



Research Article

Preliminary Experience with A Modified Procedure of Laparoscopic Proximal Gastrectomy Esophagogastric Anastomosis with Muscle Flap Plasty (Kamikawa Anastomosis)

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Abstract

Purpose: To investigate the short-term efficacy of patients undergoing laparoscopic proximal gastrectomy and esophagogastric anastomosis with single pectoral muscle flap plasty (SFT).

Methods: A descriptive case-series study method was used to retrospectively collect 5 cases of primary upper gastric carcinoma diagnosed pathologically in gastrointestinal Surgery department of the First Affiliated Hospital of Air Force Military Medical University from July 2020 to July 2021. All 5 patients were male. The average age was 57.8 years; the average body mass index was 23.78 kg/m². The tumors were all located in the posterior wall of the lower cardia stomach. 3 cases were well-differentiated adenocarcinoma and 2 cases were moderately differentiated adenocarcinoma. Laparoscopic proximal gastrectomy and esophagogastric anastomosis with single muscle flap were performed in 5 patients with well/ moderately differentiated adenocarcinoma at the esophagogastric junction. The common opening was continuously sutured with barbed wire and the anastomosis was embedded with single muscle flap. The intraoperative and postoperative recovery and pathology were observed.

Result: All patients underwent smooth operation, with an average operation time of 270 (240-280) min and an average intraoperative blood loss of 35 (20-60) ml. No patient was conversions to laparotomy. The average exhaust time of the patients was 2 (2-3) d, the upper digestive tract water-soluble angiography was performed on the 6th postoperative day to rule out

anastomotic leakage and anastomotic stenosis, and oral feeding was resumed, the nutrient tube was removed. The average fluid diet time was 6 (6-7) d, and the average postoperative hospitalization was 8 (8-9) d. An average of 21 (20-23) lymph nodes were dissected. Postoperative pathological stages were T3N1M0, T2N1M0, T3N2M0, T1bN1M0, T3N2M0.

Conclusion: The short-term efficacy of laparoscopic single muscle flap anastomosis after proximal gastrectomy is satisfactory, but further follow-up is needed to determine the long-term efficacy of this treatment plan.

Keywords: Laparoscopy; Proximal gastrectomy; Single muscle flaps; Stomach tumors

Introduction

Gastric cancer is the fifth most common cause of cancer worldwide and the third leading cause of cancer-related deaths every year [1]. Although the incidence of gastric cancer in the world is lower than before, the incidence of esophagogastric junction tumors and upper gastric tumor is gradually increasing [2,3]. Currently, the treatment of esophagogastric junction tumor and upper gastric tumor is mainly surgical [4]. However, there is no clinical consensus on the choice of surgical method for these patients. Compared with total gastrectomy, proximal gastrectomy can retain the physiological function of the stomach and has great advantages in nutrition absorption, so it has been widely accepted in Asian countries [5]. However, the risk of reflux esophagitis after proximal gastrectomy is high, which seriously affects the postoperative quality of life of patients. In order to reduce the incidence of postoperative complications, researchers have continuously improved the methods of digestive tract reconstruction. Currently, the commonly used methods of digestive tract reconstruction after proximal gastrectomy include esophagogastrostomy, jejunal interposition (JI) jejunal pouch interposition (JPI) and Double Tract Reconstruction (DTR) [6]. However, the selection of reconstruction method after proximal gastrectomy is still controversial and there is no standard method for digestive tract reconstruction. In 2016, Kuroda et al. [7] reported that Kamikawa anastomosis after

laparoscopic proximal gastrectomy showed satisfactory short-term efficacy compared with traditional esophagogastrostomy, and no reflux esophagitis was found in all patients during 1-year follow-up after surgery. However, Kamikawa anastomosis still has some disadvantages, such as complicated in operation, high suture skill requirement for the surgeon under endoscopy, long learning curve, long operation time and double muscle flap prone to ischemic necrosis. Recently, the author's center performed Single-Flap Technique (SFT) on 5 patients with laparoscopic proximal gastrectomy and esophagogastrostomy, changing double muscle flap to single muscle flap, and the short-term efficacy of all patients was satisfactory, as reported below.

Data and Methods

- 1. General Information:** A descriptive case-series study method was used to retrospectively collect 5 cases of primary upper gastric carcinoma diagnosed pathologically in gastrointestinal Surgery department of the First Affiliated Hospital of Air Force Military Medical University from July 2020 to July 2021. All 5 patients were male. The average age was 57.8 years; The average body mass index was 23.78 kg/m². The tumors were all located in the posterior wall of the lower cardia stomach. 3 cases were well-differentiated adenocarcinoma and 2 cases were moderately differentiated adenocarcinoma. The clinical data of all patients are shown in Table 1. This study was approved by the Hospital ethics Committee (Approval number: ChiECRCT20210199).

