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# Comparison of clinical efficacy between π-shaped esophagojejunostomy and overlap method in treating upper gastric cancer with double-tract reconstruction in proximal gastrectomy under total laparoscopy

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## Abstract

**Background** This study aimed to analyze the clinical efficacy of π-shaped esophagojejunostomy and the overlap method in treating upper gastric cancer with double-tract reconstruction in proximal gastrectomy under total laparoscopy.

**Method** Clinical data were collected from patients with upper gastric cancer who underwent surgery in the General Surgery Department of Jiangsu University Affiliated Hospital from June 1, 2017, to January 1, 2023. Patients were categorized into the overlap method group and the π-shaped esophagojejunostomy group. We collected perioperative and gastroscopy follow-up data from both groups 1 year after surgery.

**Results** Seventy-nine patients were included, with 46 in the overlap anastomosis group and 33 in the π-shaped esophagojejunostomy group. Both groups were evaluated for age, sex, body mass index, tumor diameter, tumor pathological Tumor, Node, Metastasis staging, intraoperative bleeding volume, number of lymph node dissections, postoperative hospitalization days, postoperative hospitalization days, catheter removal time, drainage tube removal time, recovery time, anal defecation time, postoperative bedtime activity time, hospitalization cost, Visual Analog Scale (VAS) score at rest on the first day after surgery, VAS score at activity on the first day after surgery, short-term postoperative complications and 1-year gastroscopy follow-up. No significant difference was observed in these factors ($P > 0.05$). However, the π-shaped esophagojejunostomy group had a significantly lower surgical time and anastomosis time than the overlap anastomosis group ($P < 0.05$).

**Conclusion** Both overlap anastomosis and π-shaped esophagojejunostomy are safe for double-tract reconstruction in proximal gastrectomy under total laparoscopy without increasing the incidence of perioperative and short-term complications in patients. π-shaped esophagojejunostomy has shorter surgical time and anastomosis time than overlap anastomosis.

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**Keywords** Π-shaped esophagojejunostomy, Overlap method, Double-tract reconstruction, Upper gastric cancer, Proximal gastrectomy, Total laparoscopy

## Introduction

According to 2023 Cancer statistics [1], approximately 26,500 patients were diagnosed with gastric cancer in the United States in 2023. Additionally, China's 2023 Cancer Map reveals that gastric cancer is the third most common of all malignant tumors in China. The Japanese Statute of Gastric Cancer states that upper gastric cancer mainly includes esophagogastric union cancer, gastric fundus cancer, and upper gastric body cancer [2]. Surgical procedures for upper gastric cancer include total gastrectomy (TG) and proximal gastrectomy (PG); however, the choice between these surgical procedures remains controversial [3]. PG is superior to TG in terms of patients' postoperative recovery. Accordingly, the Japanese Station of Gastric Cancer recommends PG for stage cT1 ~ 2N0M0 upper gastric cancer [2]. Recent studies have increasingly revealed that PG can still be performed on locally advanced gastric cancer, provided that D2 lymph node dissection is conducted [4–8]. This has introduced new ideas for surgical management. The combination of PG with double-tract reconstruction (DTR), that is, PG-DTR, has shown favorable results in improving patients' reflux esophagitis and reducing anastomotic strictures [9]. Additionally, the latest 2023 edition of the laparoscopic gastric cancer surgery guidelines recommends laparoscopic techniques for upper gastric cancers with progressive stages. The total laparoscopic esophagojejunal anastomosis methods include the esophagojejunal functional end-to-end anastomosis method, the esophagojejunal parametral side-to-side anastomosis (overlap) method, and the π-shaped esophagojejunostomy [10, 11].

The overlap method was first reported by Japanese scholars in 2010 [12], while π-shaped esophagojejunostomy was first reported by Kwon et al. in 2016 [13]. The overlap method is a lateral anastomosis for the pro-peristaltic esophago-jejunum, with relatively low small intestinal mesentery tension. However closing the common opening presents greater technical challenges. In contrast, π-shaped esophagojejunostomy is a lateral anastomosis for the counter-peristaltic esophago-jejunum that does not disconnect the esophagus and jejunum. The π-type anastomosis is a reverse peristaltic esophagojejunal lateral anastomosis, which does not dissect the esophagus and jejunum and involves the intraoperative pulling of the esophagus. The π-shaped esophagojejunostomy technique facilitates closure of the common opening [14]; however, in patients with a shorter small intestinal mesentery, the anastomotic tension will be greater, thereby increasing the risk of anastomotic fistula in the postoperative period [15]. In this study, we aimed to review and analyze the clinical data of patients with upper gastric cancer who underwent surgery in the Department of General Surgery at Jiangsu University Hospital, and to analyze the clinical efficacy of π-shaped esophagojejunostomy and the overlap method in treating upper gastric cancer with DTR in PG under total laparoscopy.

