

T-shaped technique for esophagojejunostomy in laparoscopic total gastrectomy for gastric cancer

Dinh Van Chien^{1,2*}, Nguyen Van Huong^{1,2}, Pham Van Thuong¹

ABSTRACT

Objective: This study aimed to evaluate the application of a T-shaped esophagojejunostomy technique using a linear stapler in laparoscopic total gastrectomy for gastric cancer. **Methods:** This was a prospective descriptive study that included patients who underwent the T-shaped esophagojejunostomy using a linear stapler in laparoscopic total gastrectomy from 2017 to 2023. **Results:** A total of 106 patients (mean age, 60.62 ± 11.8 (range 26–88 years) were included. The male-to-female ratio was 2.7:1. The gastric lesion was located in the upper third of the stomach in 21.1% of the cases and in the middle third in 76.2% of the cases. Minor intraoperative and postoperative complications occurred in 8.1% and 4.2% of the cases, respectively. No anastomotic leaks or perioperative deaths occurred during the study period. There were two (1.4%) cases of technical failure during esophagojejunostomy creation during surgery. The mean operative time was 209.5 ± 35.2 (range 140–300) minutes, and the mean postoperative hospital stay was 7.6 ± 1.9 (range 5–15) days. There were three (2.0%) cases of mild anastomotic stricture and one (0.7%) case of anastomotic recurrence. **Conclusion:** T-shaped esophagojejunostomy using a linear stapler in laparoscopic total gastrectomy is safe and effective in the treatment of gastric adenocarcinoma.

Keywords: T-shaped esophagojejunostomy, linear stapler esophagojejunostomy.

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INTRODUCTION

Restoration of Esophagojejunostomy (EJ) Digestive Continuity in Total Gastrectomy (TG) is a complex and challenging technique for gastrointestinal anastomosis. Currently, there are more than 25 EJ restoration techniques globally, but only 5 techniques are performed in laparoscopic surgery (LS), such as OrVil, Overlap, and Functional. Each technique has its advantages and challenges.

In 1968, Steichen first reported a functional gastrointestinal anastomosis technique using a linear stapler. In 2005,

Okabe H was the first to perform functional EJ anastomosis after TG using a linear stapler with laparoscopic-assisted surgery, and by 2006, he had performed entirely laparoscopic EJ anastomosis using the functional method intra-abdominally. In 2009, Shinorhara et al. reported functional EJ anastomosis after TG using a linear stapler in 55 patients with a 4% anastomotic leak rate, calling it side-to-side anastomosis. In 2013, Yuma reported functional EJ anastomosis after totally laparoscopic TG using a linear stapler in 65 patients, with no EJ anastomotic leaks, three cases of anastomotic strictures, and three cases of

technical errors during anastomosis (misplaced intestinal loop, stapler clamping on the gastric tube, and stapler jam). Postoperatively, endoscopy and imaging of the anastomosis revealed no blind pouches, making it end-to-end. In 2017, Nguyen Van Huong, Dinh Van Chien, and colleagues performed the T-Shaped EJ end-to-end anastomosis using a linear stapler after TG, and by 2020, they reported successful implementation in 70 cases with no anastomotic complications using this T-Shaped technique. This technique has since been widely applied in LS TG and proven to be highly effective for patients.

However, performing T-shaped EJ anastomosis for total laparoscopic TG is a challenging technique that requires many steps, is time-consuming, involves multiple staplers, and carries the risk of intraoperative complications and postoperative anastomotic leakage. Therefore, we conducted this study to report on: "Results of the T-Shaped Esophagojejunostomy Technique in Laparoscopic TG for Gastric Adenocarcinoma."

PATIENTS AND METHODS

Patients

This study included patients who underwent the T-shaped EJ technique using a linear stapler in laparoscopic TG for gastric cancer treatment at the Nghe An General Friendship Hospital.

Methods

A prospective descriptive study was conducted on all patients who underwent the T-Shaped EJ technique using a linear stapler in laparoscopic TG from July 2017 to July 2022.

Research indicators

- Patient characteristics included age, sex, ASA, BMI, and gastric lesion location.

