

Retrospective Study

Clinical comparison of antrum-preserving double tract reconstruction vs roux-en-Y reconstruction after gastrectomy for Siewert types II and III adenocarcinoma of the esophagogastric junction

Jiang-Wei Xiao, Zi-Lin Liu, Peng-Cheng Ye, Ya-Jun Luo, Zhi-Ming Fu, Qin Zou, Shou-Jiang Wei

Jiang-Wei Xiao, Zi-Lin Liu, Peng-Cheng Ye, Ya-Jun Luo, Zhi-Ming Fu, Shou-Jiang Wei, Department of General Surgery, the Affiliated Hospital of North Sichuan Medical College, Nanchong 637000, Sichuan Province, China

Qin Zou, West China Hospital/West China School of Nursing, Sichuan University, Chengdu 610041, Sichuan Province, China

Author contributions: Xiao JW, Liu ZL and Wei SJ designed the study; Xiao JW, Liu ZL, Ye PC, Luo YJ, Fu ZM and Wei SJ performed the research; Xiao JW, Liu ZL and Zou Q analyzed the data; Liu ZL and Xiao JW wrote the manuscript; Liu ZL and Xiao JW contributed equally to this study and shared the first authorship.

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Correspondence to: Jiang-Wei Xiao, MD, PhD, Professor, Department of General Surgery, the Affiliated Hospital of North Sichuan Medical College, Nanchong 637000, Sichuan province, China. xiaojiangwei@126.com
Telephone: +86-13890868466
Fax: +86-817-2262417

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Abstract

AIM: To explore a reasonable method of digestive tract reconstruction, namely, antrum-preserving double-tract reconstruction (ADTR), for patients with adenocarcinoma of the esophagogastric junction (AEG) and to assess its efficacy and safety in terms of long-term survival, complications, morbidity and mortality.

METHODS: A total of 55 cases were retrospectively collected, including 18 cases undergoing ADTR and 37 cases of Roux-en-Y reconstruction (RY) for AEG (Siewert types II and III) at North Sichuan Medical College. The cases were divided into two groups. The clinicopathological characteristics, perioperative outcomes, postoperative complications, morbidity and overall survival (OS) were compared for the two different reconstruction methods.

RESULTS: Basic characteristics including sex, age, body mass index (BMI), Siewert type, pT status, pN stage, and lymph node metastasis were similar in the two groups. No significant differences were found between the two groups in terms of perioperative outcomes (including the length of postoperative hospital stay, operating time, and intraoperative blood loss) and postoperative complications (consisting of anastomosis-related complications, wound infection, respiratory infection, pleural effusion, lymphorrhagia, and cholelithiasis). For the ADTR group, perioperative

recovery indexes such as time to first flatus ($P = 0.002$) and time to resuming a liquid diet ($P = 0.001$) were faster than those for the RY group. Moreover, the incidence of reflux esophagitis was significantly decreased compared with the RY group ($P = 0.048$). The postoperative morbidity and mortality rates for overall postoperative complications and the rates of tumor recurrence and metastasis were not significantly different between the two groups. Survival curves plotted using the Kaplan-Meier method and compared by log-rank test demonstrated similar outcomes for the ADTR and RY groups. Multivariate analysis of significantly different factors that presented as covariates on Cox regression analysis to assess the survival and recurrence among AEG patients showed that age, gender, BMI, pleural effusion, time to resuming a liquid diet, lymphorrhagia and tumor-node-metastasis stage were important prognostic factors for OS of AEG patients, whereas the selection of surgical method between ADTR and RY was shown to be a similar prognostic factor for OS of AEG patients.

CONCLUSION: ADTR by jejunal interposition presents similar rates of tumor recurrence, metastasis and long-term survival compared with classical reconstruction with RY esophagojejunostomy; however, it offers considerably improved near-term quality of life, especially in terms of early recovery and decreased reflux esophagitis. Thus, ADTR is recommended as a worthwhile digestive tract reconstruction method for Siewert types II and III AEG.

Key words: Adenocarcinoma of the esophagogastric junction; Roux-Y reconstruction; Total gastrectomy; Antrum-preserving double-tract reconstruction; Overall survival

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Core tip: Antrum-preserving double-tract reconstruction (ADTR) was introduced to improve the near-term quality of life and decrease reflux esophagitis in patients with adenocarcinoma of the esophagogastric junction. The clinicopathological characteristics, perioperative outcomes, postoperative complications, morbidity and overall survival after ADTR and Roux-en-Y reconstruction (RY) (ADTR group, $n = 18$ vs RY group, $n = 37$) were retrospectively compared to evaluate the efficacy and safety of the procedures. The results of the study demonstrated that ADTR was technically safe and feasible, offering an agreeable near-term quality of life, especially in terms of early recovery and the alleviation of reflux esophagitis. ADTR may be a worthwhile digestive tract reconstruction method for Siewert types II and III adenocarcinoma of the esophagogastric junction.