## Methods

### General information

Clinical data were collected from patients with upper gastric cancer who underwent surgery in the Department of General Surgery of Jiangsu University Hospital from June 1, 2017, to January 1, 2023. Patients were categorized into the overlap method and π-shaped esophagojejunostomy groups according to the esophagojejunal anastomosis method. All patients' surgeries were performed by experienced physicians. The inclusion criteria were as follows: (1) patients with preoperative gastroscopy and pathologically confirmed diagnosis of upper gastric cancer; (2) patients who did not receive neoadjuvant therapy before surgery; (3) patients who underwent proximal gastrectomy, and the anastomotic method is the DTR in proximal gastrectomy under total laparoscopy, using either the overlap method or π-shaped esophagojejunostomy for esophagojejunal anastomosis method; and (4) patients with available clinical data. The exclusion criteria were as follows: (1) tumors in the gastroesophageal junction; (2) patients who did not achieve D2 lymph node dissection; (3) patients who underwent concurrent resection of other organs; and (4) patients who were unable to undergo total laparoscopic surgery or intermediate open surgery.

The study complied with the ethical guidelines of the 1964 Declaration of Helsinki and was approved by the Jiangsu University Affiliated Hospital (approval no: KY2023K0909). All patients provided written informed consent before enrollment in the study. To protect patient privacy and ensure data security, all personal identifiers such as names and ID numbers, were removed, and patient identities were replaced with serial numbers.

### Surgical method

The enrolled patients were endotracheal intubated under general anesthesia trachea. The patient's surgical position was the large-format position, with the hand holding the mirror between the patient's legs, the chief surgeon on the patient's left side, the first assistant on the patient's right side, the observation hole in the umbilicus, and the pneumoperitoneum pressure set at 12–14 mmHg. The scope of lymph node dissection was performed

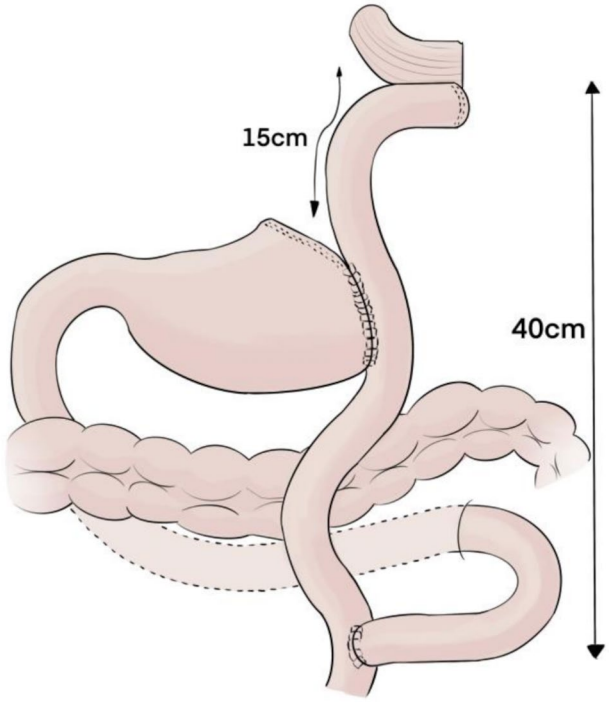


**Fig. 1** Schematic diagram of double-tract reconstruction for proximal gastrectomy

according to the 6th edition of the Japanese "Guidelines on the Treatment of Gastric Cancer" [16], and the range of lymph node dissection was No. 1, 2, 3a, 4sa, 4sb, 7, 8a, 9, 11p, and 11d lymph nodes. All enrolled patients underwent total laparoscopic PG with DTR (Fig. 1).

