

Application of double needle-double layer continuous manual suture to complete digestive tract reconstruction in totally laparoscopic distal gastrectomy

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Abstract

Background

Retrospectively register the clinical data of distal gastric cancer patients who received surgical treatment, discuss the safety and feasibility of double needle-double layer continuous manual suture to complete digestive tract reconstruction in totally laparoscopic distal gastrectomy.

Methods

Review the clinical data of 41 patients with distal gastric cancer from the gastroenterology department of the Second Affiliated Hospital of Dalian Medical University, from September 2018 to August 2019, were accepted the totally laparoscopic distal gastrectomy. During the operation, the method of double needle-double layer continuous manual suture was used for Billroth I type anastomosis to complete digestive tract reconstruction. The peri-operative clinical information and postoperative follow-up information were collected for analysis, and the clinical application value was evaluated.

Results

General Information: Male (n = 27), Female (n = 14) Age (65.02 ± 9.94) years, BMI (23.52 ± 2.56) kg/m²; Tumor location: Antrum (32, 78.0%), Angle (6, 14.6%), Body (3, 7.3%); Clinical stage: I (27, 65.9%), II (7, 17.1%), III (7, 17.1%); Operative information: Operation time (154.51 ± 33.37) min, Anastomosis time (26.88 ± 5.11) min; Intraoperative bleeding (66.34 ± 48.81) ml; First postoperative ambulation (1.07 ± 0.26) d, First postoperative flatus (3.07 ± 1.08) d, First postoperative diet (3.41 ± 1.07) d; Postoperative hospital stay (8.76 ± 6.64) d, Total hospitalization cost (70804.00 ± 14282.05) RMB yuan; Differentiation degree: High and high-moderate (3, 7.32%), Moderate and poor-moderate (24, 58.54%) Poor differentiation (14, 34.15%); Dissected lymph node (32.76 ± 13.16), Positive lymph node (2.39 ± 4.06); Pathological stage: IA (20, 48.78%), IB (3, 7.32%), IIA (4, 9.76%), IIB (5, 12.20%), IIIA (1, 2.44%), IIIB (3, 7.32%), IIIC (5, 12.20%); Complications (n = 4): Lung infection (1, 2.44%) Anastomotic leakage (1, 2.44%) Gastroparesis (2, 4.88%);

Conclusion

It is safe and feasible in clinical treatment to apply the method of double needle-double layer continuous manual suture to complete digestive tract reconstruction in totally laparoscopic distal gastrectomy.

Background

In recent years, with the advanced development of laparoscopic techniques, totally laparoscopic gastrectomy has proven to be safe and feasible, especially, Totally Laparoscopic Distal Gastrectomy

(TLDG) [1]. Choosing the ideal method for digestive tract reconstruction in distal gastrectomy is still the focus of controversy. Various methods of anastomoses by stapler has been heavily reported in previous researches such as using linear staplers to perform Delta-shaped anastomosis, Billroth II anastomosis or Roux-en-Y anastomosis[2-4]. However, there are still many problems, such as high anastomotic tension, inaccurate tumor margins and large expenses. Therefore, we started to perform totally laparoscopic hand-sewn Billroth I anastomosis with a new application of double needle-double layer continuous manual suture to complete digestive tract reconstruction and have finished 41 cases by far. We intend to analyze these cases and discuss the relevant issues about the new application in totally laparoscopic distal gastrectomy based on previously published researches and our own experiences.

Methods

1. Materials

Retrospectively register the clinical data of 41 patients with distal gastric cancer from the gastroenterology department of the Second Affiliated Hospital of Dalian Medical University, from September 2018 to August 2019, were accepted the totally laparoscopic distal gastrectomy. During the operation, the method of double needle-double layer continuous manual suture was used for Billroth I type anastomosis to complete digestive tract reconstruction.

Inclusion criteria: 1. Electronic gastroscopy and biopsy pathology diagnosis were used to confirm the distal gastric cancer before operation; 2. Chest and abdominal Computed Tomography(CT) scan confirmed no distant metastasis before operation ; 3. No serious complications of heart, lung and other important organs;

Exclusion criteria

1. Severe cardiopulmonary cerebral dysfunction, which resists general anesthesia and surgery; 2. Severe liver dysfunction, coagulation dysfunction;

The operation was performed by the same senior doctors; The patients and their families signed the informed consent related to the operation; The operations were smooth, and no serious complications occurred in the perioperative period. This study was approved by the Institutional Review Board of The Second Affiliated Hospital of Dalian Medical University.