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INTRODUCTION

The incidence of adenocarcinoma of the esophagogastric junction (AEG), a type of cancer involving the anatomical border of the esophagogastric junction (EGJ), has dramatically increased over the past several decades in Western countries. Although accurate measurement of its distribution is difficult, epidemiological data from Asian countries have not shown a similar trend; however, AEG is a fairly common malignancy in Japan, Asia, South America, and Eastern Europe^[1-6].

AEGs in the transitional junction between stratified squamous epithelium and simple columnar epithelium have distinct pathological and clinical characteristics compared with esophageal cancer and gastric cancer^[7]. Some investigators have reported on differences in gender predilection, prognosis and potential etiology after separating carcinomas of the EGJ and distal esophagus or stomach based on their anatomical relationship to the EGJ. These reports revealed that the anatomic location of these increasingly prevalent tumors could be associated with specific characteristics that are predictive of clinical outcome. Controversy and confusion persist regarding the location, definition and classification of AEGs as well as regarding the causes of these tumors^[8-10].

Among the limited consensus about the classification of AEG and the definition of the cardia, the criteria established by Siewert *et al.*^[11] are now widely accepted and used. According to Siewert's criteria, AEG is defined as a tumor with an epicenter within 5 cm proximal or distal to the endoscopic cardia where the longitudinal gastric folds end. The Siewert classification divides AEGs into three subtypes, allowing the resection approaches to be codified and comparisons to be made between surgical series (Figure 1)^[2,11,12]. Type I tumors are adenocarcinomas of the distal esophagus, which usually arise from areas with specialized intestinal metaplasia of the esophagus. Type II tumors are true carcinomas of the cardia arising immediately at the EGJ, whereas Type III tumors are subcardial gastric carcinomas infiltrating the EGJ and distal esophagus from below. In recent decades, numerous studies have demonstrated that the location of the AEG affects therapeutic management and influences the prognosis and long-term quality of life.

Despite endoscopic screening and advances in multimodality therapy, the prognosis of these tumors is poor, with a 5-year overall survival (OS) rate of approximately 20%. Surgical resection with lymphadenectomy continues to play a pivotal role in

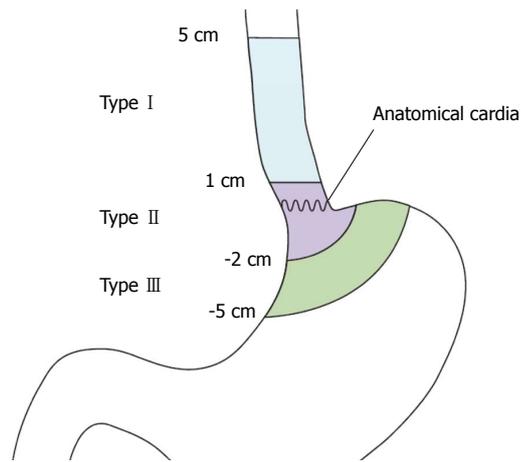


Figure 1 Modified Siewert's classification according to the distance of the tumor epicenter from the anatomical cardia. Reproduced from Mariette *et al*^[2].

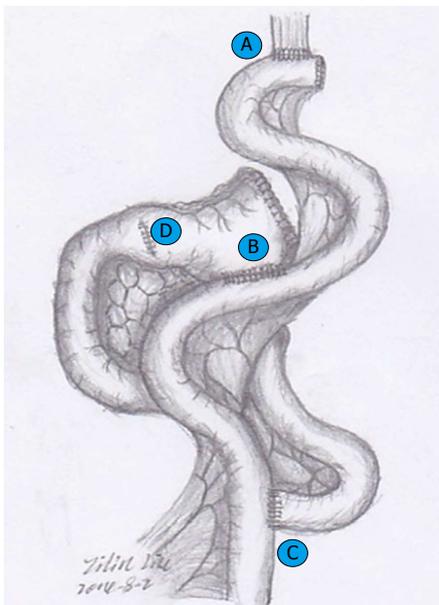


Figure 2 Antrum-preserving double-tract reconstruction. In our study, the jejunum was divided approximately 20 cm distal to the ligament of Treitz, an end-to-side esophagojejunal anastomosis (A) was performed, and the bottom of the proximal jejunum limb was anastomosed to the side of the Roux limb using a circular stapler at approximately 35 cm distal to the esophagojejunal anastomosis (C). Then, a side-to-side gastrojejunal anastomosis (B) was performed at 20 cm to the jejunojunal anastomosis, and a pyloroplasty (D) was necessarily implemented.