***Laparoscopic overlap method (Fig. 2)***

After perigastric freeing was completed, the abdominal segment of the esophagus was sufficiently free for approximately 8 cm. The esophagus was tied with a sterile cord at the cardia and downward traction. The esophagus was incised with an ultrasonic knife on the right side of the esophagus approximately 2 cm above the cardia to make a small hole without disconnecting the esophagus, and the proximal gastric specimen was placed on the left side of the abdominal cavity. The jejunum was dissected at approximately 20 cm from the ligament of Treitz. The distal jejunum was incised with an electrosurgical knife 6 cm from the end of the dissection to create a small hole on the opposite of the mesentery, and the gastric tube was inserted into the esophagus to guide the two arms of the 60-mm linear cutter-closers to extend into the small holes of the esophagus and the jejunum. The esophagojejunal anastomosis was completed, and the common opening was closed with the 60-mm linear cutter-closers to confirm the anastomosis, the common opening was

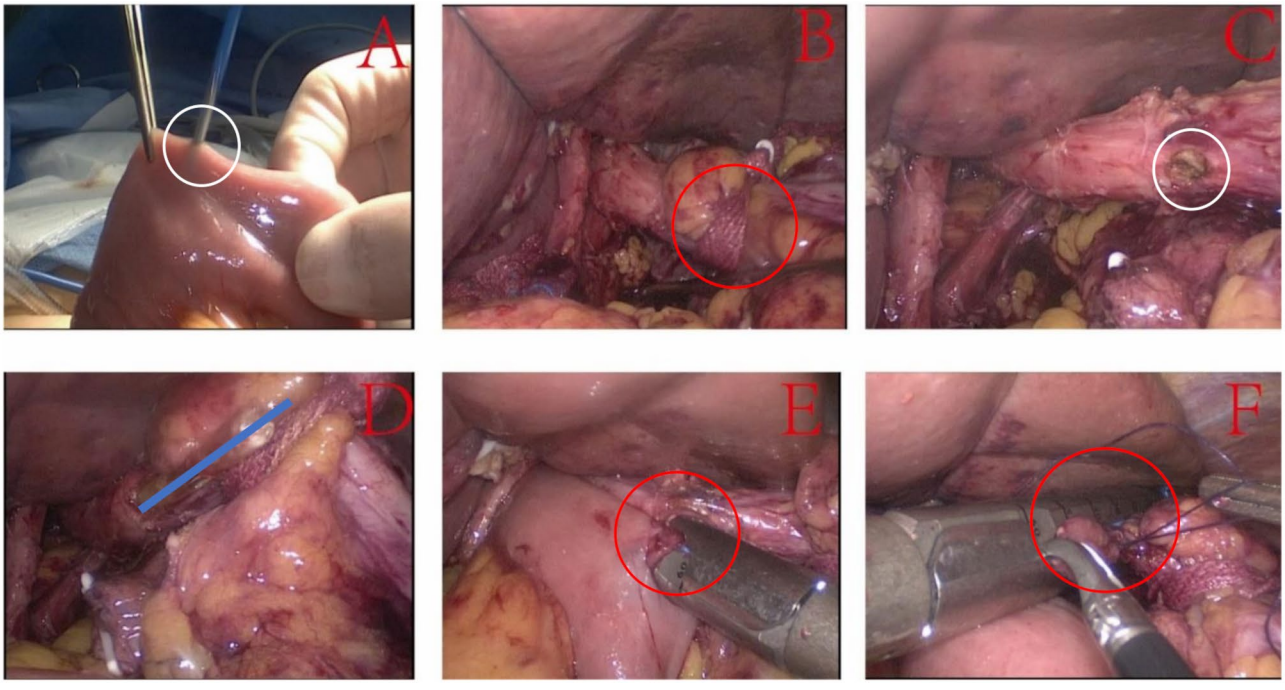


**Fig. 2** Laparoscopic overlap method. (**A**) Cut the jejunum and the mesenteric vessels at a position 20–25 cm away from the suspensory ligament of the duodenum. The distal jejunum was incised at 6 cm from the end of the dissection to create a small hole opposite the mesentery with an electrosurgical knife (white circle). (**B**) An aseptic rope is tied to traction the esophagus (red circle). (**C**) A small incision on the right side of the esophagus 2 cm above the cardia (white circle). (**D**) The gastric tube passes through a small hole in the esophagus and guides a linear cutting and closing device (blue line). (**E**) Both arms of the linear cutter-closer are extended into a small hole in the incision rim of the esophagus and the jejunum (red circle). (**F**) With the help of sterile ropes, a linear cutter-closer closes the common opening

further strengthened using a 3 – 0 barb thread. Finally, a jejunal side-to-side anastomosis and residual gastrojejunal anastomosis were performed.

