Clinical Outcomes of Laparoscopic Proximal Gastrectomy with Double Tract Reconstruction in Early Stage of Siewert type II for Adenocarcinoma of Esophagogastric Junction

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Research Article

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Abstract

Objective: The aim of the current study was to investigate the surgical related complication rates, nutritional status, prognosis and the quality of daily life following laparoscopic proximal gastrectomy (LPG) with double tract reconstruction in comparison to those of laparoscopic total gastrectomy (LTG) for Siewert type II adenocarcinoma of esophagogastric junction in three tertiary institutions.

Methods: We compared the postoperative outcomes of the two surgical approaches using a well-characterized cohort of early stage gastric carcinoma patients through a retrospective review between January 2017 and December 2018. Both groups were compared regarding patient characteristics, surgical results, the change of body mass index, serum hemoglobin, albumin, vitamin B12 and quality of life (QoL). QoL was assessed by the Chinese version of Quality of Life Questionnaire Oesophagogastric-25 (QLQ-OG25). The incidence of reflux esophagitis, dumping syndrome, and retention syndrome, were also compared to evaluate postoperative restoration.

Results: Both study groups were comparable with respect to general patient characteristics. No mortality and no significant differences were found for QoL and surgery-related data except operation time (p < 0.05). The LPG group was associated with a better recovery of body mass index, a fewer incidence of reflux complications and better nutrition parameters (p < 0.05) than the LTG group.

Conclusions: In this study, double tract reconstruction after a LPG procedure is safe for gastroesophageal junction cancer. It is superior to the LTG with respect to less incidence of reflux disease, better body weight and improved postoperative nutrition status.

Introduction

The incidence of adenocarcinoma of the esophagogastric junction (AEG) has been increasing worldwide, which attracts great attention among medical professionals because of its anatomical location and unique biological behavior. A classical clinical system based on the relationship between tumor center and the area of the esophagogastric junction (EGJ) was first established by Siewert in 1987 [1]. In this recognized system, the AEG is divided into three types: Siewert type I: the tumor center is 1 cm-5 cm above the EGJ and grows downward and invades it; Siewert type II: the tumor center is 1 cm above or 2 cm below the EGJ and invades it; Siewert type III: the tumor center is 2 cm-5 cm below the EGJ and invades it. The most frequently used therapeutic modality for AEG is surgical resection.

As a special tumor across the thoracic and abdominal anatomic areas, AEG has certain particularity surgical path and resection range of esophagus and stomach, which is a problem to be explored. The worldwide standard recommendation for the Siewert type II and III is still total gastric resection, especially for the advanced stage of AEG. But, complications including anemia, weight loss and dumping syndrome after TG are depressing. A recent review of literature reporting proximal gastrectomy on treatment of early stage showed an encouraging postoperative five-year survival rate and recurrence rate [2]. As the surgical options available for the treatment of Siewert type II of AEG increase, the ability to acquire a better recovery and quality of life postoperatively takes on great importance.

An ideal digestive tract reconstruction after LPG is most likely associated with rare complications and a better quality of life. QoL is a medical recognized outcome measure in the choice of patients received different surgical process with gastric cancer [3]. Recently, LPG with double tract reconstruction (DTR) is considered to be a less...
invasive surgical approach for the early stage of Siewert type II AGE patients with a result of better nutritional status and QoL. This technique minimizes the morbidity of the reflux disease and saves partial stomach that would maintenance the normal gastro-duodenal channels.