the treatment of AEG. Although total gastrectomy is recommended as the standard treatment, 60% to 70% of tumors localizing in the cardiac region can obtain a radical cure by proximal gastrectomy with appropriate lymphadenectomy. This approach is widely applied, especially in cases of early gastric cancer^[13,14]. Radical tumor resection and long-term tumor-free survival are ideal treatment outcomes, and patients' quality of life can be restored to normal if functional alimentary canal reconstruction is performed soon after diagnosis.

Although Siewert's classification is used to determine treatment strategy, the approach remains controversial. An optimal surgical strategy has not yet been established. Therefore, we have developed a modified double-track anastomosis for alimentary canal reconstruction after radical proximal gastrectomy by combining the advantages of Roux-en-Y and functional reconstruction of the stomach with jejunal interposition, which preserves the antrum so that chyme can be thoroughly mixed prior to transit to the duodenal passage and reduces the morbidity of backflow sequelae by offering an adequate evacuation tract (Figure 2). The purpose of this study was to compare the surgical outcomes for two reconstruction methods, antrum-preserving double-tract reconstruction (ADTR) and traditional Roux-en-Y reconstruction (RY) with esophagojejunostomy, after total gastrectomy, and to determine the best surgical approach for optimal postoperative quality of life.

MATERIALS AND METHODS

Patients

We retrospectively collected a database of 55 consecutive patients (48 males and 7 females) with AEG who underwent curative surgical resection between January 2012 and June 2013 at the Department of General Surgery of the Affiliated Hospital of North Sichuan Medical College, China. The type of AEG was classified according to Siewert's criteria. All of the patients suffering from synchronous gastric double cancer who had a history of or concurrent other cancer(s), distant metastasis, a previous history of surgery for gastric or esophageal cancer or gastric stump cancer were excluded. Furthermore, no patient underwent preoperative neoadjuvant chemotherapy or radiotherapy.

Surgical indications and procedures

Before surgery, hematological examination, abdominal ultrasonography, chest radiography, or computed tomography (CT) scan were routinely performed on all patients for tumor staging. The Siewert type of the tumors was determined preoperatively by upper gastrointestinal fiberoptic screening and biopsy, which also offered references for the surgical approach. To summarize these findings, the preoperative Siewert's subtype and surgical procedure were ultimately determined. In accordance with the Japanese gastric cancer treatment guidelines 2010 (ver. 3)^[15], D2 lymph node dissection was performed in patients on the basis of tumor location, size and lymph node metastasis. Appropriate combined organ resection (*i.e.*, splenectomy) was performed to achieve a curative resection.

All of the patients were operated on *via* an abdominal approach, and procedures including laparotomy and laparoscopy-assisted gastrectomy were implemented *via* a midline upper abdominal incision.