***Laparoscopic π-shaped esophagojejunostomy (Fig. 3)***

After perigastric freeing was completed, the abdominal esophagus was sufficiently free for approximately 8 cm. The esophagus was tied with a sterile cord at the cardia and downward traction. The esophagus was incised with an ultrasonic knife to make a small hole in the right side of the esophagus approximately 2 cm above the cardia without disconnecting the esophagus. The proximal gastric specimen was placed on the left side of the abdominal cavity. The jejunum was dissected at approximately 20 cm from the ligament of Treitz, and a small hole was incised at the distal jejunal stump on the opposite of the mesentery with an electrosurgical knife. A gastric tube was inserted into the esophagus to guide the two arms of the 60-mm linear cutter-closers to extend into the small holes of the esophagus and jejunum to complete the esophagojejunal anastomosis. The common opening was then closed using the 60-mm linear cutter-closers to complete the π-shaped esophagojejunostomy. The common anastomosis was strengthened with the 3 – 0 barb thread, and the specimen was dissected. Subsequently, a jejunal side-to-side anastomosis and residual gastrojejunal anastomosis were performed.

**Data collection**

Data collected from the enrolled patients included: (1) General data: Age, sex, height, weight, tumor diameter, pathological Tumor, Node, Metastasis (TNM) stage of the tumor; (2) Intraoperative clinical data: Operation time, anastomosis time, the volume of intraoperative bleeding, and the number of lymph nodes cleared; and (3) Postoperative clinical data: Number of days of postoperative hospitalization, the time of catheter removal, the drainage tube removal time, time of resumption of gas evacuation, time of anal defecation, time of postoperative bed activity, hospitalization cost, Visual Analog Scale (VAS) score at rest on the first postoperative day, VAS score at activity on the first postoperative day, postoperative complications, and gastroscopy follow-up within 1 year after surgery.

**Statistical analysis**

Clinical data were analyzed using SPSS 26.0 statistical software. The normality of continuous variables was