The aim of the current study was to investigate the surgical related complication rates, nutritional status, prognosis and the quality of daily life following LPG with DTR in three tertiary institutions. For this purpose we have used defined and validated scoring system to evaluate postoperative functional outcomes as reported in the previous study[4, 5]

Materials And Methods

Double –tract reconstruction technique

Radical resection of Siewert type II of AGE with D1 lymph node dissection was done as previous study[6]. After the proximal stomach is removed, conventional RY reconstruction was done. In general, an ideal jejuna loop must be long (35-40cm), mobile and well vascularized to reach the esophagus with no tension. We usually choose the area of the jejunum distal to the ligament of Treitz while protecting the mesenteric vessel arcade. Firstly, the anvil with a diameter of 25mm is applied at the stump of the esophagus and purse-string suture is tied, then a matched circular stapler is carefully inserted into the jejunal pouch bringing the jejunum loop in front of the transverse colon. After attaching the anvil to the central rod, the stapler device is fired to complete the esophago-jejunostomy. Secondly, a side to side gastrojejunostomy is finished using ECHELON FLEX 29mm columnar stapler cutter at a distance about 10-15cm far from the esophagojejunostomy on the anterior wall of the great curvature of residual stomach(Fig. 1). So, the food can be divided into the remnant stomach through the duodenum and jejunum maintaining the continuity of the digestive tract. Finally, a roux-en-y type jejunojjunostomy is performed using 25mm ETHICON circular stapler, about 15-20cm far from the gastrojejunostomy, to maintain the intrinsic physiological biliopancreatic passage.

This technique consists of three anastomoses(Fig. 2): gastrojejunostomy is 10–15 cm below the EJA and the jejunojjunostomy is 20–25 cm below the gastrojejunostomy. Double-tract reconstruction therefore preserved the partial stomach and pylori to the conventional TG with differ reconstruction methods. Unlike jejunal interposition, this method maintains the continuity of the upper digestive tract, making it easier to perform. Furthermore, it has a dual route for food passage, reducing the incidence of delayed food emptying obstacle.

Patient selection

Eighty-seven patients diagnosed with Siewert type II of AGE at three tertiary hospitals (the Central Hospital of Wuhan/NO.1 hospital of wuhan/the Central hospital of yichang) between January 2017, and December 2018, were involved in this study. The inclusion and exclusion criteria in patient selection are shown in Table 1. All preoperative and postoperative data were reviewed by using institutional surgical database involved in this research. The clinical pathologic data, outcomes after surgery were shown in Table 2.
| **Inclusion criteria**                                                                 |
|--------------------------------------------------------------------------------------|
| Siewert type II adenocarcinoma of esophagogastric junction is diagnosed before operation. |
| Total gastrectomy with RY anastomosis or Proximal gastrectomy with double tract reconstruction was done. |
| No distant transfer, radical surgery was confirmed R0 resection by postoperative pathological test. |
| Voluntary to accept and complete the postoperative questionnaires of quality of life during the follow-up period. |

| **Exclusion criteria**                                                                 |
|--------------------------------------------------------------------------------------|
| History of radiotherapy and/or chemotherapy or targeted drug therapy before surgery |
| History of other malignant disease.                                                   |
| Gastrointestinal dysmotility caused by diabetes, Parkinson’s disease or other diseases can influence the GI motility. |
| Lack of clinical data                                                                 |

Table 1
Subject inclusion criteria
Table 2
General information and surgical results

| Variables                  | EJA after LTG | DTR after LPG | p     |
|---------------------------|---------------|---------------|-------|
|                           | (n = 45)      | (n = 42)      |       |
| Age (years)               | 59.7 ± 5.5    | 59.1 ± 7.1    | 0.730*|
| Gender (male/female)      | 28/17         | 30/12         | 0.363†|
| Body mass index           | 23.36 ± 1.93  | 22.71 ± 2.49  | 0.349*|
| Operative time (min)      | 260.2 ± 22.1  | 205 ± 11.8    | 0.001*|
| Blood loss (ml)           | 258.7 ± 91.3  | 210.5 ± 63.4  | 0.056*|
| Complications             | 10/35         | 13/29         | 0.356†|
| Anastomotic fistula       | 3             | 2             |       |
| Anastomotic bleeding      | 1             | 2             |       |
| Pneumonia                 | 4             | 5             |       |
| Intestinal obstruction    | 2             | 4             |       |
| Stage of disease (AJCC 7th ed.) | 19/26 | 15/27         | 0.534†|
| T1N0M0                    | 19            | 15            |       |
| T1N1M0 T2N0M0             | 26            | 27            |       |
| Time to sips of water (d) | 4(3–5)        | 4(3–6)        | 0.676‡|
| Time to liquid diet (d)   | 8(6–9)        | 8(6–10)       | 0.883‡|
| Postoperative stay (d)    | 11.5(10–15)   | 11(10–15)     | 0.486‡|

