Research Article

Clinical Efficacy of Laparoscopic-Assisted Proximal Gastrectomy with Postoperative Double-Channel Digestive Tract Reconstruction: A Case-Control Analysis

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Objective. To investigate the clinical effect of laparoscopic-assisted proximal gastrectomy with postoperative double-channel digestive tract reconstruction.

Methods. A total of 40 patients with proximal gastric cancer who underwent gastrectomy in Zhujiang Hospital, Southern Medical University, were selected to collect relevant clinical data. They were divided into two groups according to their treatment methods: TG-RY group (total gastrectomy with Roux-en-Y reconstruction group) and PG-DT group (proximal gastrectomy with double tract reconstruction group). The general data, perioperative indicators, nutritional indicators, and postoperative complications of the two groups were analyzed and compared.

Results. There was no statistical significance in the comparison of general data between the two groups, but the proportion of III stage patients of TNM stage in the PG-DT group was larger than that in the TG-RY group. Meanwhile, the intraoperative blood loss, postoperative hospital stay, and first exhaust time in PG-DT group were lower than those in TG-RY group \((P < 0.05)\). After surgery, the nutritional indexes of the PG-DT group decreased, and the decrease degree was less than that of the TG-RY group, while the infection indicators of the PG-DT group increased less than that of the TG-RY group. Statistical analysis of postoperative complications showed that the total incidence of PG-DT group was lower than that of TG-RY group.

Conclusion. Proximal gastric cancer resection and postoperative DTR anastomosis can effectively speed up the recovery of patients and reduce the incidence of postoperative complications, with good efficacy. This experiment provides evidence for the advantages of various postoperative anastomosis methods and also provides a reliable basis for clinicians’ diagnosis and treatment, thus effectively improving patients’ postoperative quality of life.

1. Introduction

Gastric cancer (GC) remains an important cancer worldwide that killing countless people every year [1]. Gastric cancer ranks fifth in global morbidity and fourth in mortality. China is one of the countries with the highest incidence of gastric cancer [2]. Surgery is currently the main treatment for gastric cancer and the only cure, but the curative resection rate is low [3]. Proximal gastric cancer refers to partial adenocarcinoma of esophagogastric junction (AEG), gastric fundus cancer, and upper 1/3 gastric body cancer. Currently, surgery is the main treatment method for proximal gastric cancer, and surgical methods for proximal gastric cancer can be divided into total gastrectomy and proximal gastrectomy according to the scope of resection [4]. The incidence of proximal gastric cancer may be related to a variety of factors [5], such as diet, lifestyle, environmental factors, and immunocompromise, as well as chronic gastritis and Helicobacter pylori long-term infection. Although the incidence of gastric cancer has reached a stable level in recent years, the
proportion of proximal gastric cancer shows a trend of gradual increase [6].

With the continuous maturity of laparoscopic technology and the development of prospective studies related to laparoscopic-assisted tumor resection, the application of laparoscopic technology in the treatment of gastric cancer has been widely valued due to its advantages of small incision, quick postoperative recovery, and less blood loss [7]. At present, there is little difference in clinical studies on surgical treatment methods and the scope of lymph node dissection, but the selection of postoperative digestive tract reconstruction methods is still controversial due to different anatomic way and anatomic methods, and how to choose the operation is simple; efficient and safe digestive tract reconstruction method has been becoming the current hot [8]. There are various methods for postoperative digestive tract reconstruction of proximal gastric cancer [8, 9], mainly including total gastrectomy with Roux-en-y reconstruction (TG-RY), proximal gastrectomy with esophagogastronomy (PG-EG), proximal gastrectomy with jejunal interposition (PG-JI), and proximal gastrectomy with double tract reconstruction (PG-DT), but there is still no universally accepted ideal method of digestive tract reconstruction.

TG-RY is the most widely carried out and applied surgical method in the treatment of proximal gastric cancer, with the advantages of lymph node dissection and antireflux effect. However, some scholars have pointed out [10] that the rate of distal perigastric lymph node metastasis in patients with proximal gastric cancer is very low, and lymph node dissection is not helpful to improve the survival of patients. And total gastrectomy also has disadvantages, Masuzawa et al. [11] found in a retrospective analysis that compared with proximal gastrectomy, total gastrectomy was characterized by longer operative time, more blood loss, significantly lower postoperative hemoglobin and albumin levels, and higher incidence of dumping syndrome and diarrhea after total gastrectomy.