- Surgical Results: Surgical method, blood loss, surgery duration, and intraoperative complications.
- Early Results: Time to first flatus, time to gastric tube removal, time to postoperative feeding, postoperative complications, and length of hospital stay after surgery.
- Long-term Results: anastomotic stricture, recurrence, and reflux.

T-Shaped EJ Technique using a Linear Stapler: The patient is placed in a supine position with legs apart, the surgeon stands on the left side and inserts 5 trocars. The stomach was dissected and D2 lymphadenectomy was performed. Digestive tract continuity was restored by performing EJ using the following steps.

Step 1: The esophagogastric junction was dissected up to the diaphragmatic hiatus, approximately 8-10 cm to ensure the resection margin and sufficient space for anastomosis with the linear stapler (Figure 1). Create a small hole on the left side of the esophagus at the Z-line, about 1-2 cm, and perform a biopsy on the resection margin.

Step 2: Prepare the jejunal loop 40-60 cm from the ligament of Treitz, and the jejunal mesentery along the mesenteric border is approximately 3 cm in size (Figure 2), ensuring that the mesentery is not extended. A small hole was then created in the free border of the jejunum to insert the stapler.

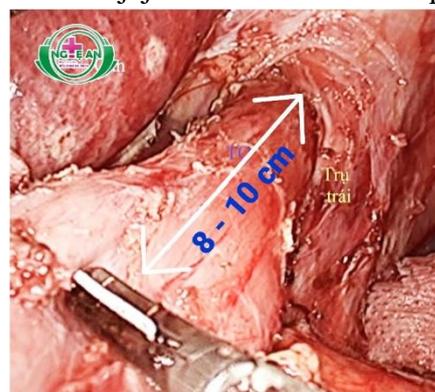


Figure 1. Dissection of the esophagogastric junction

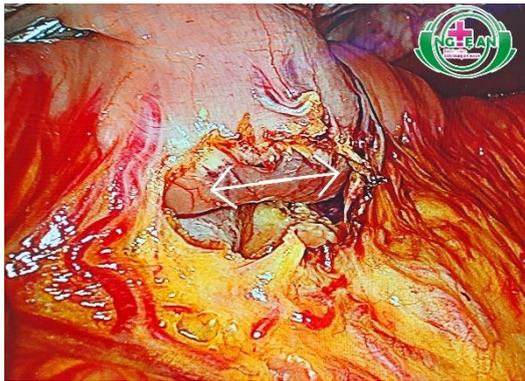


Figure 2. Freeing the jejunal mesentery

Step 3: Use the first stapler to anastomose the jejunum to the esophagus and check for hemostasis if bleeding occurs (Figure 3).

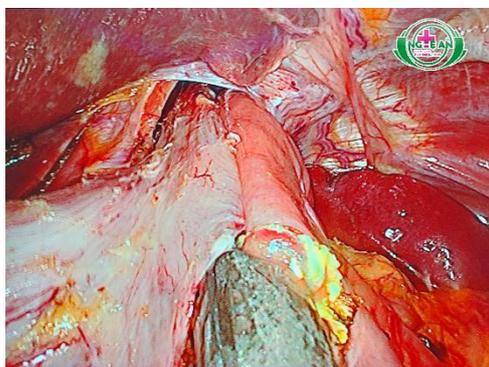
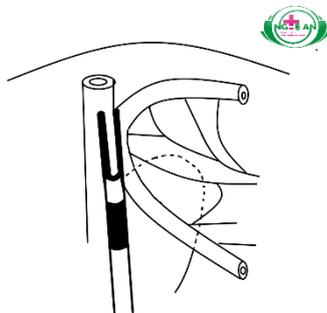


Figure 3. Jejunal anastomosis to the esophagus

Step 4: Use the second stapler through the mesenteric hole to simultaneously transect the jejunum and esophagus and seal the anastomosis (Figure 4). Air or water was inflated through the gastric tube to check the patency of the anastomosis.