ID	Hospital date	Age (years)	Gender	BMI (kg/m ²)	Tumor size	TNM	Date of surgery	Operation time(min)	Blood loss (ml)	Exhaust time (day)	fluid diet time (day)	Discharge date	Length of stay (day)	Number of lymph nodes cleared	Tumor site	Preoperative pathology	Physical Examination	CT examination
1	15-07-2020	54	male	23	2.5 cm×2.0 cm	cT3N2M0	16-07-2020	280	40	3	7	23-07-2020	8	20	gastric fundus posterior wall near the cardia	Well differentiated adenocarcinoma	Without special	Suggests mild thickening of the cardia wall with a few surrounding slightly enlarged lymph nodes
2	02-09-2020	69	male	23.1	0.8 cm×0.8 cm	cT1bN1M0	03-09-2020	275	60	2	7	11-09-2020	9	20	gastric fundus posterior wall near the cardia	Moderately differentiated adenocarcinoma	Without special	Suggests mild thickening and strengthening of the cardia wall
3	12-12-2020	58	male	23.4	1.5 cm×1.0 cm	cT3N2M0	13-12-2020	276	20	2	6	20-12-2020	8	23	gastric fundus posterior wall near the cardia	Moderately differentiated adenocarcinoma	Without special	Suggests mild thickening of the cardia wall with a few surrounding slightly enlarged lymph nodes
4	10-03-2021	62	male	24.3	2.0 cm×1.6 cm	cT2N1M0	11-03-2021	280	25	2	6	18-03-2021	8	21	gastric fundus posterior wall near the cardia	Well differentiated adenocarcinoma	Without special	Suggests mild thickening and strengthening of the cardia wall
5	25-05-2021	46	male	25.1	1.8 cm×1.4 cm	cT3N1M0	26-05-2021	240	30	2	6	03-06-2021	8	21	gastric fundus posterior wall near the cardia	Well differentiated adenocarcinoma	Without special	Suggests thickening and stiffness of the cardia wall, surrounded by a few slightly enlarged lymph nodes

Table 1: Clinical data of 5 patients with gastric cancer.

2. Surgical Methods: All the 5 patients were treated with tracheal intubation and general anesthesia, supine position, with their legs spread apart, routine “five-hole arc method” was used for abdominal operation holes, laparoscopic instruments were inserted, routine abdominal exploration, peritoneum, omentum and viscera were investigated, and metastatic lesions were detected. Proximal gastrectomy with D2 lymph node dissection was completed according to the 5th edition of Gastric Cancer Treatment Guidelines. Early postoperative nutrition tube provides enteral nutrition support [8].

Reverse puncture esophagogastric single muscle flap anastomosis:(1) An arc incision of about 5 cm was made in the sub-umbilical to establish pneumoperitoneum, and an incision of about 1 cm was made at 2 cm in the lower part of the proposed esophageal resection, and a stapler nail holder with a needle of 25 mm was inserted, as shown in Figure 1a;(2) Reverse puncture through the esophageal wall at a position 2 cm to the upper right of the esophageal incision;(3) The 60 mm Endostapler transection the esophagus about 1 cm above the esophageal incision, as shown in Figure 1b;(4) The nail holder was removed from the side walls, and the sutures of about 5 cm were reserved for traction, the remaining sutures were cut off, pneumoperitoneum was closed, and the specimen was removed from the sub-umbilical incision to make a tubular stomach on the premise that the tumor resection margin was guaranteed, the tumor is located in the gastric fundus posterior wall near the cardia, without invasion of serosal layer, the upper margins is 3.0cm away from the tumor, the lower margins is 5 cm away from the tumor, 3-4 cm away from the proximal end of the anterior wall of the remnant stomach is marked with a “ㄣ” shape, the width is about 3.0cm, the upper and lower spacing is about 4.0cm, as shown in Figure 1c. (5) The “ㄣ” shape is cut horizontally on both sides and longitudinally along the serosa layer and muscle layer on the right side, the left serosa is retained to form a single muscle flap, as shown in Figure 1d. (6) The width of the muscle flap is about 3 cm, which is used to wrap the anastomosis in the follow-up, as show in Figure 1e. The anterior wall of the stomach is opened about 2 cm longitudinally at about 4 cm below the proposed anastomosis at the lower margins of the muscle flap. The circular stapler is put into sterile gloves outside the body, and then the 25 mm circular stapler is disposed through the opening of the stomach wall. The circular stapler is punctured about 1 cm below the “ㄣ” type muscle flap; (7) Put the remnant stomach back into the abdominal cavity, put the gloves on the stapler into the incision protector, establish pneumoperitoneum again, connect with the esophageal nail holder, press and tighten it, and then anastomose the remnant of the esophagus. The operator stands on the right side, covers the anastomosis with a single muscle flap, continuously strengthens the suture with 3 #0 barbed wire, and wraps the “ㄣ” continuous suture on the pulp muscle flap of the anterior wall of the stomach around the anastomosis, as show in Figure1f,1g,1h ,1i.