PG-DT is a new method of digestive tract reconstruction after proximal gastrectomy proposed by Japanese scholars in recent years [12]. Tomoki et al. [13] conducted a one-year follow-up of 41 patients who underwent PG-DT, and the results showed that patients who underwent PG-DT had a lower incidence of gastric reflux symptoms and postoperative complications. Du et al. [14] conducted meta-analysis for PG-DT treatment of patients with proximal gastric cancer and found that PG-DT has advantages in intraoperative bleeding, postoperative exhaust time, hospital stays, incidence of postoperative complications, and postoperative nutritional indicators compared with total gastrectomy.

In addition to the above methods of digestive tract reconstruction, there are many other postoperative digestive tract anastomosis methods for proximal gastric cancer, but various operations and anastomosis methods have different advantages and disadvantages. As surgery disrupts the continuity of the digestive tract anatomical structure and affects physiological functions, some patients may experience gastrointestinal symptoms of varying degrees after surgery, such as acid reflux, abdominal distention, and burning sensation, and in severe cases, their quality of life and nutritional status may be affected [15]. It is important to find a suitable method for reconstruction of digestive tract to reduce symptoms and increase nutritional status of patients. At present, TG-RY and PG-DT are two widely used treatments in clinical practice, with different therapeutic effects. In view of this, our research group collected the treatment data of patients with proximal gastric cancer who received surgical treatment and made statistical analysis and comparison of their general data, perioperative indicators, nutritional indicators, and postoperative complications. To investigate the clinical effect of laparoscopic-assisted proximal gastrectomy with postoperative double-channel digestive tract reconstruction.

2. Materials and Methods

2.1. Patient General Data. The clinical data of patients who were undergoing radical resection of proximal gastric cancer in Zhujiang Hospital, Southern Medical University Hospital, from January 2018 to December 2021, were retrospectively collected. This study has been approved by the Ethics Committee of Zhujiang Hospital, Southern Medical University (Ethical Batch No.: 2017-PTWK-004), and informed consent was obtained from each patient prior to inclusion in the study. Inclusion criteria are as follows: all patients were confirmed to have primary upper gastric cancer by preoperative CT or pathological examination, and no tumor distant metastasis was observed by preoperative and intraoperative examination. Postoperative pathological biopsies of all patients showed negative tumor resection margins. Exclusion criteria are as follows: patients with previous gastrointestinal resection, other systemic malignancies, and other surgical contraindications were excluded.

Finally, 40 cases were included and divided into control group (TG-RY group, n = 22) and experimental group (PG-DT group, n = 18) according to different surgical methods and digestive tract reconstruction methods. The general information of age, gender, tumor location, tumor type, and TNM stage were statistically compared between the two groups.

2.2. Surgical Methods. TG-RY group: the patient underwent total gastrectomy and D2 lymph node dissection. The duodenal stump of the patient was closed, jejunum was severed at 15 cm away from Treitz ligament, and esophagus and distal jejunum were anastomosed. End-to-side anastomosis between proximal jejunum and distal jejunum was performed at 25-30 cm below the esophagojejunum anastomosis.

PG-DT group: the patient underwent proximal gastrectomy and D1+ lymph node dissection. The esophagus was resected at 2 cm from the proximal stomach to the upper edge of the tumor, and the stomach was severed at 5 cm from the distal stomach to the edge of the tumor. Jejunum was then cut off at 15 cm away from Treitz ligament, and anastomosis was performed between esophagus and distal jejunum. Lateral anastomosis between jejunum and the anterior wall of remnant stomach was performed at 10-15 cm below the esophagojejunum anastomosis. Finally,
proximal jejunum and distal jejunum were anastomosed at 30 cm below the remnant stomach jejunum anastomosis.

2.3. Observational Index

(1) Preoperative and postoperative nutritional indicators and inflammatory indicators were collected, such as hemoglobin (HGB) concentration, albumin (ALB) count, total protein (TP) count, and neutrophil count (NEUT).

(2) The intraoperative situation of patients was compared, such as operation time, perioperative bleeding, postoperative hospital stay, abdominal drainage tube indwelling, and the time of first resumed venting, and time of first returned to full liquid diet.

(3) Early postoperative complications were counted, including incision-related complications, abdominal infection, intra-abdominal bleeding, anastomotic complications (stenosis, fistula, and bleeding), urinary infection, respiratory infection, and other adverse events. Follow-up methods: all patients in the study were followed up in outpatient or telephone mode by surgical team physicians, and all patients were followed up six months after surgery.

2.4. Statistical Analysis. SPSS20.0 software was used for statistical analysis. Measurement data were expressed as mean ± standard deviation (x ± s) and analyzed by independent sample T or Kruskal-Wallis test. The count data were expressed as frequency (%) and analyzed by χ² test. P < 0.05 indicated that the difference was statistically significant.