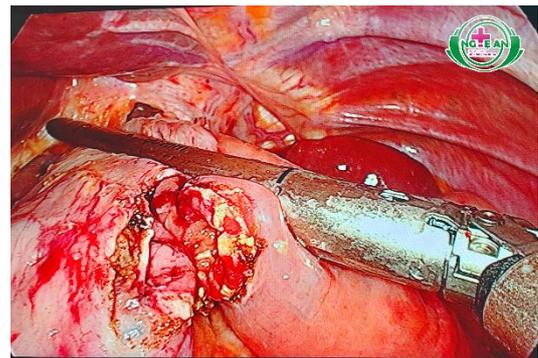
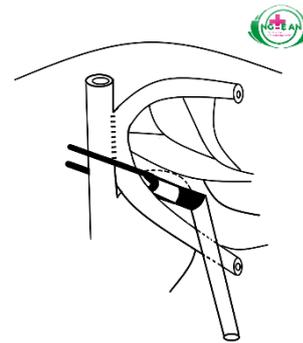


Figure 4. Simultaneous transection and sealing of the EJ.

The Y-limb end-to-side was re-anastomosed using a linear stapler.

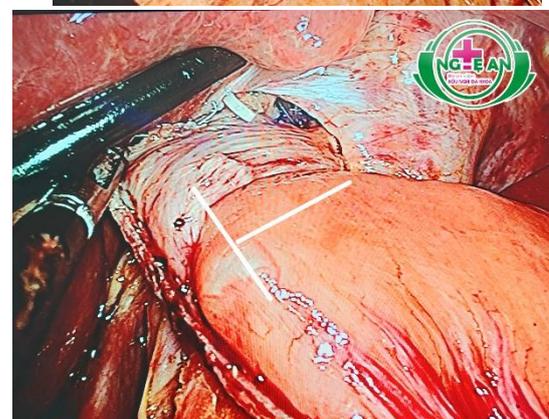
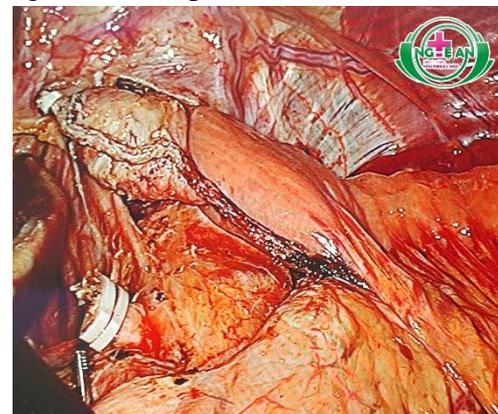


Figure 5. EJ uses the T-shaped technique

Ethical Considerations:

This study was approved by the hospital ethics and scientific research committee. All information was used solely for research

purposes and patient confidentiality was maintained.

Data were processed using SPSS software version 26.0.

RESULTS

In total, 106 patients were included in this study. The youngest patient in the study group was 26 years old and the oldest was 88 years old. The lowest BMI was 13.3 kg/m², and the highest was 25 kg/m². The male-to-female ratio was 2.3/1. Preoperative health status was mainly ASA1 or ASA2. The gastric lesion location in the study group was primarily in the middle third. (Table 1)

Table 1. Patient Characteristics

Age	63,2 ± 11,7 (26 – 88) years	
BMI	20,2 ± 2,2 (13,3 - 25) kg/m ²	
Gender	Male	74 (69,8%)
	Female	32 (30,2%)
ASA	ASA1	47 (44,3%)
	ASA2	44 (41,5%)
	ASA3	15 (14,2%)
Gastric lesion location	Upper third	11 (10,4%)
	Middle third	94 (88,7%)
	Whole	01 (0,9%)

Complete laparoscopic TG with EJ was performed in 100% of patients using the T-shaped technique with a linear stapler. A total of 4.7% of patients experienced intraoperative complications, including 1 (0.9%) patient with left hepatic capsule injury, 2 (1.9%) patients with splenic capsule tears, 1 (0.9%) patient with upper polar vessel injury causing approximately 200 ml blood loss, and 1 (0.9%) patient with a small bowel seromuscular tear during anastomosis. Two patients experienced technical errors during the EJ. The shortest distance from the upper lesion margin to the resection margin was 2 cm and the longest was 7 cm. All resection margins were cancer-free. (Table 2)