2. Methods

2.1 No gastric tubes were placed before all the operations. All the operations were performed using the German Braun AESCULAP 3D HD laparoscopic system. The anesthesia mode, body position, and trocar position of the puncture were shown in Fig. 1. According to the 15th edition of Japanese Classification of Gastric Carcinoma, the laparoscopic distal gastrectomy and D2 lymph node dissection were performed.

2.2 Digestive tract reconstruction

2.2.1 Anastomotic placement

The duodenum and the great curvature of remnant stomach were occluded by the interdiction clamps about 2 cm away from the predetermined position of the anastomotic opening to block the reflux of digestive fluid. Then the great curvature of remnant stomach was cut through the whole layer of the gastric wall by the ultrasonic knife, its size was equal to the width of the duodenum, and the two were placed side by side;

2.2.2 The first needle to continuous suture of sarcoplasmic layer of the posterior wall

First, The upper and lower margins of the posterior duodenal wall are sewn with one stitch each to the seromuscular layer of the posterior gastric wall to obtain relative immobilization between the duodenal stump and the remnant stomach, and then the posterior wall of the remnant stomach and the posterior wall of the duodenum were sutured continuously from the top to the bottom with the absorbable reverse needling line (Covidien VLOCL0614), and the needles were kept for standby;

2.2.3 The second needle to continuous suture of the whole layer from the posterior wall to anterior wall

The second absorbable reverse needling line (Covidien VLOCL0614) was sewed continuously from bottom to top in the whole layer of the posterior wall of the anastomosis, then it was changed to the Cornell suture method to sew the whole layer of the anterior wall of the anastomosis until the starting point of the second needle, and the anastomosis was completely closed;

2.2.4 The first standby needle to continuous suture of sarcoplasmic layer of the anterior wall

From the bottom to the top, the sarcoplasmic layer anastomosis of the anterior wall was continuously sutured with the first standby needle to complete the embedding of the sarcoplasmic layer of the anastomosis.

2.2.5 Release the interdiction clamps

Release the interdiction clamps at the both sides of the anastomose, complete the reconstruction of the digestive tract. If necessary, electronic gastroscope can be used to check the internal patency of the anastomose and whether there are bleeding and weak points.

See Fig. 2 for details.

3. Observation index

3.1 General Information: Age, Sex, BMI, Previous abdominal surgery, Tumor location, Clinical stage;

3.2 Surgical Information: Operation time, Anastomosis time, Intraoperative bleeding; Tumor diameter, Tumor margin, Dissected lymph node, First postoperative ambulation, First postoperative flatus, First

postoperative diet, Postoperative hospital stay, Total hospitalization cost; Differentiation degree, Pathological stage; Complications

3.3 Postoperative follow-up Information: reexamination of upper gastric imaging and gastroscopy.

4. Statistical method

All data analysis was done by SPSS 24.0 statistical software. The count data was measured by χ^2 test, the normal distribution measurement data was described by $\bar{x} \pm s$, and the skewed distribution measurement data was described by median M (range), and the standard level α is 0.05, the difference was statistically significant when $p < 0.05$.

Results

1. General Information

41 patients were included in this study, containing 27 males and 14 females; The mean age was (65.02 ± 9.94) years; The mean BMI was (23.52 ± 2.56) kg/m²; The tumor location was also counted: Antrum (32, 78.0%), Angle (6, 14.6%), Body (3, 7.3%); The tumor clinical stage: I (27, 65.9%), II (7, 17.1%), III (7, 17.1%);

As show in the Table 1.

Table 1
General Information

Index	n = 41
Age(years)	65.02 ± 9.94
Sex(M/F)	27/14
BMI(kg/m ²)	23.52 ± 2.56
Previous abdominal surgery(n)	2(13.3%)
Tumor location	
Antrum	32(78.0%)
Angle	6(14.6%)
Body	3(7.3%)
Clinical stage	
I	27(65.9%)
II	7(17.1%)
III	7(17.1%)
IV	0
The data were expressed as mean ± SD or number(%)	
<i>F</i> female, <i>M</i> male	

2. Surgical Information

The mean duration of the operation was (154.51 ± 33.37)min and the mean time to complete the anastomosis was (26.88 ± 5.11)min, as show in Fig. 3. The intraoperative bleeding was (66.34 ± 48.81) ml;The mean tumor diameter was (3.07 ± 1.68)cm. The proximal tumor margin was (5.09 ± 1.47)cm. The distal tumor margin was (3.23 ± 1.28)cm. Dissected lymph node was (32.76 ± 13.16), and positive lymph node was (2.39 ± 4.06); Differentiation degree: High and high-moderate(3,7.32%), Moderate and poor-moderate (24,58.54%),Poor differentiation (14,34.15%); Postoperative pathological TNM stage results reported 23 cases in stage I: IA (20,48.78%), IB (3,7.32%); 9 cases in stage II:IIA (4,9.76%), IIB (5,12.20%); And 9 cases in stage III:IIIA (1,2.44%), IIIB (3,7.32%), IIIC (5,12.20%);