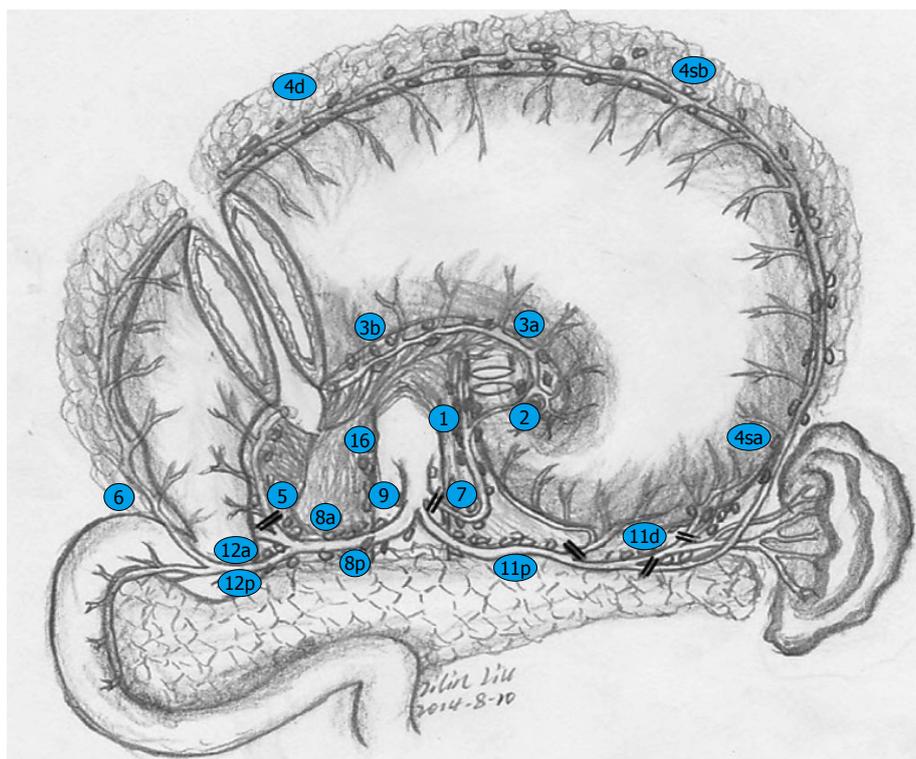


Figure 3 The extent of systematic lymphadenectomy in the antrum-preserving double-tract reconstruction approach for adenocarcinoma of the esophagogastric junction. The details of the antrum-preserving double-tract reconstruction method are as follows: we divided the omentum majus along the transverse colon, then stripped the anterior lobe of the transverse mesocolon and isolated the pancreatic capsule at the inferior pancreatic edge and at the head of the pancreas. Then, we skeletonized the right gastroepiploic artery and vein but preserved their completeness with a No. 6 lymphadenectomy. Based on the Japanese gastric cancer treatment guidelines 2010 (ver. 3), the common hepatic artery, left and right gastric vessels, proximal splenic artery and left gastroepiploic vessels were all skeletonized and ligated, with the exception of the common hepatic artery. In addition, the lymph nodes that are marked in the left figure (such as Nos. 7, 8a, 9, 1, 3, and 11p) were dissected, whereas the resection of No. 16 was controversial.

For the RY group, standard D2 lymphadenectomy and total gastrectomy were performed. The jejunum was divided approximately 20 cm distal to the ligament of Treitz; then, the distal jejunal limb was brought through the transverse mesocolon *via* the retrocolic route, and the stump was closed with a linear stapler. An end-to-side esophagojejunostomy was performed mechanically with a circular stapler, while the bottom of the proximal jejunum limb was anastomosed to the side of the Roux limb with a circular stapler at approximately 35 cm distal to the esophagojejunal anastomosis. For the ADTR group, the surgical procedure and its lymphadenectomy details are shown in Figures 2 and 3. At least 6 cm distal to the lower edge of the tumor, the remnant gastric antrum was retained and closed with a linear stapler after proximal gastrectomy. The jejunum was mobilized and severed approximately 15 cm distal to the ligament of Treitz. End-to-side esophagojejunostomy was implemented with a circular stapler between the stump closing of the distal jejunal limb and the esophagus, and a side-to-end jejunoduodenostomy was constructed with a circular stapler 35 cm distal to the esophagojejunal anastomosis. Finally, the remnant gastric antrum was anastomosed mechanically by a 6-8 cm side-to-side gastrojejunostomy with a linear stapler, approximately 20 cm proximal to the jejunoduodenal

anastomosis.

Histopathologic assessment and follow-up

Based on the American UICC 7th tumor-node-metastasis (TNM) classification^[16,17], the gastric carcinoma scheme was used for Siewert types II and III AEG staging, and the regional lymph nodes and tumor histology were evaluated according to the Japanese classification of gastric carcinoma 3rd English edition^[18]. The survival data for all of the patients were ascertained in June 2014. During the follow-up period, which ranged from 12 to 30 mo (median 17 mo), all of the patients' basic characteristics, including operative time, blood loss, postoperative time to first flatus, time to resuming a liquid diet, length of hospitalization, early and late postoperative complications and OS were collected and analyzed.

Statistical analysis

Quantitative data are expressed as the mean \pm SD, whereas qualitative data are shown as prevalence. A two-sample Student's *t*-test or Mann-Whitney rank sum test was used to compare continuous data, and the χ^2 test or Fisher's exact test was performed to evaluate proportions. All-cause mortality and disease-specific survival curves were plotted using the Kaplan-