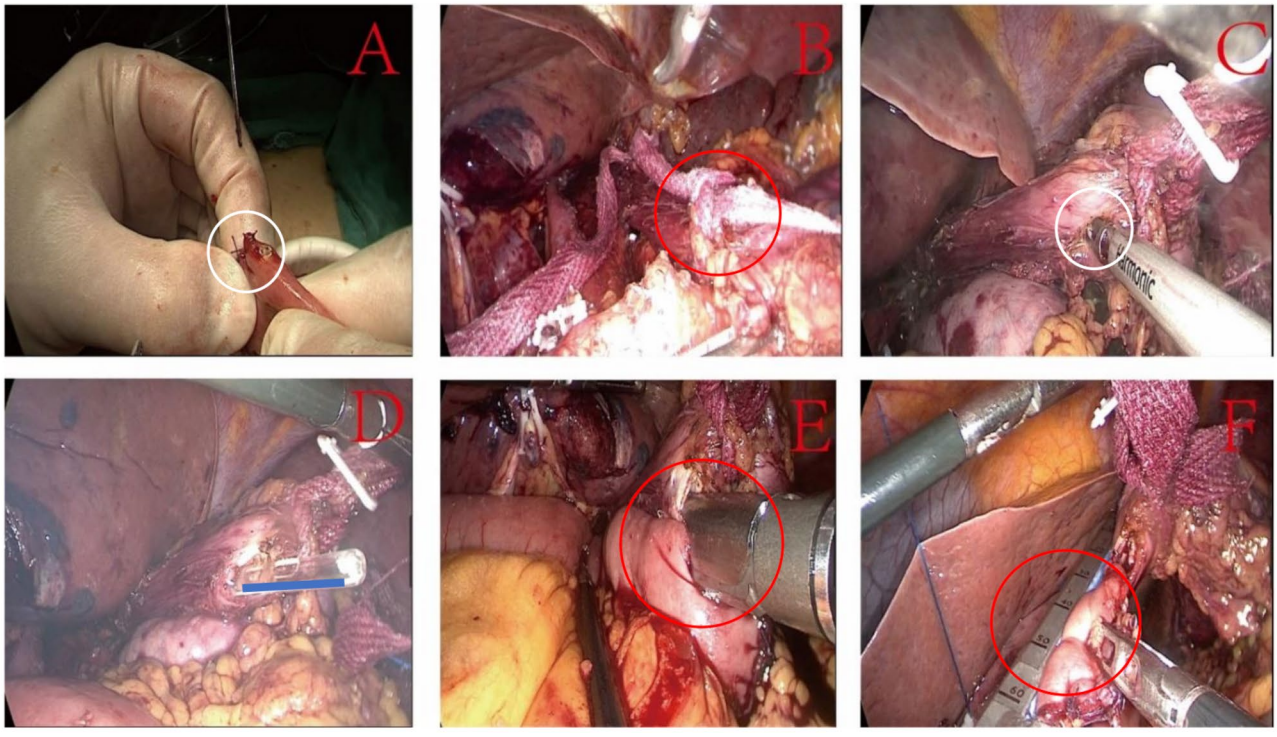


**Fig. 3** Laparoscopic π-shaped esophagojejunostomy (**A**) Cut the jejunum and the mesenteric vessels at a position 20–25 cm away from the suspensory ligament of the duodenum. A small hole was incised at the distal jejunal stump on the opposite of the mesentery with an electrosurgical knife (white circle). (**B**) An aseptic rope is tied to traction the esophagus (red circle). (**C**) A small incision on the right side of the esophagus 2 cm above the cardia (white circle). The gastric tube passes through a small hole in the esophagus and guides a linear cutting and closing device (blue line). (**E**) Both arms of the linear cutter-closer are extended into a small hole in the incision rim of the esophagus and the jejunum (red circle). (**F**) With the help of sterile ropes, a linear cutter-closer closes the common opening

**Table 1** Comparison of patients' basic characteristics

| Factor | Overlap method ($n=46$) | π-shaped esophagojejunostomy ($n=33$) | t/c²value | *P*-value |
|---|---|---|---|---|
| Age (Y) | 65.89 ± 8.04 | 65.91 ± 8.17 | 0.0096 | 0.9923 |
| Body mass index | 21.66 ± 3.80 | 23.16 ± 2.73 | 1.940 | 0.0561 |
| Sex | | | 2.483 | 0.1151 |
| Male | 33 | 18 | | |
| Female | 13 | 15 | | |
| Tumor diameter (cm) | 4.28 ± 2.23 | 3.87 ± 2.12 | 0.8348 | 0.4064 |
| Tumor pathology TNM stage | | | 0.7408 | 0.6905 |
| I | 14 | 11 | | |
| II | 7 | 7 | | |
| III | 25 | 15 | | |

**Table 2** Comparison of patients' intraoperative conditions

| Factor | Overlap method ($n=46$) | π-shaped esophagojejunostomy ($n=33$) | t-value | *P*-value |
|---|---|---|---|---|
| Operative time (min) | 303.8 ± 19.66 | 294.6 ± 18.48 | 2.112 | 0.0379 |
| Anastomosis time (min) | 84.30 ± 8.96 | 79.91 ± 7.50 | 2.298 | 0.0243 |
| Intraoperative bleeding (ml) | 67.61 ± 38.35 | 85.91 ± 59.31 | 1.665 | 0.1000 |
| Number of lymph node dissection | 24.43 ± 9.13 | 20.94 ± 6.72 | 1.865 | 0.0660 |

**Table 3** Postoperative recovery of patients

| Factor | Overlap method ($n=46$) | π-shaped esophagojejunostomy ($n=33$) | t-value/Z | *P*-value |
|---|---|---|---|---|
| Days of postoperative hospitalization (day) | 11.33 ± 2.71 | 12.03 ± 2.80 | 1.124 | 0.2646 |
| Time of catheter removal (day) | 3(2,4) | 3(2,3.5) | 0.52 | 0.959 |
| Time of drain removal (day) | 10(8,11) | 10(8,11.5) | 0.151 | 0.880 |
| Recovery time of anal discharge (day) | 2.39 ± 0.54 | 2.21 ± 0.70 | 1.292 | 0.2003 |
| Time of resumption of defecation (day) | 3.54 ± 0.62 | 3.58 ± 0.83 | 0.1976 | 0.8439 |
| Time of getting out of bed (day) | 1(1,2) | 1(1,2) | 0.501 | 0.617 |
| Cost of hospitalization (CNY) | 74,135 ± 8992 | 76,955 ± 8868 | 1.383 | 0.1708 |
| VAS score on the first day of postoperative rest | 4.07 ± 1.37 | 4.30 ± 1.36 | 0.7629 | 0.4479 |
| VAS score on the first day of postoperative activity | 5.80 ± 1.43 | 5.91 ± 1.16 | 0.3455 | 0.7306 |