Data are presented as number of patients (%) or mean ± SD or median (range), as appropriate.
* Student t-test †Chi-square test ‡Mann-Whitney U test

**Functional outcome and nutritive data assessment**

To evaluate the quality of life after surgery, one validated and internationally accepted instrument was employed in this research for data collection: Quality of Life Questionnaire Oesophagogastric-25 (QLQ-OG25). The QLQ-OG25 questionnaires were divided into the 13 categories like eating restrictions, dysphasia, reflux, pain, anxiety, body image, taste, dry mouth, and hair loss described previously designing especially for patients with malignant diseases undergoing surgery[7, 8]. In general, the higher scores in the functional scales of the QLQ-OG25 represented a poor postoperative recovery. Moreover, total plasma protein, prealbumin, serum hemoglobin, and vitamin B12 levels were also used to evaluate nutritional condition in this research. All assessments were carried out at 1\3\6 months and 1 year after operation. Data were collected through the outpatient clinic as well as through a telephone interview.
**Statistical Analyses**

Variables that fulfilled the criteria for a normal distribution were analysed using the Kolmogorov–Smirnov test, and normally distributed data were expressed as mean ± SD, followed by a two-tailed Student's t tests to determine the P values. Chi-square was used for enumeration data consisted of categorical variable. Statistical analyses were performed using SPSS software, version 21.0 (SPSS, Chicago, IL, USA). A difference between groups with a p-value of <0.05 were considered statistically significant.

**Results**

Only patients who completed the entire follow-up were included in the analysis. Forty-two patients received LPG with DTR gastrojejunostomy, and the rest 45 patients underwent the TG with conventional EJA reconstruction. No significant differences were found between groups regarding demographic or clinical characteristics (Table 2). We considered the cohort is suitable for comparing the outcomes between the LPG with DTR and the LTG with EJA procedure. No mortality was found during the whole study cycles. Anastomotic complications were low (5.7%). The common complications directly related to surgery were pneumonia (10.3%), ileus (6.9%). No statistical significance was confirmed within the two different digestive tract reconstruction styles with respect to any of the factors that were directly linked to expected operation time (260.2 ± 22.1 vs 205 ± 11.8, p < 0.001). Other serious surgical complications like peritoneal abscess, pancreatic fistula, were not found in our cohort, patients in general satisfied with surgical outcomes, and the vast majority of patients reiterated that they would opt for each reconstruction way again, given the similar conditions. Both the body weight changes and nutritional index show a descending trend after surgery. In practical terms, at the point of 6 month follow up, the condition of serum hemoglobin, vitamin B12 level and loss of weight was inferior in the LTG group as compared to that in the LPG with DTR procedure, and the difference was statistically significant (Table 3);
### Table 3
Comparison of clinical and laboratory parameters