Of the 41 patients, no serious complications occurred but four controllable ones: one case of postoperative pulmonary infection(1, 2.44%), one case of anastomotic leakage(1, 2.44%), two cases of gastroparesis(2, 4.88%). All the above patients recovered after conservative nonoperative treatment;

All patients were able to get out of bed the first day after operation. First postoperative ambulation was (1.07 ± 0.26) days, First postoperative flatus was (3.07 ± 1.08) days. First postoperative diet was (3.41 ± 1.07) days. Postoperative hospital stay was (8.76 ± 6.64) days, and total hospitalization cost was (70804.00 ± 14282.05) RMB yuan;

As show in the Table 2.

Table 2
Intraoperative and postoperative Information [means \pm standard deviations, n(%)]

Index	n = 41
Operation time (min)	154.51 \pm 33.37
Anastomosis time ^a (min)	26.88 \pm 5.11
Intraoperative bleeding (ml)	66.34 \pm 48.81
Maximal tumor diameter (cm)	3.07 \pm 1.68
Proximal tumor margin (cm)	5.09 \pm 1.47
Distal tumor margin (cm)	3.23 \pm 1.28
Dissected lymph node (n)	32.76 \pm 13.16
Positive lymph node (n)	2.39 \pm 4.06
First postoperative ambulation (day)	1.07 \pm 0.26
First postoperative flatus (day)	3.07 \pm 1.08
First postoperative diet (day)	3.41 \pm 1.07
Postoperative hospital stay (day)	8.76 \pm 6.64
Total hospitalization cost (CNY)	70804.00 \pm 14282.05
Differentiation degree	
High and high-moderate differentiation	3(7.32)
Moderate and poor-moderate differentiation	24(58.54)
Poor differentiation	14(34.15)
Pathological stage	
IA	20(48.78)
IB	3(7.32)
IIA	4(9.76)
IIB	5(12.20)
IIIA	1(2.44)
IIIB	3(7.32)

The data were expressed as mean \pm SD or number (%), as appropriate

^a The time from suturing the seromuscular layer of posterior duodenal wall and gastric wall to the seromuscular suture completed of the anterior wall of anastomotic stoma

Index	n = 41
IIIC	5(12.20)
IV	0
Complications	
Lung infection	1(2.44)
Anastomotic leakage	1(2.44)
Gastroparesis	2(4.88)
The data were expressed as mean ± SD or number (%), as appropriate	
^a The time from suturing the seromuscular layer of posterior duodenal wall and gastric wall to the seromuscular suture completed of the anterior wall of anastomotic stoma	

3. Postoperative Follow-up Information

All the patients returned visit in the outpatient department when the 1st and 3th month after operation. All Patients exhibited a satisfactory appetite, and there was no discomfort symptom such as abdominal pain and bloating. The upper gastrointestinal imaging showed that the anastomosis was unobstructed as the contrast agent smoothly entered the duodenum (Fig. 4). Gastroscope examination 3 months after the operation showed that the anastomosis was well healed and there was no stenosis (Fig. 5).

Discussion

Totally laparoscopic gastrectomy has shown distinct advantages comparing to laparoscopic-assisted gastrectomy^[4-6]. In totally laparoscopic distal gastrectomy, digestive tract reconstruction has been a key and difficult part of the surgery. At present, various anastomotic methods have their own advantages and disadvantages. For patients with lower gastric cancer, most of them underwent Delta-shaped anastomosis, Billroth II anastomosis or Roux-en-Y anastomosis by stapler^[1, 7, 8]. The Billroth I anastomosis is considered to be more in line with the human physiology and anatomy, so it has been favored by surgeons. So far, triangle-shaped anastomosis or modified triangle-shaped anastomosis by stapler is the mostly chosen kind of Billroth I anastomosis^[7, 9]. Totally laparoscopic triangle-shaped anastomosis by stapler requires overlapping the remnant stomach wall and duodenum, theoretically wasting part of the remnant stomach wall and duodenal wall and increasing the anastomotic tension. At the same time, dissecting tumors located higher or near the gastric body is prone to cause insufficient margins, thus greatly limiting the indications for totally laparoscopic Billroth I anastomosis^[10]. Billroth II anastomosis can lead to reflux gastritis due to bile reflux, which could increase the incidence of remnant gastric cancer^[11]. As a result, it has fallen out of favor for digestive tract reconstruction. Roux-en-Y anastomosis requires two anastomoses, and thus increases the number of intestinal stumps, which

requires rather complicated steps. Also, like Billroth II anastomosis, Roux-en-Y anastomosis does not highly conform to the human physiology and anatomy^[8, 12]. If postoperative complication of biliary tract diseases such as bile duct stones occur, ERCP and other tests cannot be performed. Totally laparoscopic hand-sewn Billroth I anastomosis can avoid the shortcomings of both Roux-en-Y anastomosis and Billroth II anastomosis.