Table 2. Surgical Results

Intraoperative complications	05 (4,7%)
Technical errors in EJ	02 (1,8%)
Mean surgery duration	201,5 ± 29,0 (145 - 270) phút
Mean intraoperative blood loss	32,59 ± 19,3 (15 - 200) ml
Distance from upper lesion margin to resection margin	4,58 ± 1,04 (2 – 7) cm
Negative upper resection margin pathology	106 (100%)

Postoperative complications occurred in 3.8% of cases, all of which were managed medically and resulted in discharge. No anastomotic leakage or postoperative death occurred. 59 (55.7%) did not require a postoperative nasojejun tube. 49 (46.2%) patients had all drains

removed and 44 (41.5%) began oral feeding on the second postoperative day. Eight (7.5%) patients were discharged on the fifth postoperative day, 32 (30.2%) on the sixth day, and 31 (29.2%) on the seventh day. (Table 3)

At the 6-month follow-up, 3.6% of the patients reported symptoms of esophageal reflux, which usually occurred after eating a large meal. Three (2.7%) patients experienced mild dysphagia with dry food, which was confirmed by endoscopy, showing mild anastomotic stricture that did not require dilation or revision surgery. 1 (0.9%) experienced anastomotic recurrence. (Table 3)

Table 3. Postoperative Treatment and Follow-Up Results

Complication	Pneumonia	1 (0,9%)
	Residual abscess	1 (0,9%)
	Surgical site infection	1 (0,9%)
	Anastomotic leak	0 (0,0%)
	Urinary tract infection	1 (0,9%)
Postoperative nasojejunal tube duration	17,9 ± 24,2 (0 - 96) hours	
Drain removal time	2,96 ± 1,2 (2 - 7) days	
Oral feeding time	3,4 ± 1,4 (2 - 7) days	
Mean hospital stays	7,56 ± 2,23 (5 - 15) days	
Esophageal reflux	04 (3,6%)	
Postoperative anastomotic stricture	03 (2,7%)	
Anastomotic recurrence	01 (0,9%)	

DISCUSSIONS

Our study had a mean age of 63.2 ± 11.7 years, with the youngest being 26 years old and the oldest 88 years old. 69.8% were male and 30.2% female, with a male-to-female ratio of 2.3:1. According to previous studies, the mean age of gastric cancer patients in countries like Japan ranges from 62.7 to 64.8 years, whereas in Europe and the United States, it ranges from 63.6 to 73 years [3],[4],[5]. The preoperative health statuses were mainly ASA1 (44.3%) and ASA2 (41.5%). The mean BMI was 20.2 ± 2.2 kg/m², with the lowest being 13.3 kg/m² and the highest 25 kg/m². We indicated TG in cases of gastric cancer located in the cardia,

body, greater curvature, ulcerated infiltrative type, and where the cancer margin was less than 6 cm from the cardia, to ensure complete removal of cancerous tissue.

T-shaped technique for EJ in laparoscopic total gastrectomy: We performed digestive tract reconstruction using the Roux-en-Y method, creating an end-to-end anastomosis using the T-shaped technique without prior cutting of the esophagus and jejunum using a linear stapler. We found that total laparoscopic anastomosis using the T-shaped technique has several advantages over laparoscopic-assisted or open surgery, such as a wider surgical field, easier surgical manipulation, smaller incisions, and faster

postoperative recovery. Additionally, simultaneous closure of the anastomosis reduces the operative steps, shortens the surgery time, reduces the number of staplers needed, and lowers surgical costs. We have drawn several technical insights for performing T-shaped EJ using a linear stapler as follows:

Prepare the jejunal loop 40–60 cm from the ligament of Treitz and mark the direction and reference points clearly to avoid incorrect orientation of the loop.

The cardia of the esophagus was dissected up to the diaphragm, and the esophagus was mobilized widely to facilitate the EJ.