3. Results

3.1. Comparison of General Data of Patients. A total of 40 patients were included in this study, including 24 males and 16 females. There were no significant differences in age, tumor diameter, pathological type, and tumor location between 2 groups (P > 0.05). However, in comparison of TNM staging, most patients in the PG-DT group presented stage II and stage III, and the proportion of stage III patients was larger than that in the TG-RY group (Table 1).

3.2. Comparison of Perioperative-Related Clinical Indicators. Comparison of intraoperative conditions between the two groups showed that the amount of intraoperative blood loss, postoperative hospital stay, and first exhaust time in the PG-DT group were less than those in the TG-RY group (P < 0.05). There was no statistical significance in the comparison of operation time, number of lymph nodes, duration of abdominal drainage tube indwelling, and the time of first total liquid diet between the two groups (P > 0.05), as shown in Table 2.

3.3. Comparison of Long-Term Nutritional Status of Patients. The nutritional indexes of patients in the two groups before and 3 days after operation were collected and recorded. There were no significant differences in preoperative hemoglobin (HB), albumin (ALB), and total protein (TP) between the two groups (P > 0.05). Intragroup comparative analysis of indicators showed that compared with the preoperative, nutritional indicators of all patients were significantly decreased 3 days after surgery (P < 0.05). Comparison of nutritional indexes between the two groups showed that TP, ALB, and HB which decreased degree in TG-RY group at 3 days after surgery were higher than those in PG-DT group (P < 0.05) (Tables 3–5).

3.4. Comparison of Postoperative Complications. All patients were followed up at least 6 months after surgery, and the changes of infection indicators (white blood cells, neutrophils, and lymphocytes) and postoperative complications (anastomotic leakage, abdominal infection, pulmonary related complications, etc.) were recorded statistically before and 3 days after surgery. There were no significant differences in preoperative infection indicators among all patients (P > 0.05). However, in TG-RY group, white blood cells (WBC) and neutrophils (NEUT) indexes had a higher upward trend 3 days after surgery, while lymphocyte (LYM) indexes decreased more (P > 0.05) (Figure 1). The incidence of postoperative infection may be higher in TG-RY group. The postoperative complications of the patients were further compared. The total incidence of postoperative

### Table 1: Baseline comparison between the two groups.

| Gender        | TG-RY (n = 22) | PG-DT (n = 18) | P  |
|---------------|----------------|----------------|----|
| Male [%]      | 16 (72.7%)     | 8 (44.4%)      | 0.069 |
| Female [%]    | 6 (27.3%)      | 10 (55.6%)     |    |
| Age (year)    | 59.27 ± 11.72  | 59.72 ± 8.33   | 0.895 |
| BMI (kg/m²)   | 21.58 ± 3.31   | 20.71 ± 3.05   | 0.413 |
| Diameter of tumor (cm) | 4.98 ± 3.39 | 5.35 ± 3.41 | 0.742 |
| Differentiated degree [%] | 15 (68.2%) | 12 (66.7%) | 0.550 |
| Poorly differentiated | 7 (31.8%) | 6 (33.3%) |    |
| High differentiation | 0 | 1 (5.6%) |    |
| Pathological pattern |    |    | 0.499 |
| Adenocarcinoma | 20 (90.9%) | 16 (88.9%) |    |
| Signet-ring cell carcinoma | 2 (9.0%) | 1 (5.6%) |    |
| Mucinous adenocarcinoma | 0 | 1 (5.6%) |    |
| Tumor TNM staging [%] |    |    | 0.026^* |
| I              | 5 (22.7%)      | 0              |    |
| II             | 7 (31.8%)      | 3 (16.7%)      |    |
| III            | 10 (45.5%)     | 15 (83.3%)     |    |
| Tumor location |    |    | 0.256 |
| Gastric body   | 10 (45.45%)    | 5 (27.8%)      |    |
| Fundus of stomach | 3 (13.6%) | 1 (5.6%) |    |
| Cardia         | 9 (40.9%)      | 12 (66.7%)     |    |
increasing incidence worldwide with significance (AEG), as a cancer proximal gastric cancer, has an

4. Discussion

was higher than that in PG-DT group 5 cases (27.8%) complications in TG-RY group was 8 cases (36.4%), which was higher than that in PG-DT group 5 cases (27.8%) (P < 0.05), as shown in Table 6.