Indications

At present, there is no published researches at home and abroad yet on hand-sewn Billroth I anastomosis in digestive tract reconstruction after totally laparoscopic distal gastrectomy for the treatment of lower gastric cancer. Our team developed a hand suture technique to directly perform standard end-to-end anastomosis of the remnant stomach and duodenal stump. Similar to hand-sewn Billroth I anastomosis in open gastrectomy, this method could reserve partial walls of the remnant stomach and duodenum compared with triangle-shaped anastomosis by stapler, ensuring sufficient tumor margins and radical dissection of tumor tissues. Therefore, operative indications for totally laparoscopic Billroth I anastomosis can be greatly broadened and the difficulty of the surgery can be ultimately reduced. Our team concluded that indications for totally laparoscopic hand-sewn Billroth I anastomosis should be equivalent to that of traditional Billroth I anastomosis in open gastrectomy under mature cooperation of skilled surgeons.

Safety And Feasibility

In our study, the mean duration of the operation was 154.51 ± 33.37 min and the mean time to complete the anastomosis was 26.88 ± 5.11 min (Fig. 3). The amount of intraoperative bleeding was 66.34 ± 48.81 mL. There was no significant statistical difference in terms of operation time between anastomosis by stapler vs by hand^[13]. Lymph node dissection was performed strictly according to the standard radical (D2) lymphadenectomy. The number of lymph nodes was 32.76 ± 13.16 , of which the number of positive ones was 2.39 ± 4.06 , accounting for 7.47%. The number of dissected lymph nodes was much more than that required by Japanese Classification of Gastric Carcinoma. The pathological examination of the proximal and distal margins of the specimens was negative, also, tumor-free distance of both proximal and distal margins is within the required range (Table 2). Therefore, radical dissection could be guaranteed. Gastrointestinal imaging showed normal gastric emptying on the 6th postoperative day (Fig. 4). Only 1 patient developed pulmonary infection and received anti-infective treatment. One patient developed anastomotic leakage, received unobstructed surgical drainage and placed into nasoenteral nutrition tube for enteral nutrition support, and recovered 2 weeks later. There was two cases of gastroparesis who recovered on the 18th and 25th day after operation respectively by gastrointestinal decompression and nasoenteral nutrition tube through gastroscope for enteral nutrition. All the above patients recovered after conservative nonoperative treatment. All 41 patients recovered well and were follow up after surgery, no serious complications or perioperative death occurred

The patient returned visit at the 3th months after surgery and gastroscopic results showed unobstructed anastomosis and smooth mucosa (Fig. 5). In addition, total hospitalization cost for this group of patients was (70804.00 ± 14282.05)RMB yuan, which was significantly lower than that reported by Shinohara T, Wang Y and others^[14, 15]. The results above indicate that totally laparoscopic hand-sewn Billroth I anastomosis is a safe and feasible method for digestive tract reconstruction.

Advantages

Totally laparoscopic hand-sewn Billroth I anastomosis has the following advantages: (1) It conforms to human anatomy and physiology. Totally laparoscopic hand-sewn Billroth I anastomosis manages to save the continuity of digestive tract and the feedback mechanism of autocrine and paracrine, which are more consistent with the normal physiological structure. Therefore, reflux gastritis caused by bile reflux can be avoided^[3]. (2) A clear field of vision during totally laparoscopic hand-sewn Billroth I anastomosis is guaranteed. Compared with other anastomotic methods, this one is limited to the right upper abdomen. There is no need to frequently change the field of vision, which can decrease the difficulty of assistant coordination. (3) The number of anastomoses is decreased, which reduces complications such as anastomotic bleeding and leakage. Under skilled cooperation of teamwork, time of total operation and time of anastomosis by hand were not significantly longer than those by staplers^[13]. Besides, the operation time was gradually reduced with the extension of the learning curve (Fig. 4). (4) The hand-sewn anastomosis is relatively smooth comparing to anastomosis by stapler which is prone to have overlapped corners or “Dog ear” causing higher risk of anastomotic leakage as well as adhesion. (5) Fully ensure the resection range and reduce anastomotic tension. Hand-sewn Billroth I anastomosis is a standard end-to-end anastomosis, which could reserve the overlapped gastroduodenal wall wasted in triangle-shaped anastomosis by stapler. (6) Mesenteric hiatal hernia and Peterson hernia can be avoided in hand-sewn Billroth I anastomosis. (7) Decreased complications such as adhesive ileus. This procedure is limited to the right upper abdomen, which could reduce potential mechanical stimulation and mucosal damage to jejunum therefore decreasing the incidence rate of postoperative intestinal adhesion.