assessed using the Shapiro-Wilk test ($P>0.05$ indicating normal distribution). Normally distributed data are presented as mean ± standard deviation ($\bar{x} \pm s$) and compared using an independent t-test. Non-normally distributed data are presented as median (interquartile range) and compared using the Mann-Whitney U test (two groups). Categorical variables were analyzed using chi-square or Fisher's exact test. A *P*-value of $<0.05$ was considered statistically significant.

## Results

### Comparison of general information

Seventy-nine patients were included in the study, with 46 in the overlap method group and 33 in the π-shaped esophagojejunostomy group. No significant difference was observed between the two groups in age, sex, body mass index (BMI), tumor diameter, or tumor pathology TNM stage ($P>0.05$) (Table 1).

### Comparison of intraoperative data

No significant difference was observed between the overlap method group and the π-shaped esophagojejunostomy group in intraoperative bleeding and the number of lymph nodes dissected ($P>0.05$) (Table 2). However, the π-shaped esophagojejunostomy group had significantly shorter operative and anastomosis times than the overlap method group ($P<0.05$) (Table 2).

### Comparison of patients' postoperative recovery

Regarding postoperative recovery of patients, the differences in the number of days of postoperative hospitalization, time of catheter removal, the time of removal of the drainage tube, recovery time of anal discharge, time of resumption of defecation, time of getting out of bed, cost of hospitalization, VAS score on the first day of postoperative rest, and VAS score on the first day of postoperative activity were not statistically significant between both groups ($P>0.05$) (Table 3).

### Postoperative short-term complications

Postoperative complications occurred in 12 patients in the overlap method group and nine patients in the π-shaped esophagojejunostomy group, with no

**Table 4** Comparison of short-term postoperative complications

| Factor | Overlap method ($n=46$) | π-shaped esophagojejunostomy ($n=33$) | *P*-value |
|---|---|---|---|
| Anastomotic fistulas | | | |
| Yes | 2 | 1 | >0.9999 |
| No | 44 | 32 | |
| Anastomotic bleeding | 0 | 0 | |
| Anastomotic stenosis | 0 | 0 | |
| Pulmonary infection | | | 0.7654 |
| Yes | 7 | 6 | |
| No | 39 | 27 | |
| Lymphorrhagia | | | >0.9999 |
| Yes | 3 | 2 | |
| No | 43 | 31 | |

**Table 5** Gastroscopic examination within 1 year after operation

| Factor | Overlap method ($n=39$) | π-shaped esophagojejunostomy ($n=30$) | *P*-value |
|---|---|---|---|
| Anastomosing stomatitis | | | |
| Yes | 16 | 13 | 0.8473 |
| No | 23 | 17 | |
| Reflux esophagitis | | | 0.6271 |
| Yes | 3 | 1 | |
| No | 36 | 29 | |
| Dumping syndrome | | | 0.5757 |
| Yes | 1 | 2 | |
| No | 38 | 28 | |

statistically significant difference in overall complication rates ($P>0.05$). Two anastomotic fistulas in the overlap method group and one in the π-shaped esophagojejunostomy group developed anastomotic fistulas, all classified as grade II according to the Clavien-Dindo grading system [17]; all other patients were classified as grade I. Comparing the anastomotic fistula, lung infection, and lymphatic leakage aspects individually, the difference between the two groups of patients was still not statistically significant ($P>0.05$) (Table 4).

#### Gastroscopic examination within 1 year after surgery

Seven patients in the overlap method group and three in the π-shaped esophagojejunostomy group were lost to follow-up. Anastomosing stomatitis was observed in 16 patients in the overlap method group and 13 in the π-shaped esophagojejunostomy group after the operation, and none had any obvious self-conscious symptom; no significant difference was observed in the statistical analysis of the patients in the two groups ($P>0.05$) (Table 5). For postoperative dumping syndrome and reflux esophagitis, the differences between the two groups were not statistically significant ($P>0.05$) (Table 5).