The mesenteric defect was opened along the mesenteric border of the jejunum by approximately 2-3 cm, which was sufficient for anastomosis without the need to close the mesenteric defect.

Before using the first stapler to anastomose the jejunum to the esophagus, the gastric tube was correctly positioned to avoid cutting it. If the gastric tube is cut, the anastomosis is exposed, and the tube is cut transversely at the top of the anastomosis, allowing it to pass through the digestive tract naturally.

After using the first stapler, hemostasis was checked at the cutting site using monopolar cautery on the cutting plane to prevent bleeding without causing burns on the stapler lines, which could lead to anastomotic leakage.

Before using the second stapler to close the anastomosis, we ensured that the posterior wall of the anastomosis was not pulled too far downward, which could have caused anastomotic stricture. The gastric tube was inserted into the anastomosis, and air or water was used to check anastomotic patency and seal.

If the stapler does not completely close the esophageal tissue, Hemolok clips are used to save the staplers. It is not always necessary to reinforce the anastomosis or use a nasojejunal tube postoperatively if there is no risk.

Intraoperative complications in our study were 4.7%, including 1 (0.9%) case of liver injury during liver retraction causing left hepatic parenchymal bleeding, 2 (1.9%) cases of splenic capsule tear during gastrosplenic ligament dissection and lymph node dissection in groups 4sa and 10 causing bleeding, 1 (0.9%) case of small bowel seromuscular tear during anastomosis, and 1 (0.9%) case of upper polar splenic vessel injury during lymph node dissection causing approximately 200 ml blood loss, all managed laparoscopically with electrocautery, clip application, and seromuscular suturing with 4-0 Vicryl in an X-stitch pattern. Two patients experienced technical errors during anastomosis involving the gastric tube, which was managed by transversely cutting the tube at the top of the anastomosis. A postoperative endoscopy at one month showed no residual tubes. No conversion to open surgery or intraoperative deaths occurred. Ebehara Y reported an intraoperative complication rate of 7.7%, with 2 patients converting to open surgery due to technical errors during anastomosis involving incorrect loop orientation and stapler application to the gastric tube [5]. The complication rate in international literature ranges from 0.9% to 7.4% [1],[3],[4],[5].

Postoperative complications were 3.6%, including 1 case of residual subphrenic abscess, 1 case of pneumonia on the fourth postoperative day, 1 case of surgical site infection, and 1 case of urinary tract infection. No anastomotic leakage or postoperative mortality was observed.

Ebihara Y reported an overall complication rate of 15% with a 1.5% mortality rate [5]. Kim EY reported complication rates of 18.5% for total laparoscopic and 17.2% for laparoscopic-assisted surgeries [6]. Western and American authors have reported complication rates of 21-26% [1].

We recorded a mean blood loss of 32.59 ± 19.3 ml, a mean surgery duration of 201.5 ± 29.0 minutes, an mean nasojejunal tube duration of 17.9 ± 24.2 hours, with 59 (55.7%) patients not requiring a nasojejunal tube postoperatively, an mean drain removal time of 2.96 ± 1.2 days, an mean time to start oral feeding of 3.4 ± 1.4 days, and an mean hospital stay of 7.56 ± 2.23 days (range 5-15 days).

Postoperative follow-up showed that 3.6% of patients experienced symptoms of esophageal reflux at the 6-month check-up, typically occurring after large meals, which improved with dietary adjustments. A total of 2.7% of patients showed signs of dysphagia with dry foods, with endoscopy revealing mild anastomotic stricture that did not require dilation or revision surgery. One patient (0.9%) experienced anastomotic recurrence 23 months after surgery. Recurrence rates reported in Asian studies ranged from 0.3% to 1.7%, with postoperative metastasis rates of 4.5% to 15% [7]. Ebihara Y reported a 4.6% rate of anastomotic stricture [5].

CONCLUSIONS

The T-shaped EJ technique using a linear stapler is safe and effective for the laparoscopic TG treatment of gastric adenocarcinoma.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

SOURCES OF FUNDING

None.

CONSENT

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal upon request.

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