| Variables          | Time      | EJA after LTG | DTR after LPG | p      |
|--------------------|-----------|---------------|---------------|--------|
|                    | (n = 42)  | (n = 39)      |               |        |
| **BMI**            | 1month    | 23.36 ± 1.93  | 22.71 ± 2.48  | 0.349  |
|                    | 3month    | 21.48 ± 1.92  | 21.89 ± 2.46  | 0.554  |
|                    | 6month    | 20.69 ± 1.62  | 22.00 ± 2.34  | 0.041* |
|                    | 1year     | 21.01 ± 1.65  | 22.61 ± 2.51  | 0.018* |
| **Hemoglobin (g/l)**| 1month    | 131.1 ± 8.2   | 129.4 ± 6.7   | 0.461  |
|                    | 3month    | 110.2 ± 7.9   | 113.5 ± 4.2   | 0.103  |
|                    | 6month    | 110.5 ± 6.3   | 115.7 ± 5.1   | 0.006* |
|                    | 1year     | 110.9 ± 5.9   | 117.2 ± 5.1   | 0.001* |
| **Albumin (g/l)**  | 1month    | 43.5 ± 2.9    | 42.5 ± 2.3    | 0.255  |
|                    | 3month    | 37.0 ± 2.6    | 36.9 ± 2.5    | 0.848  |
|                    | 6month    | 37.1 ± 2.5    | 37.0 ± 2.5    | 0.958  |
|                    | 1year     | 40.2 ± 3.4    | 40.3 ± 3.9    | 0.984  |
| **Vitamin B₁₂ (pg/ml)**| 1month    | 728.8 ± 54.2  | 713.6 ± 58.6  | 0.387  |
|                    | 3month    | 614.6 ± 51.4  | 604.9 ± 52.2  | 0.570  |
|                    | 6month    | 499.9 ± 42.0  | 534.1 ± 50.6  | 0.022* |
|                    | 1year     | 498.9 ± 44.0  | 535.8 ± 51.0  | 0.016* |

Data are presented as median ± standard deviation,*represents $p < 0.05$

Follow up was done through outpatient or telephone, deadline was December 2018. Of the 87 patients, 82 patients were followed up with a follow-up rate of 94.3%, a follow-up time of 24 months. During the subsequent follow-up, a similar phenomenon occurred again, the BMI content in LPG group is much closer to preoperative level. Up to 2 years after the operation, the serum albumin level in the LPG group exhibited a better recovery. Interestingly, all the data except vitamin B₁₂ related to postoperative hematologic and nutritional were improved with time in these patients, probably due to a general improvement as diet control and body adaptive capacity in the longer term (Table 3).

For long-term complications, we also do a survey at the last follow up point, the incidence of reflux esophagitis was rare in the LPG group compared to the LTG procedure group, although the difference was not statistically significant. Complaints about dumping syndrome and retention syndrome were more commonly reported in the LTG group during follow-up phone calls but not exhibited a statistically significant difference compared to patients within the LPG group (Table 4). When concerned about the qol of patients after surgery, the majority indicators performed better in the LPG group, although the difference was not statistically significant but dietary restrictions (Table 5).
Table 4  
Short term complication comparison 12 months after surgery

| Variables                  | EJA after LTG | DTR after LPG | p      |
|---------------------------|---------------|---------------|--------|
|                           | Case number ratio | Case number ratio |     |
| Reflux esophagitis syndrome | 5 11.9%       | 3 7.7%        | 0.525† |
| Dumping syndrome          | 2 4.7%        | 1 2.6%        | 0.601† |
| Retention syndrome        | 3 7.1%        | 2 5.1%        | 0.707† |

Data are presented as number of patients (%)†Chi-square test ¶ Fisher's exact test
Table 5
Outcomes about QLQ-OG25 (represented by $x \pm s$ for the two surgical procedures at different times after operation.