Difficulties And Countermeasures

Although totally laparoscopic hand-sewn Billroth I anastomosis has many advantages, it is still a very difficult technique for some surgery teams that newly start practicing totally laparoscopic hand-sewn Billroth I anastomosis. For example, it has been previously reported that intra-abdominal anastomosis can increase the incidence rate of abdominal infection^[16]. In our study, bulldog clamp was used to block the gastric and duodenal stumps respectively to avoid intestinal fluid leakage, and not removed until full-thickness anastomosis was completed. Also, the surgical team needs to discuss in advance about the specific anastomosis steps in great details to achieve perfect cooperation^[17].

Conclusions

Double needle-double layer continuous manual suture is a better method of digestive tract reconstruction compared with that by stapler in totally laparoscopic distal gastrectomy, as it not only ensures the completion of Billroth I anastomosis, but also ensures sufficient tumor margins and reduces anastomotic tension. Besides, it can reduce the operation cost to a certain extent. The way of double needle-double layer continuous manual suture to complete digestive tract reconstruction in totally laparoscopic distal gastrectomy is a safe and feasible method. It is worth further discussion and practice, and prospective controlled studies of large samples are needed.

Abbreviations

Totally Laparoscopic Distal Gastrectomy (TLDG)

Computed Tomography(CT)

Declarations

Ethics approval and consent to participate

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1964 and later versions. The study has been granted an exemption from the Ethics Committee of the Second Affiliated Hospital of Dalian Medical University Ethics Committee; Informed consent was obtained from all individual participants included in the study.

Consent for publication

All authors agreed with the content and all gave explicit consent for publication.

Availability of data and materials

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Competing interests

There is no conflict of interest in this research.

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Authors' contributions

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by WB Z, ML Y, XM S, HY C, Z F, ZH C, DB L, EJ Y. Dr. SY R summarized the overall treatment plan, designed the experimental ideas, checked the experimental data, calculated the statistical data. The first draft was written by Dr.XS Z and the previous versions of the manuscript were commented by all the other authors. The final manuscript was read and approved by all the authors.

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Figures

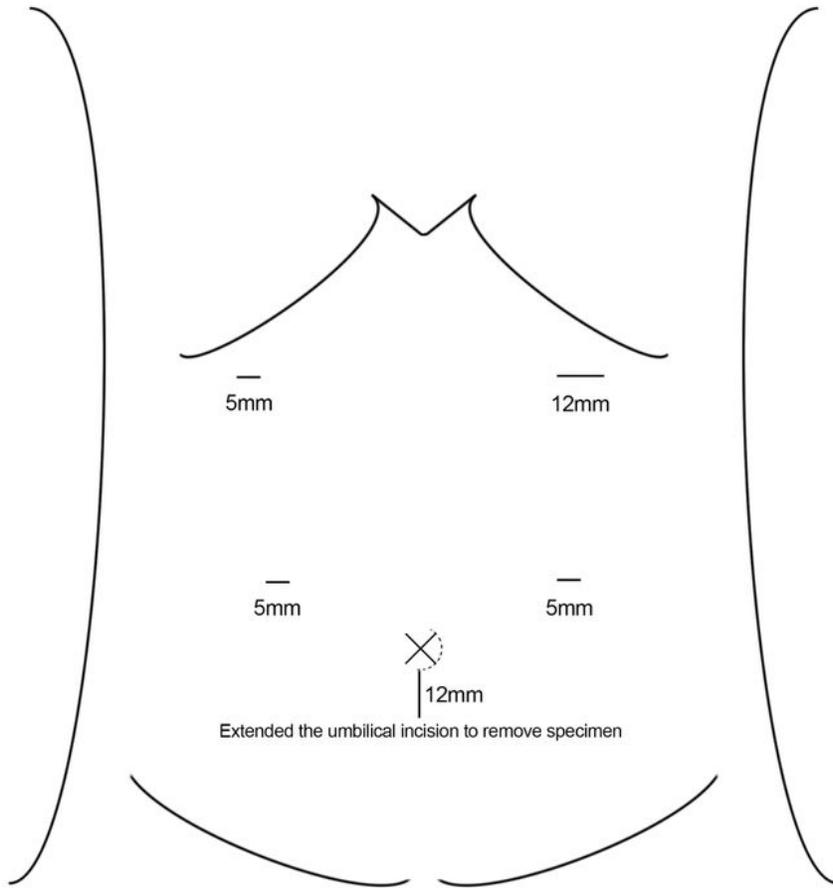


Fig 1

Figure 1

Placement of trocars. Two 12-mm and three 5-mm trocars were used in operation. The 12 mm trocar below the umbilicus is used as the observation hole, and another 12 mm trocar is the main operation hole.