Table 1 Pathological characteristics of the antrum-preserving double-tract reconstruction group and the Roux-en-Y reconstruction group

| Pathologic characteristic | ADTR (<i>n</i> = 18) | RY (<i>n</i> = 37) | <i>P</i> value |
|---------------------------|-----------------------|---------------------|----------------|
| Sex ratio (Male:Female) | 17:1 | 31:6 | 0.406 |
| Age (yr) | 61.94 ± 6.41 | 62.08 ± 7.98 | 0.950 |
| BMI (kg/m ²) | 21.50 ± 2.61 | 20.98 ± 2.66 | 0.683 |
| Siewert type | | | 0.497 |
| II | 7 | 11 | |
| III | 11 | 26 | |
| pT status | | | 0.744 |
| T1a | 0 | 0 | |
| T1b | 3 | 3 | |
| T2 | 1 | 4 | |
| T3 | 2 | 5 | |
| T4a | 12 | 25 | |
| Lymph node metastasis | | | 0.709 |
| pN0 | 6 | 8 | |
| pN1 | 4 | 9 | |
| pN2 | 7 | 15 | |
| pN3a | 1 | 5 | |
| pN3b | 0 | 0 | |
| Tumor TNM stage | | | 0.002 |
| I a | 3 | 0 | |
| I b | 2 | 0 | |
| II a | 1 | 4 | |
| II b | 1 | 6 | |
| III a | 3 | 3 | |
| III b | 7 | 7 | |
| III c | 1 | 17 | |
| Histological type | | | 0.002 |
| Well differentiated | 3 | 16 | |
| Moderately differentiated | 11 | 13 | |
| Poorly differentiated | 4 | 8 | |

ADTR: Antrum-preserving double-tract reconstruction; RY: Antrum-preserving double-tract reconstruction; TNM: Tumor-node-metastasis.

Meier method and compared using the log-rank test. A multivariate analysis of significantly different factors was performed using covariates of a Cox regression analysis to assess survival and recurrence in patients with AEG. A two-sided *P*-value less than 0.05 was considered statistically significant. All of the statistical analyses were performed with the SPSS package version 13.0 for Windows (SPSS Inc., Chicago, Illinois, United States).

RESULTS

Patient demographics and tumor characteristics

From January 2012 to June 2013, 55 patients including 48 males and 7 females (mean age 62.04 ± 7.44 years, range from 45 to 79 years) underwent surgical resection with curative intention for AEG according to the 7th UICC TNM classification of malignant tumors. Twenty patients had type II AEG, and 35 patients had type III AEG, according to Siewert's classification. Patient demographics and tumor characteristics are presented in Table 1. With the exception of the tumor TNM stage and the histological type of tumor, both groups were comparable with regard to age, sex, Siewert type, pT status and lymph node metastasis

Table 2 Comparison of perioperative outcomes between the antrum-preserving double-tract reconstruction group and the Roux-en-Y reconstruction group

| Clinical feature | ADTR (<i>n</i> = 18) | RY (<i>n</i> = 37) | <i>P</i> value |
|---------------------------------|-----------------------|---------------------|----------------|
| Postoperative hospital stay (d) | 12.88 ± 5.81 | 14.08 ± 5.85 | 0.495 |
| Operating time (min) | 282.22 ± 77.93 | 274.86 ± 63.23 | 0.709 |
| Intraoperative blood loss (mL) | 362.77 ± 294.15 | 270.81 ± 148.22 | 0.601 |
| First flatus time (d) | 2.94 ± 0.83 | 3.97 ± 1.11 | 0.002 |
| Time to resume liquid diet (d) | 4.47 ± 1.28 | 6.11 ± 1.82 | 0.001 |

ADTR: Antrum-preserving double-tract reconstruction; RY: Antrum-preserving double-tract reconstruction.

status. According to the postoperative pathologic inspection, there were no cases of positive surgical margins, and the patients from both groups underwent R0 curative resections.

Surgical background and postoperative complications

A total of 18 patients underwent surgical intervention by ADTR; the remaining 37 patients underwent RY reconstruction after total gastrectomy. The perioperative outcomes of the ADTR and RY groups are shown in Table 2. Comparing the perioperative outcomes between the ADTR and RY groups, there were no significant differences in terms of body mass index (BMI), postoperative length of hospital stay, operating time or intraoperative blood loss, whereas the time to first flatus in the ADTR group was significantly shorter than that in the RY group (2.94 ± 0.83 d vs 3.97 ± 1.11 d, *P* = 0.002). A similar outcome for the time to resuming a liquid diet was detected for the two groups (4.47 ± 1.28 d vs 6.11 ± 1.82 d, *P* = 0.001).

Follow-up outcomes and prognostic findings

The median follow-up period for patients in the two groups was 17 mo (range 12-30 mo). In these patients, a comparison of the overall postoperative complication rate did not present a statistically significant difference. There were no differences in major complications, including anastomotic leakage, anastomotic stenosis, anastomotic hemorrhage, wound infection, respiratory infection, pleural effusion, lymphorrhagia, and other surgery-related complications, between the two groups. However, the incidence of reflux esophagitis was more common in the RY group compared with the ADTR group (Table 3).