| Variables            | Time  | EJA after LTG | DTR after LPG | $p$   |
|----------------------|-------|---------------|---------------|-------|
|                      | (n = 43) | (n = 39)      |               |       |
| Dysphagia            | 6months | 19.1 ± 9.86   | 18.4 ± 7.19   | 0.695 |
|                      | 1year   | 10.9 ± 4.67   | 9.5 ± 2.99    | 0.121 |
| Dietary restrictions | 6months | 14.8 ± 6.18   | 13.7 ± 6.67   | 0.440 |
|                      | 1year   | 10.3 ± 3.13   | 9.1 ± 2.50    | 0.048*|
| Reflux               | 6months | 16.8 ± 10.57  | 18.5 ± 13.71  | 0.541 |
|                      | 1year   | 12.2 ± 9.74   | 13.9 ± 12.09  | 0.473 |
| Anxiety              | 6months | 6.2 ± 10.50   | 7.6 ± 12.09   | 0.536 |
|                      | 1year   | 4.6 ± 6.16    | 5.6 ± 4.56    | 0.417 |
| Hard to eat together | 6months | 5.9 ± 7.70    | 6.4 ± 6.87    | 0.734 |
|                      | 1year   | 5.1 ± 6.19    | 5.8 ± 5.60    | 0.593 |
| Dry                  | 6months | 5.1 ± 5.50    | 5.6 ± 7.27    | 0.712 |
|                      | 1year   | 4.3 ± 3.80    | 5.0 ± 3.14    | 0.536 |
| Dysgeusis            | 6months | 4.2 ± 3.19    | 4.9 ± 5.49    | 0.500 |
|                      | 1year   | 3.3 ± 2.65    | 3.8 ± 4.18    | 0.585 |
| Contour of body      | 6months | 3.5 ± 3.31    | 3.4 ± 3.47    | 0.866 |
|                      | 1year   | 3.6 ± 4.32    | 3.1 ± 4.15    | 0.541 |
| Hard to swallow saliva | 6months | 2.6 ± 4.19    | 1.7 ± 3.05    | 0.270 |
|                      | 1year   | 2.3 ± 3.10    | 1.5 ± 2.26    | 0.210 |
| Choke                | 6months | 8.0 ± 4.91    | 7.5 ± 4.47    | 0.610 |
|                      | 1year   | 7.3 ± 5.64    | 6.8 ± 4.49    | 0.689 |
| Cough                | 6months | 4.0 ± 3.47    | 3.9 ± 3.38    | 0.944 |
|                      | 1year   | 3.9 ± 3.31    | 3.8 ± 3.49    | 0.985 |
| Difficulty speaking  | 6months | 3.0 ± 1.76    | 3.0 ± 1.83    | 0.907 |
|                      | 1year   | 2.6 ± 1.23    | 2.5 ± 1.21    | 0.801 |
| Hair loss            | 6months | 15.3 ± 13.85  | 16.4 ± 11.33  | 0.682 |
|                      | 1year   | 13.1 ± 10.89  | 14.4 ± 10.63  | 0.595 |

Discussion
The incidence of AEG has gradually increased in the past two decades, and the incidence of early gastric cancer has increased sharply in China as the improvement of health consciousness and promoting the endoscopic techniques in basic hospitals\cite{9–11}. Guidelines are available for common surgical options for Siewert type I and III of AEG according to the consensus from the international tumor cooperation group\cite{12, 13}. More recently, Ivor-Lewis esophagectomy with lymph node dissection (mediastinal and partial abdominal lymph nodes) is recommended for the former, in general, it can be treated with reference to distal esophageal cancer\cite{14}. In the event of latter, the patient should receive a total gastrectomy with D2 lymph node dissection. Treatment of Siewert type II traditionally consisted of surgical resection with proximal stomach for early stage smaller-size tumor and total gastrectomy for larger, invasive tumor. However, it is well documented that proximal gastrectomy with remnant stomach-esophageal anastomosis alone usually results in high anastomotic leakage rate due to reflux esophagitis and delayed gastric emptying\cite{15}. Thus, it is extremely important that an appropriate digestive tract reconstruction has been associated with a decrease rate of complications when underwent proximal stomach resection and is therefore reserved for early stage Siewert type II AEG patients who are not candidates for total gastrectomy.

The choice of reconstruction manner after gastrectomy involves not only a continuation of the anatomical structure, but is also aimed to preserve the physiological function. The most attractive of the antrum-preserving alternatives is the double tract method, which consists of subtotal gastrectomy, creation of the residual stomach and preservation of the duodenal route. This original operation was described by Aikou T in 1988 in order to gain the smooth transfer of larger foods through the duodenal route\cite{16}. In an attempt to improve functional outcomes, some points were made when carrying out the anastomosis between the residual stomach and the jejunum, maintained the physiological pancreaticocibal synchronism. One debated issue is whether DTR should be offered to young patients. Two reasons to avoid these procedure in young patients relate to the high incidence of gastric stump cancer with increasing age and the morbidity of re-operations in these potentially relapse patients. The presence of distant metastatic condition is generally a contraindication to DTR. These unfortunate patients should be managed with total stomach resection with esophago-jejunostomy (RY).