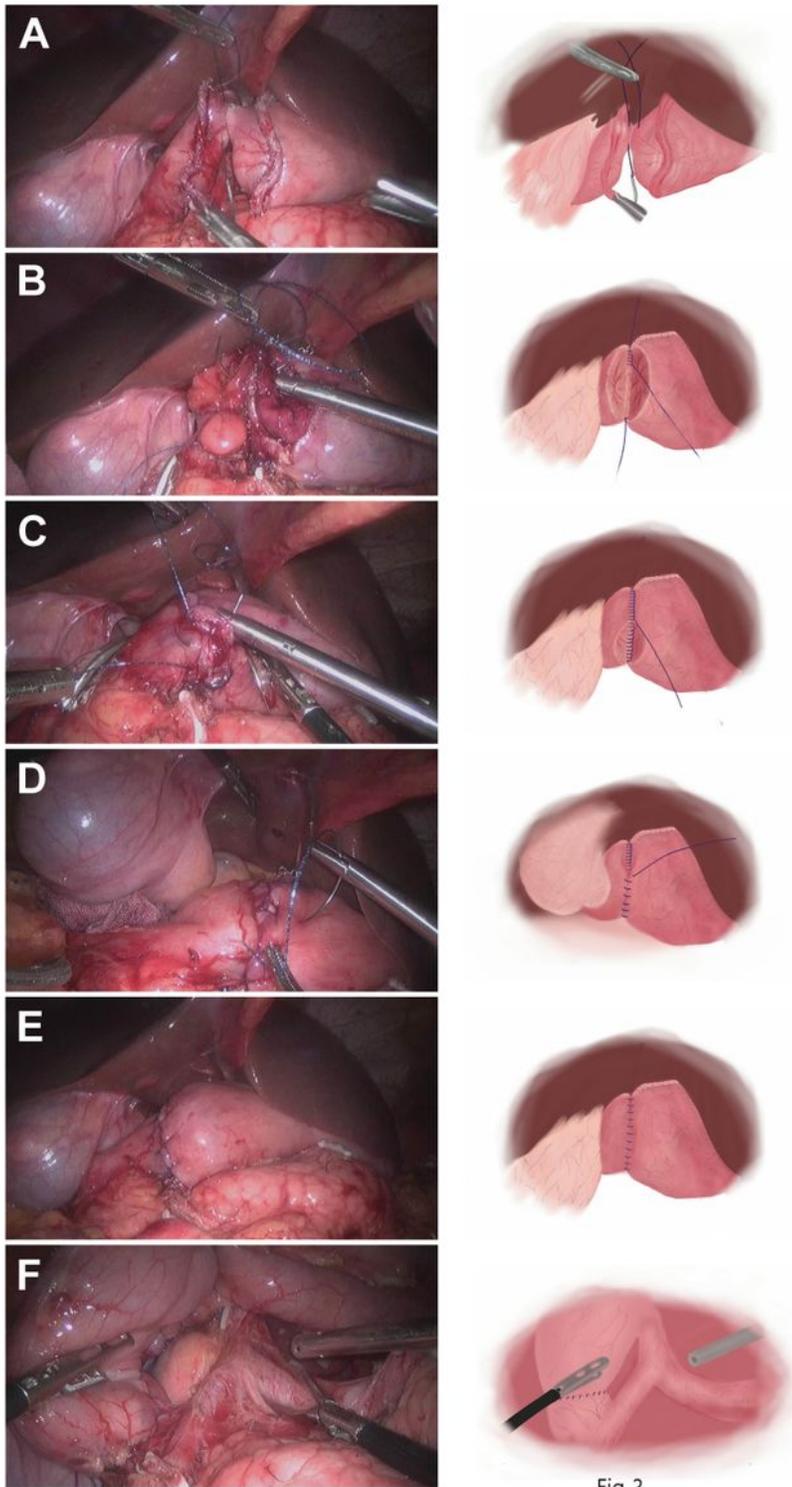


Fig 2

Figure 2

Step of double needle-double layer continuous manual suture to complete digestive tract reconstruction in TLDG (Video capture of anastomotic procedure and sketch of anastomosis). A The first needle to continuous suture of sarcoplasmic layer of the posterior wall from the top to the bottom with the absorbable reverse needling line B The second needle to continuous suture of the whole layer from the posterior wall to anterior wall. C The second needle to Cornell suture the whole layer of the anterior wall of

the anastomosis D The first standby needle to continuous suture of sarcoplasmic layer of the anterior wall. E Display of anastomotic anterior wall. F Display of anastomotic posterior wall.