Table 3: Comparison of total protein (TP) before and after operation (g/L).

|                        | TG-RY (n = 22) | PG-DT (n = 18) | P     |
|------------------------|----------------|----------------|-------|
| Total protein          |                |                |       |
| preoperation           | 124.00 ± 24.98 | 112.56 ± 20.50 | 0.137 |
| postoperation          | 110.55 ± 19.28 | 104.50 ± 16.19 | 0.038 |
| P                      | 0.043*         | 0.212          |       |

Table 4: Comparison of hemoglobin (HB) in patients before and after operation (g/L).

|                        | TG-RY (n = 22) | PG-DT (n = 18) | P     |
|------------------------|----------------|----------------|-------|
| Hemoglobin preoperation| 38.15 ± 6.03   | 37.8 ± 3.81    | 0.347 |
| postoperation          | 30.14 ± 5.22   | 32.80 ± 4.04   | 0.167 |
| P                      | 0.013*         | 0.042*         |       |

Table 5: Comparison of albumin (ALB) before and after operation (g/L).

|                        | TG-RY (n = 22) | PG-DT (n = 18) | P     |
|------------------------|----------------|----------------|-------|
| Albumin preoperation   | 65.2 ± 6.12    | 67.17 ± 6.21   | 0.467 |
| postoperation          | 56.84 ± 4.02   | 58.43 ± 6.57   | 0.325 |
| P                      | 0.026*         | 0.037*         |       |

complications in TG-RY group was 8 cases (36.4%), which was higher than that in PG-DT group 5 cases (27.8%) (P < 0.05), as shown in Table 6.

In recent years, adenocarcinoma of esophago-gastric junction (AEG), as a cancer proximal gastric cancer, has an increasing incidence worldwide with significant regional differences. Nowadays, with the comprehensive application of various treatment methods in AEG, the postoperative survival time of patients is prolonged, and surgery still plays an important role in AEG [16]. Therefore, clinicians pay more and more attention to the quality of life of patients after surgery on the premise of ensuring the tumor is eradicated. At present, AEG surgery methods include TG (total gastrectomy) and PG (proximal gastrectomy), both of which have their advantages and disadvantages and are controversial [17]. PG retains the distal stomach and theoretically has better postoperative feeding and digestive functions than TG. However, domestic and foreign studies have found that PG has no less tumor safety and postoperative survival rate than TG [18].

At present, esophagogastrectomy (EG), double tract reconstruction (DTR), and gastroesophagostomy are fairly widely used in postoperative anastomosis [19]. EG is an earlier anastomotic method used in PG, which has the advantages of simplicity of operator, fewer postoperative anastomosis-related complications, and certain antireflux effect [20]. DTR is the PG antireflux anastomosis with the highest expert recommendation rate in China, and this method has a trend of gradually surpassing EG in clinical application in China. By placing a jejunum between the esophagus and stomach, the reflux distance can be extended, and food can be absorbed downward through two channels, improving the postoperative nutritional status and reducing the occurrence of gastric retention [21].

This study collected the treatment data of patients with proximal gastric cancer to evaluate the clinical efficacy of laparoscopic-assisted resection of proximal gastric cancer and postoperative digestive tract reconstruction. There were differences in preoperative TNM staging between the two groups, it is speculated that the TNM stage of patients is related to the choice of treatment mode of patients, which can be further studied in the later stage. Then, the safety of postoperative digestive tract reconstruction was evaluated. In the PG-DT group, intraoperative blood loss, postoperative hospital stay, and first exhaust time were smaller, indicating higher safety. Large amount of intraoperative blood loss will not only cause postoperative stress but also increase the cardiopulmonary function load of patients, which may lead to electrolyte imbalance and abnormal coagulation function of patients and ultimately may lead to slow recovery of patients and even increase the occurrence of postoperative complications. Therefore, it can be seen that PG-DT therapy has a good surgical safety and can promote the postoperative recovery of patients.

Follow-up results also showed that the nutritional indexes of all patients decreased after surgery compared with
that before surgery, and the nutritional indexes of patients in TG-RY group decreased more after surgery. The use of post-operative DTR anastomosis not only can have a better post-operative nutritional status but also can reduce the incidence of complications and better treatment effect. Therefore, it can be seen that laparoscopic-assisted proximal gastric cancer resection with postoperative double-channel reconstruction for gastric cancer patients has significant efficacy, which can effectively ensure the safety of patients’ life during surgery, improve the postoperative recovery speed of patients, and reduce the occurrence of postoperative complications. However, due to many changes in clinical treatment, doctors need to choose the most suitable surgical method according to the actual situation. This study provides a more effective treatment method for patients.

5. Conclusion

In conclusion, proximal gastric cancer resection and postoperative DTR anastomosis can effectively accelerate the recovery speed of patients and reduce the incidence of postoperative complications, with good efficacy. The effect of laparoscopic-assisted surgery is better. However, there are many deficiencies in this study as follows; due to the loss of follow-up patients in the later period, the statistics of postoperative cancer recurrence rate were not carried out in this study, and further statistics are needed in the future to make the study more perfect.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Authors’ Contributions

Qian Yang and Weisheng Mo contributed equally to this work.
Acknowledgments

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