Several prospective studies have compared the surgical outcomes after LPG with DTR and LTG with RY in the treatment of AEG. No difference was found in improving reflux symptom between the two procedures. However, the increasing percentages of the serum albumin, total protein, and hemoglobin levels were significantly higher in patients received DTR\cite{17–19}. Eiji Nomura et al from the Tokai University Hachioji Hospital reported the results of a study evaluating functional outcomes between differ types of reconstruction following LPG and TG. The post-/preoperative body weight ratios were significantly higher in the patients underwent DTR\cite{20}. Takiguchi et al and Nakamura M et al conducted a propensity-score matching analysis and found double tract building was superior to conventional RY reconstruction after LTG in QoL\cite{3}. Others, however, have reported similar results\cite{21, 22}. Since the nutritional status and QoL followed the DTR after LPG is still controversial, fewer literature to report it in the treatment of AEG, the purpose of this study is to discuss the clinical and postoperative recovery impact of surgical option choice.

In this study, after analyzed the postoperative follow-up data, we find BMI of patients who underwent LPG with DTR was higher than that of patients with LTG procedure, the possible reason was that some patients with gastric tumor had complications such as nutritional deficient diseases, many studies have demonstrated that RY reconstructive style had positive effects on weight loss. The LTG procedure cost more time and dissected more lymph node numbers. About 16 months after surgery, one gastric carcinoma recurrence (5%) was found in LPG group, this data is in agreement with those reported in literature concerned. It was noting that the cancerous rate of gastric stump in LTG maybe closely related to pathological grade and regional lymph node metastasis. In addition,
this study showed that the proportion of improved nutritional status was significantly higher than that of LTG. Compared with RY reconstruction after LTG, DTR after LPG could guarantee residual stomach. Unlike removed the whole stomach, this method maintains the continuity of the digestive tract, making it time-saving to perform the procedure. Furthermore, it has a dual route for food passage, reducing the incidence of delayed remnant gastric emptying. Compared with LTG, we found no more serious incidence of reflux symptoms related to gastric stump in LPG (Table 4). We suspected that the fewer malnutrition rate especially low risk of vitamin B12 deficiency in LPG group can be associated with the storage function of the remnant stomach.

In our opinion, the stomach has great role in the maintentance of normal nutrition, working primarily to secret intrinsic factor and to store food so that the frequency of reflux symptoms may be limited. Thus, surgical resection of the whole stomach may lead to the loss of vitamin B\textsubscript{12} absorption, necessary for normal hemoglobin synthesis, result in pernicious or macrocytic anemia. Patients received total gastrectomy may require monthly administration of vitamin B\textsubscript{12} (nasal or intramuscular). Another advantage of preserved distal stomach is that it allows the chyme passes through the gastroduodenal channel, promoting the gastrointestinal peptide hormone exposure, avoiding potential body weight loss caused by excessive growth of intestinal bacteria, insufficient secretion of trypsin and poor absorption (Fig. 3). Postoperatively, patients underwent proximal gastrectomy are able to gain weight and return to a much better level of general nutrition. Additionally, residual stomach often means a larger reservoir than intestinal and therefore less risk for gastrointestinal motility disorder complications. In general, the results of surgical resection of proximal stomach depend on the choice of reconstruction manners. In the literature, the outcomes for patients with differ reconstruction after proximal gastrectomy has been variable. Here, we recommended preserve half of the stomach at least during the procedure of DRT after LPG. DRT has dual-output channel, one is the jejunum - remnant stomach - duodenum - jejunum, and the other is the continuity of the jejunum. Each channel can provide energy and nutritional stores for body use (Fig). Hence, it may avoid the risk of high intestinal obstruction due to the recurrence of abdominal lymph node, except for the condition both the channels are packed with tumor compression. In this research, DRT indeed brings some benefits like ideal postoperative food intake, low risk of anemia and better weight maintenance as the preservation of a partial stomach without burdening the risk of anastomotic strictures, reflux, and indigestion. Thus, the double tract technique appears to be a more physiological reconstruction.