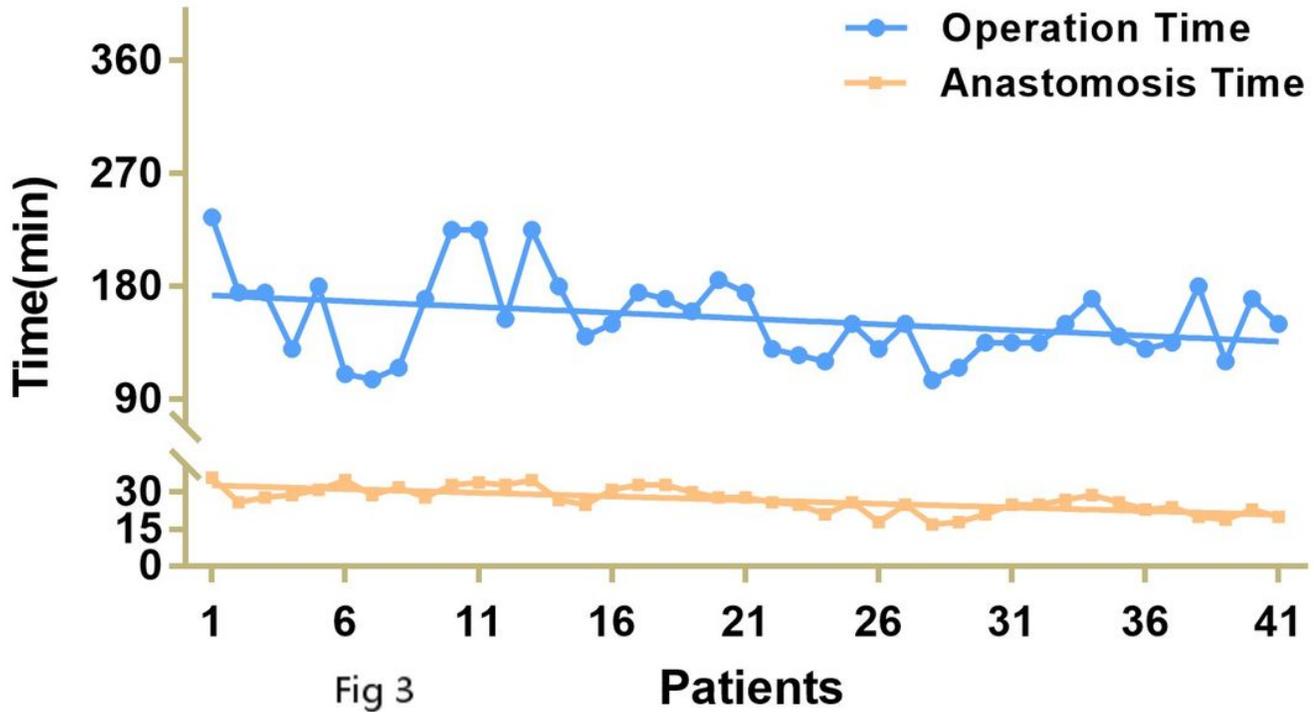


Figure 3

Time of the total operation and the hand-sewn anastomosis of each patient. The hand-sewn anastomosis procedural time was defined as the time from suturing the seromuscular layer of posterior duodenal wall and gastric wall to the seromuscular suture completed of the anterior wall of anastomotic stoma.

