cut and made a biopsy at the resection line till no cancer cells were left. After surgery, the patient was stable, there was no sign of choking, endoscopy showed no ulcer and no stenosis of the anastomosis. Follow-up up to 23 months after surgery, the patient appeared to have difficulty swallowing, and the endoscopic image showed an ulcer of 2x3cm in size, biopsy showed an image of gastric carcinoma. The patient has been counseled on chemoradiotherapy and

targeted therapy. Shinohara T, et al. reported the recurrence rate after laparoscopic surgery for breast cancer is 20.0% [5]. The rate of tumor recurrence after surgery of the authors in Asia ranges from 0.3 to 1.7% and metastasis after surgery is 4.5% - 15% [9], [10]. Ebihara Y, et al had a complication rate of anastomosis of 4.6% [6]. The rate of this stenosis is higher than that of author Li Z [11], who had 3 (1.0%) patients with postoperative anastomosis.

Performing the technique of functional end-to-end esophagojejunostomy by linear stapler without previous resection of esophagus and jejunum for 106 patients, we have some technical experience as follows:

Functional end-to-end esophagojejunostomy by linear stapler without previous resection of esophagus and jejunum have many advantages such as less manipulations, a larger surgical field, less use of suture machines, and lower operative time. If the gastric cardia tumor is large or invades the esophagus, it is more convenient to use a circular suture machine.

Preparing a jejunum loop 40 - 60 cm from the Treitz ligament, clearly mark the direction, and avoid the reverse connection of the loop.

Dissecting the cardia and the esophagus to the esophageal hiatus. Extensive esophageal mobility is favorable for anastomosis.

Cutting the mesentery along the mesenteric border of the jejunum about 2-3cm, which is enough to make the anastomosis and does not need to be sutured closed.

Before pressing the first stapler to connect the jejunum to the esophagus, pay attention to checking the nasogastric tube, and avoid cutting the tube. If the nasogastric tube is cut, the anastomosis is exposed and the tube is cut across the top of the anastomosis, then the tube falls along the gastrointestinal tract.

After pressing the first stapler, it is necessary to check the cutting area. If bleeding, use an electric knife along the cutting area to stop the bleeding. Beware of the duration to avoid burning the connecting area of staples leading to leakage of the anastomosis.

Before pressing the 2nd stapler to close the anastomosis, pay attention to not pulling the back of the anastomosis down too long, which will cause to the stenosis of the anastomosis, and at the same time, inserting the gastrostomy into the connecting mouth and check with air or water to confirm circulation and sealing of the anastomosis.

In case, the stapler was already pressed but the esophageal part has not been removed entirely, then combined with a Hemolok clamp to save the number of staplers. It would be redundant to strengthen the anastomosis with more sutures and nasojejunal circulation after surgery if there is no risk.

Conclusion

The technique of functional end-to-end esophagojejunostomy by linear stapler without previous resection of the esophagus and jejunum is a safe and effective technique in totally laparoscopic total gastrectomy.

Conflict of interest: The authors declare that they have no conflict of interest.

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