Nowadays, because the proved excellent disease free survival rate of early-stage upper gastric cancer patients, increasing emphasis on recovery of psychological and social roles after operation drew our eyes. Increasing attention on quality of life in patients diagnosed with early stage AEG, therefore a careful survey of postoperative daily life situation is necessary. The QLQ-OG25 module is widely used in assessment of the quality of life of AEG patients after surgery. Although, several studies have shown the qoL of DTR after LPG was not superior to that of LTG procedure. This little study showed similar results: in term of long-term results, patients underwent DTR after LPG showed no significantly postoperative recovery expect dietary restrictions, but the mechanism was still unclear. Even though, for early stage upper gastric cancer patients, we conducted that DTR after LPG may be preferred for surgical treatment.

There were certain limitations in our research. Firstly, the short follow up period—just 2 years was a limitation to elucidate the incidence rate of gastric stump carcinoma after PG. Secondly, relatively simple questionnaire was involved in data analysis, there was no doubt some other parameters might also influence the evaluation result. Clearly, unconsolidated recognition in the perceptions of function recovery definition may also lead to an unconscious bias on participants while combining data for self-assessment questionnaire form, relying on the
individual understanding of these patients. Finally, this study is based on the retrospective analysis which could have resulted in a selection bias. Another potential interference factor is that the surgical procedure is finished in differ medical units, although the surgeons have acquainted anatomical knowledge and perfect technique.

Conclusion

In summary, the choice of surgical strategy for Siewert type II AEG is dependent on the stage of tumor, the anticipated functional outcomes as a result of therapy, and the risk of complications. For T1 and early T2 tumors, proximal gastrectomy with DTR may be easy to operate, less morbid and better quality of life than other digestive tract reconstruction style and therefore a superior choice. Although these results are encouraging, we cannot make any conclusion about long term outcomes until more adequately power multi-center controlled clinical trials that will hopefully provide with the answers in the near future.

Abbreviations

LTG: laparoscopic total gastrectomy ; LPG: laparoscopic proximal gastrectomy ; AEG: adenocarcinoma of the esophagogastric junction ; QoL: Quality of life; QLQ-OG25 Quality of Life Questionnaire Oesophagogastric-25; DTR double tract reconstruction; EGJ esophago-gastric junction

Declarations

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Statement of Ethics

All patients provided written informed consent to participate prior to surgery. Ethical approval was given by the medical ethics committee of the hospitals (Central Hospital of Wuhan/NO.1 hospital of wuhan/the Central hospital of yichang) involved in this research. All procedures performed in this study involving human participants were conducted in accordance with Chinese ethical standards and the 2008 Declaration of Helsinki.

Availability of data and materials

All data generated or analysed during this study are included in this article. All data are fully available without restriction.

Competing interests

The authors have no conflicts of interest to declare.

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Author Contributions

Concept and design: CW; search and collection of data: LL, LLP, LXG and HH; analysis of data and interpretation: LL and LXG; tables and figures: LL, LLP and LXG; writing the manuscript and review: CW.

Consent for publication

Written informed consent was obtained from the patients for publication of this research and any accompanying images.

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Figures
Figure 1

Schematic illustration of the double tract reconstruction after laparoscopic proximal gastrectomy
Figure 2

Schematic illustration of the residuals gastro-jejunostomy. Additional remark: residuals gastro-jejunostomy was accomplished using a 29mm circular stapler: the proximal jejunum was repositioned as to allow a side to side anastomosis with no tension.
Figure 3

Schematic illustration of the double tract channel under upper gastrointestinal radiography. A large amount of food enters the duodenum through the remnant stomach.