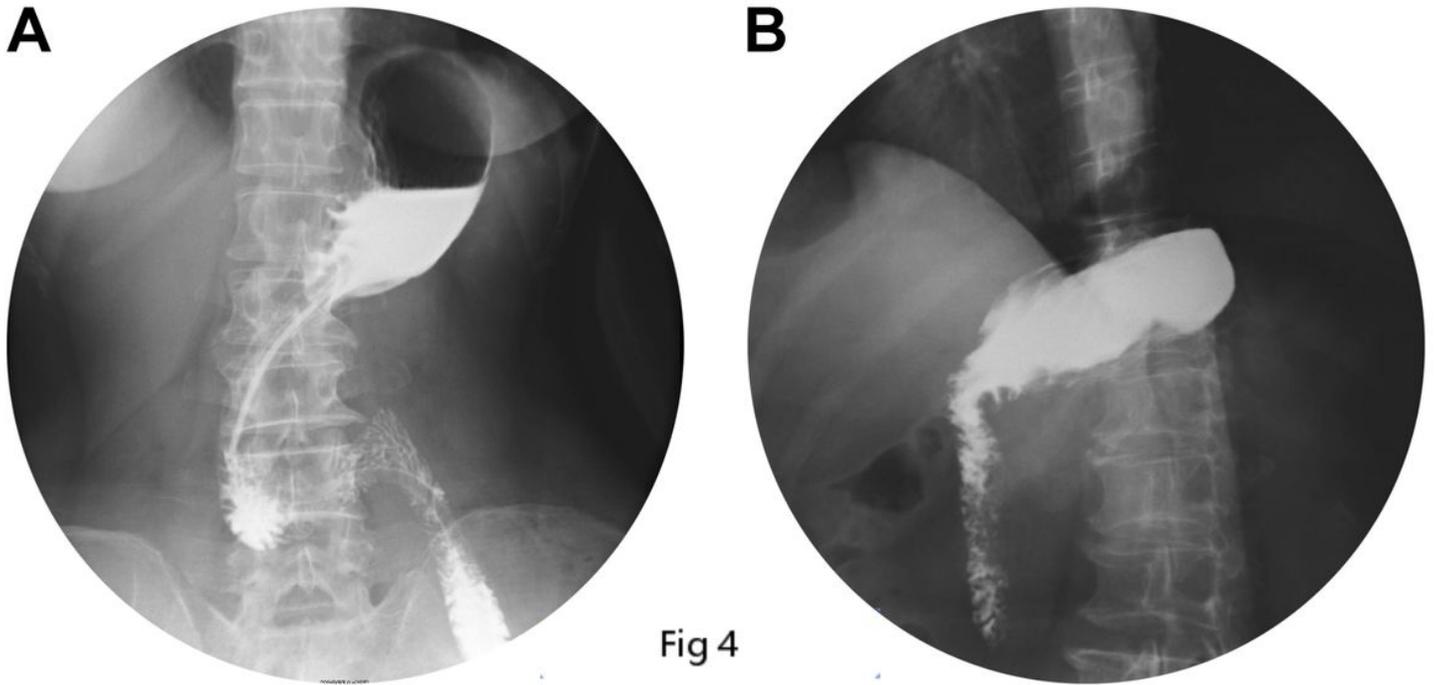


Fig 4

Figure 4

Upper gastrointestinal imaging 6 days and 1 month after operation. A X-ray performed 6 days after the operation shows that the anastomotic stoma was unobstructed and there was no anastomotic leakage. B X-ray imaging performed 1 month after the operation.

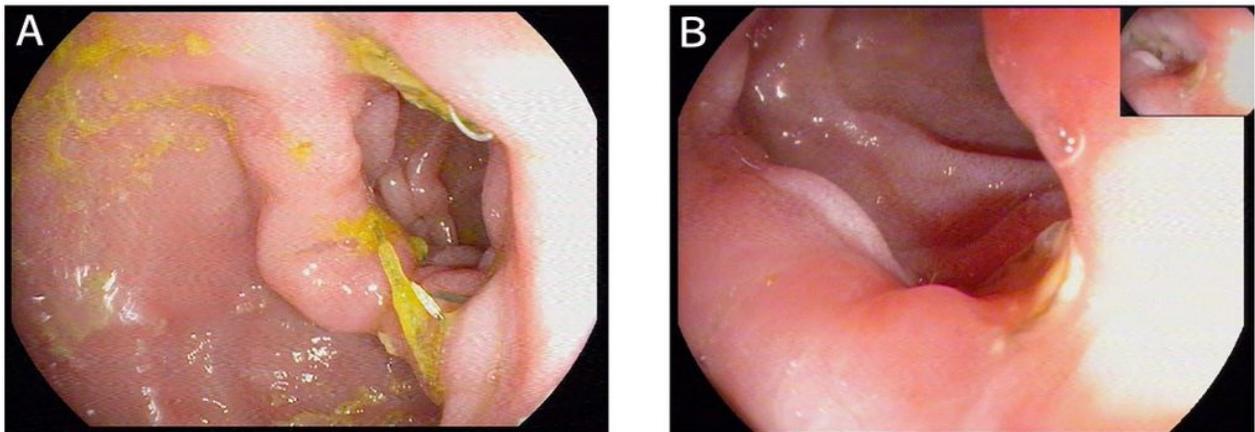


Fig 5

Figure 5

Gastroscopic images of anastomosis 1 months and 3 months after the operation. A Gastroscopic view at postoperative 1 months after the hand-sewn anastomosis procedure. B Gastroscopic view at postoperative 3 months after the hand-sewn anastomosis procedure.

Supplementary Files

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