## Discussion

This study compared the clinical efficacy of two esophagojejunal anastomosis methods (π-shaped and Overlap method) during DTR in PG under total laparoscopy. This is the first study to confirm that no significant difference exists between the two anastomosis methods in terms of perioperative safety and short-term complications. However, the π-shaped anastomosis can significantly shorten the operation and anastomosis times. This finding provides an important basis for optimizing the anastomosis technique in laparoscopic PG. Although previous studies have explored the advantages and disadvantages of the π-shaped and overlap anastomosis in TG, no prior study has directly compared these two anastomosis methods in DTR during PG under total laparoscopy. Additionally, this study has drawn schematic diagrams of the anastomosis methods and surgical images.

The incidence of proximal gastric cancer has increased [18]. The main surgical procedure for patients with proximal gastric cancer was TG, however, TG is often associated with weight loss, dumping syndrome, and anemia [19]. Similarly, patients who undergo PG experience acid reflux after surgery, which negatively affects the postoperative quality of life. Therefore, many surgeons do not recommend PG. However, with many scholars exploring the anastomotic modes of digestive tract reconstruction after PG, jejunal interposition and DTR have become popular. PG has significant advantages in terms

of patients' postoperative food intake [20], postoperative weight loss [21], and maintenance of patients' appetite [22], while also enabling patients to maintain high vitamin B12 levels after surgery [23]. Meanwhile, for upper gastric cancer, PG is not significantly different from TG in terms of the therapeutic efficacy of lymph node dissection [24].

DTR is the most widely used anastomotic modality for PG, as found by Xu et al. through a meta-analysis of upper gastric cancers with a lower rate of postoperative reflux after DTR compared to that of TG [25]. This finding agrees with the findings of other studies [26]. Additionally, Xiao et al. found that the DTR of PG in total laparoscopic resection was superior to that of the DTR performed using the traditional open group [27]. As the key surgical step in DTR for PG under total laparoscopy is the anastomosis of esophageal jejunum, this study analyzed the advantages and disadvantages of esophageal jejunum anastomosis in the two groups by statistically analyzing the outcomes of patients with upper gastric cancers who had undergone surgery in our hospital.

The study's findings revealed that the anastomosis and operative times of patients in the π-shaped esophagojejunostomy group were significantly shorter than those of patients in the overlap method group. However, no significant difference was observed in postoperative recovery between the two groups. This finding suggests that both anastomosis methods are safe and reliable in the PG-DTR surgical approach, a finding reported for the first time in this study. The reduction in operative time may be attributed to the technical characteristics of the π-shaped anastomosis. Unlike the overlap method, which requires an opening at a position 6 cm away from the jejunal stump, the π-shaped anastomosis directly uses the jejunal stump for anastomosis, avoiding the steps of secondary incision and dissection of the mesentery of the jejunum, and simplifying the operation process. In addition, the π-shaped anastomosis closes the common opening in the antiperistaltic direction, eliminating the need to adjust the direction of the mesentery of the jejunum, and reducing the time-consuming process of instrument conversion and suture reinforcement. This finding is consistent with the technical advantages of the π-shaped anastomosis, such as "not dividing the esophagus and reducing the traction tension," as proposed by Kwon et al. In contrast, due to the need for precise alignment in the peristaltic direction, the overlap method has a higher difficulty in closing the common opening, which may prolong the anastomosis time. Although theoretically, the π-shaped anastomosis may increase the risk of anastomotic leakage due to the increased tension of the mesentery, this study found no significant difference in the incidence of anastomotic leakage between the two groups. This indicates that the safety of the π-shaped anastomosis can be controlled in experienced medical centers. Notably, although the π-shaped anastomosis has an advantage in terms of time efficiency, no significant difference was observed between the two groups in terms of long-term functional outcomes, such as postoperative reflux esophagitis and anastomotic stomatitis. This may be attributed to the structural characteristics of DTR itself. Regardless of the esophagojejunal anastomosis method used, DTR reduces the occurrence of reflux by preserving the residual stomach-jejunum anastomosis. This finding further supports the value of double-tract anastomosis as the preferred reconstruction method for PG.