Regarding tumor recurrence and metastasis for patients' long-term prognosis, no significant difference was identified between the two groups. Univariate Cox regression analysis of OS among AEG patients with operative intervention demonstrated that age, gender, BMI, pleural effusion, time to resuming a liquid diet, lymphorrhagia and TNM stage were prognostic factors for AEG in our study (Table 4). Meanwhile, multivariate Cox regression analyses confirmed that pleural

Table 3 Postoperative complications in the antrum-preserving double-tract reconstruction group and Roux-en-Y reconstruction groups

| Complication | ADTR (n = 18) | RY (n = 37) | P value |
|------------------------------------|---------------|-------------|---------|
| Anastomosis-related complications | | | |
| Anastomotic leakage | 1 | 0 | 0.148 |
| Anastomotic stenosis | 0 | 1 | 0.481 |
| Anastomotic hemorrhage | 0 | 0 | - |
| Early complications | | | |
| Wound infection | 2 | 3 | 0.716 |
| Respiratory infection | 1 | 4 | 0.525 |
| Pleural effusion | 2 | 3 | 0.716 |
| Lymphorrhagia | 1 | 3 | 0.732 |
| Long-term complications | | | |
| Reflux esophagitis | 0 | 6 | 0.048 |
| Cholelithiasis | 1 | 3 | 0.732 |
| Tumor recurrence | 1 | 6 | 0.266 |
| Tumor metastasis | 1 | 5 | 0.374 |
| Overall postoperative complication | 3 | 7 | 0.839 |

Table 4 Univariate Cox regression analysis of overall survival among patients with gastrectomy

| Characteristic | HR | 95%CI | P value |
|---------------------------------------|--------|-------------|---------|
| Age | 1.110 | 1.04-1.19 | 0.003 |
| Gender | 9.160 | 1.47-56.93 | 0.018 |
| BMI | 0.821 | 0.68-0.99 | 0.039 |
| Surgical method | 0.573 | 0.16-2.13 | 0.406 |
| Intraoperative blood loss | 1.000 | 0.99-1.01 | 0.496 |
| Length of postoperative hospital stay | 1.030 | 0.92-1.14 | 0.628 |
| Pleural effusion | 24.280 | 5.53-106.50 | < 0.001 |
| Time to first flatus | 0.685 | 0.49-0.96 | 0.448 |
| Time to resuming a liquid diet | 0.685 | 0.49-0.96 | 0.026 |
| Lymphorrhagia | 9.620 | 1.48-62.54 | 0.018 |
| TNM stage | 2.310 | 1.59-3.35 | < 0.001 |

BMI: Body mass index; TNM: Tumor-node-metastasis.

effusion and lymphorrhagia had a significant effect on OS among AEG patients; however, BMI did not show a positive result for OS prognosis (Table 5). Furthermore, our follow-up data showed that the OS did not show a significant difference between the ADTR (55.6%) and RY (48.6%) groups (Figure 4).

DISCUSSION

Compared with other digestive tract tumors, AEGs pose numerous clinical controversies regarding histogenesis and clinicopathological characteristics as well as treatment strategies and prognosis. Surgical resection with *en bloc* tumor removal and regional lymphadenectomy is currently recommended as the mainstay of potentially curative therapy in the treatment of AEG. Meanwhile, concomitant postoperative complaints and complications such as delayed gastric emptying, reflux esophagitis, remnant gastritis or anastomosis, anastomotic ulcer, anastomotic stricture, and malnutrition seriously diminish patients'

Table 5 Multivariate Cox regression analysis of overall survival among patients with gastrectomy

| Characteristic | HR | 95%CI | P value |
|--------------------------------|-------|--------------|---------|
| Age | 1.13 | 1.06-1.22 | 0.001 |
| Gender | 6.29 | 1.01-39.17 | 0.049 |
| Pleural effusion | 22.77 | 4.35-119.124 | < 0.001 |
| Time to resuming a liquid diet | 0.65 | 0.45-0.93 | 0.020 |
| Lymphorrhagia | 15.14 | 1.84-124.47 | 0.011 |
| TNM stage | | | |
| 1 | 0 | 0 | 0.982 |
| 2 | 0.02 | 0.01-0.350 | 0.003 |
| 3 | 0.19 | 0.01-0.651 | 0.146 |
| 4 | 0.05 | 0.01-0.484 | 0.007 |
| 5 | 0.03 | 0.01-0.446 | 0.009 |
| 6 | 0.43 | 0.16-1.13 | 0.087 |

TNM: Tumor-node-metastasis.

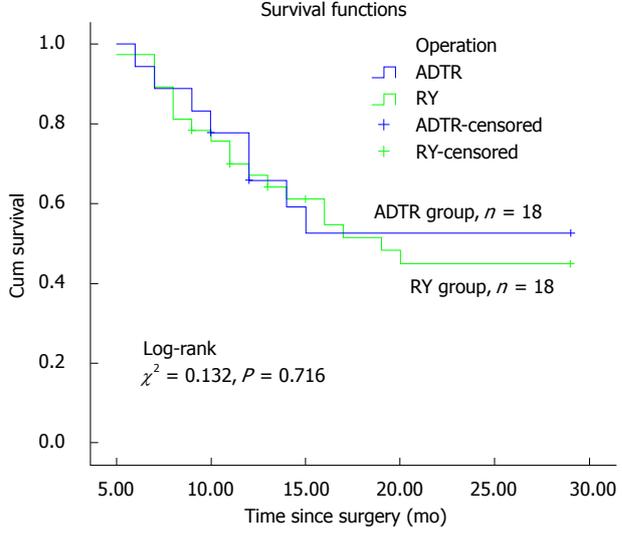


Figure 4 Kaplan-Meier graph showing overall survival in patients grouped according to operative procedure. P = 0.716 between groups. RY: Roux-en-Y reconstruction; ADTR: Antrum-preserving double-tract reconstruction.

postoperative quality of life. Hence, intraoperative digestive tract reconstruction methods play a vital role in minimizing postoperative complications for AEG patients. Therefore, the investigation of optimal reconstruction methods has been recognized as one of the main approaches to improving patients' quality of life. The Japanese gastric cancer treatment guidelines 2010 (ver. 3) note that standard gastrectomy is the principal surgical procedure performed with curative intent; this treatment involves the complete resection of the stomach with D2 lymph node dissection. Proximal gastrectomy is adequate only for early gastric cancer (cT1cN0M) located in the upper third of the stomach^[17,19,20]. Reconstruction methods for proximal gastrectomy are far less prevalent than for total gastrectomy. Digestive tract reconstruction options for total gastrectomy are clinically applied in more than 50% of cases; however, classical RY remains the optimal choice because there is a lack of high-level

multi-center randomized controlled studies to generate evidence-based support for other methods. Whether RY with esophagojejunal anastomosis for total gastrectomy is the best solution for AEG remains controversial, and numerous problems must be addressed^[21-24]. First, total gastrectomy implemented for AEG may be classified in the excessive resection range. For example, "the 13th Japanese Gastric Cancer statute" advocated that lymph nodes Nos. 5, 6, 12a, 12b and 14v should be regarded as third station lymph nodes (D3) that do not need to be removed for proximal gastric tumors. Second, it is important to determine whether the incidence of cholelithiasis and postoperative malnutrition will increase or whether bile secretion will decrease when the duodenal pathway is absent^[25]. Third, total gastrectomy not only prevents gastric juice secretion from affecting the assimilation of iron and causing iron deficiency anemia (IDA) but also decreases intrinsic factor secretion, which impedes vitamin B12 absorption and causes megaloblastic anemia (MA), which ultimately results in post-gastrectomy malabsorption syndrome. Hence, we explored and improved a new method of digestive tract reconstruction involving ADTR and compared it to the classical Roux-en-Y esophagojejunostomy for total gastrectomy. We found that ADTR could commendably overcome the disadvantages of the RY method and enhance patients' postoperative quality of life^[12,26].

ADTR was first reported for proximal gastrectomy by Aikou *et al.*^[27] in 1988 and was confirmed to offer numerous advantages. ADTR offers a more reasonable resection region and lymphadenectomy, especially for the majority of patients undergoing total gastrectomy. The duodenal chymus pathway remains intact during ADTR, which stimulates gastrointestinal hormone secretion (such as pancreaticozym, cholecystokinin, and insulin). As a result, ADTR retains the primordial digestive function and reduces the incidence of postoperative malnutrition and cholelithiasis^[28].

Furthermore, the remnant gastric antrum provides the capacity for food storage, which not only delays emptying time to ensure the efficient mixing of food with the digestive juices but also promotes gastrin (GAS) secretion for adequate chymus digestion, ultimately enhancing patients' long-term quality of life^[29]. Moreover, ADTR provides double output channels for food transit, and this split transit approach can effectively prevent and reduce the incidence of esophageal reflux and dumping syndrome^[29-31]. Additionally, the remnant gastric antrum maintains gastric hormone secretion, which partially aids in the absorption of iron and prevents malabsorption of vitamin B12, decreasing the incidence of post gastrectomy malabsorption syndrome.