Cui et al. found that the overlap method is safe in PG-DTR by retrospectively analyzing data from 37 cases [28]. Similarly, Hu et al. confirmed that π-shaped esophagojejunostomy did not increase anastomotic fistula and patient stress in PG-DTR by reviewing the clinical data from 48 cases [29]. TG has been reported in the application of these two methods in total laparoscopic radical gastrectomy [30], however, their application in PG-DTR has not been reported. According to foreign literature, the probability of esophagojejunal anastomotic fistula after total laparoscopic TG is approximately 6% [31], while the statistical data of Chinese scholars is approximately 2% [32], consistent with the findings of our study. These findings suggest that total laparoscopic anastomosis does not increase the probability of anastomotic fistula of the esophago-jejunum [33]. Although this study did not find a statistically significant difference in the incidence of reflux esophagitis and anastomotic stomatitis between the two groups within 1 year after surgery ($P > 0.05$), noteworthy is that the π-type anastomosis group revealed a slightly higher trend in the incidence of anastomotic stomatitis (five out of 13 cases in the overlap group vs. six out of 11 cases in the π-type group). This phenomenon may be related to the antiperistaltic design of the π-type anastomosis as antiperistaltic anastomosis may increase the local friction when food passes through, potentially leading to a higher risk of chronic mucosal inflammation. Similar findings have been reported by Kawakatsu et al., who observed that the incidence of mucosal hyperemia under endoscopy after antiperistaltic anastomosis was 15% higher than that in the peristaltic group ($P = 0.08$) [34]. Additionally, the shorter jejunal loop in the π-type anastomosis may reduce the mixing time of food with bile and pancreatic juice. Hirahara et al. found that the incidence of anemia in the π-type anastomosis group was 9.2% higher than that in the overlap group 5 years after surgery ($P = 0.04$) [35], which suggests that we need to conduct long-term monitoring of the nutritional indicators of patients.

This study had some limitations. First, the sample size was small due to the strict inclusion and exclusion

criteria. A smaller sample size will lead to a decrease in statistical power, potentially limiting the ability to provide sufficient statistical power to detect the true differences between the two groups. Even if actual differences exist in clinical efficacy, the limited sample size may result in false negative findings. For example, when comparing the long-term efficacy of esophagojejunal π-type anastomosis and overlap anastomosis, subtle but clinically important differences may have gone undetected due to the insufficient sample size. As previous studies have noted, an overly small sample size will increase the risk of type II errors, that is, wrongly accepting the null hypothesis (i.e. failing to detect a true difference between the two groups) [36, 37]. Second, the retrospective nature of this study introduces selection bias in the choice of patient enrollment. Due to the presence of selection bias, baseline characteristics of the patients between the two groups may not be balanced. For example, although factors such as age, sex, BMI, tumor diameter, and tumor pathological TNM staging were compared, other unaccounted factors may still be unevenly distributed between the two groups. These uncontrolled confounding factors may affect the research findings, making it impossible for us to accurately determine whether it is the anastomosis method itself or other factors that have led to the observed differences. Third, the patients were not followed up for 5-year overall survival and progression-free survival, and the effect of the two anastomotic modalities on the long-term prognosis of the patients was not further investigated. We plan to incorporate long-term follow-up data in our future research. Fourth, this was a single-center study.

## Conclusions

Both the overlap method and π-shaped esophagojejunostomy are safe for total laparoscopic PG-DTR, without increasing the incidence of perioperative and short-term complications in patients. The π-shaped esophagojejunostomy offers shorter operative and less anastomotic times compared to the overlap method, making it a more suitable option for patients with DTR in PG and a recommended approach in clinical practice.

### Abbreviations

| | |
|---|---|
| BMI | Body Mass Index |
| DTR | Double-Tract Reconstruction |
| PG | Proximal Gastrectomy |
| TG | Total Gastrectomy |
| TNM | Tumor, Node, Metastasis |
| VAS | Visual Analog Scale |

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Not applicable.

### Author contributions

HH and FX wrote the manuscript and analyzed the data. LLY, LYF, ZLW, LQJ conducted the data collection and analysis. FX, HH and CJX designe the study.

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### Data availability

The datasets during and/or analysed during the current study available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

The study design was approved by the Jiangsu University Affiliated Hospital (approval no: KY2023K0909).

### Consent for publication

All patients provided written informed consent before enrollment in the study and consent for publication.

### Competing interests

The authors declare no competing interests.

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