The data for 55 AEG patients were retrospectively analyzed. Comparing the pathological characteristics between the ADTR and RY groups revealed no significant difference in terms of Siewert type, pT status or lymph node metastasis (pN). An advanced tumor TNM

stage usually indicated a worse prognosis, whereas a well-differentiated histological type predicted a better prognosis. Although significant differences were shown with respect to the TNM stage and the degree of histological differentiation in our study, they had opposite trends and their effects could not be confirmed. In the ADTR group, the obvious advantages were observed for the time to first flatus (2.94 ± 0.83 d vs 3.97 ± 1.11 d, $P = 0.002$) and the time to resuming a liquid diet (4.47 ± 1.28 d vs 6.11 ± 1.82 d, $P = 0.001$). However, no differences were found with respect to perioperative outcomes, anastomosis-related complications or early complications between the two groups. Similarly, there were no statistically significant differences with respect to tumor recurrence or metastasis during the follow-up period (range, 12-30 mo). The Kaplan-Meier graph showing OS according to operative procedure between the two groups also demonstrated similar outcomes (Figure 4), which confirmed that ADTR was technically safe and feasible, compared with conventional Roux-en-Y esophagojejunostomy after total gastrectomy.

Based on the outcome of the Cox regression analysis, our study revealed that age, gender, BMI, pleural effusion, time to resuming a liquid diet, lymphorrhagia, and TNM stage were important prognostic factors for OS in this setting. Hence, we conclude that ADTR may be suitable to improve the quality of life and OS of AEG patients. It was found that pleural effusion and lymphorrhagia play an important role in prognosis and OS, and extensive surgical intervention is required to decrease these complications. In our opinion, redundant or rough posterior mediastinum anatomy might cause pleura injury and result in pleural effusion, which together with lymphorrhagia, mainly caused by uncompleted lymph-vessel ligation, seriously affected the OS of AEG patients. Therefore, elaborate anatomy around the cardia and sufficient ligation were recommended to improve the OS of AEG patients. In addition, we observed that an early return to a liquid diet could afford patients better quality of life. Notably, intraoperative blood loss did not affect the prognosis of AEG. One possible explanation is that we transfused sufficient blood products to avoid hypovolemia and its corresponding factors. With respect to tumor recurrence, metastasis and long-term survival, there were no differences between the ADTR group and the RY group. These results confirmed that the ADTR method is a safe and reasonable reconstruction procedure.

In conclusion, the ADTR approach is recommended over traditional Roux-en-Y esophagojejunostomy for Siewert types II and III AEG. Although ADTR provides similar rates of tumor recurrence, metastasis and long-term survival, this approach considerably improves the near-term quality of life, especially in terms of early recovery and decreased reflux esophagitis. Therefore, ADTR is recommended as a worthwhile digestive tract

reconstruction approach.

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COMMENTS

Background

The incidence of adenocarcinoma of the esophagogastric junction (AEG) is rising rapidly and surgery remains the only established curative treatment for AEG in its resectable stages. However, the alimentary canal reconstruction method, which plays a determining factor in postgastrectomy quality of life among AEG patients, has not been established. To explore a reasonable reconstruction method for AEG patient, the authors developed a new reconstruction method, antrum-preserving double tract reconstruction (ADTR), and assessed its efficacy and safety in terms of long-term survival, complication morbidity, and mortality retrospectively at our institution since January 2012.

Research frontiers

With the development of standard surgery for AEG, gastrointestinal surgeons have taken an increased interest in optimal digestive tract reconstruction pattern which not only provides radical tumor removal but also alleviates the surgery-related complications as soon as possible and offers satisfying quality of life.

Innovations and breakthroughs

The present study modified the double-track anastomosis for alimentary canal reconstruction after radical proximal gastrectomy by combining the advantages of Roux-en-Y and functional reconstruction of the stomach with jejunal interposition, which preserves the antrum so that chyme can be thoroughly mixed prior to transit to the duodenal passage and reduces the morbidity of backflow sequelae by offering an adequate evacuation tract. Thus, the procedure ADTR obviously shortened the perioperative recovery indexes such as time to first flatus and time to resuming a liquid diet. The postoperative morbidity and mortality rates for overall postoperative complications and the rates of tumor recurrence and metastasis were not significantly different between the two groups.

Applications

The study suggests that ADTR is technically safe and feasible, offering an agreeable near-term quality of life, especially in terms of early recovery and the alleviation of reflux esophagitis. ADTR may be a worthwhile digestive tract reconstruction method for Siewert types II and III AEG.

Peer-review

The present study provides a practical and well-illustrated review of the safety and feasibility of ADTR for AEG. Based on the experience with 55 AEG patients, the conclusion is that ADTR is technically safe and feasible, with acceptable surgical outcomes.

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