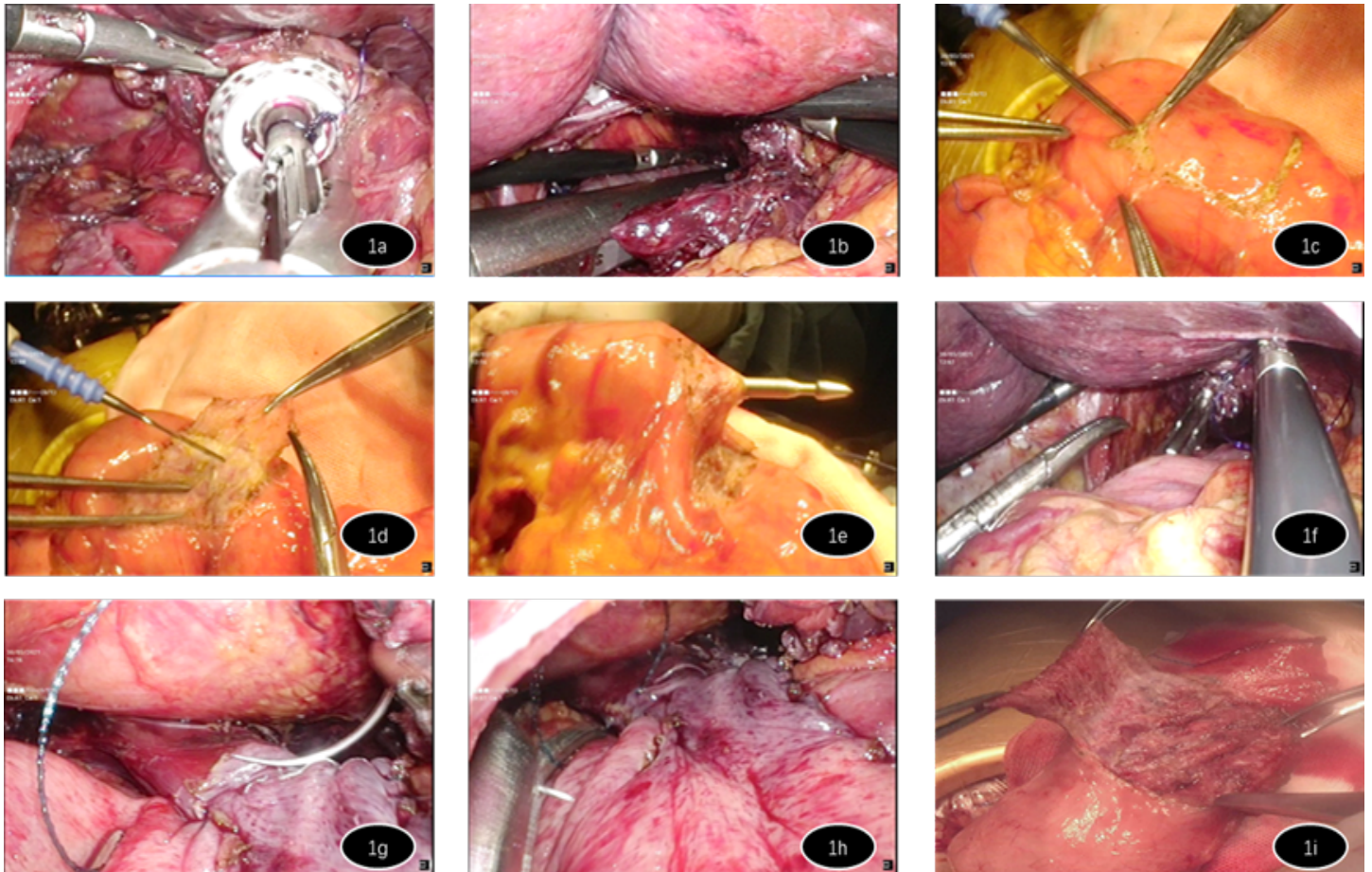


Figure 1: Laparoscopic Proximal Gastrectomy Esophagogastric Kamikawa Anastomosis Modification Procedure 1a. an incision of about 1 cm was made at 2 cm in the lower part of the proposed esophageal resection, and a stapler nail holder with a needle of 25 mm was inserted; 1b. The 60 mm Endostapler transected the esophagus about 1 cm above the esophageal incision; 1c. 3-4 cm away from the proximal end of the anterior wall of the remnant stomach is marked with a “ \sqcap ” shape, the width is about 3.0cm, the upper and lower spacing is about 4.0cm; 1d. The electric scalpels incised the plasma membrane and muscle layer on the upper and lower sides of the “ \sqcap ” shaped transverse row and the right side of the longitudinal row, preserving the left plasma membrane and forming a single muscle flap. 1e. Single muscle flap overlying the anastomosis; 1f. continuous reinforcement of the anastomosis with barbed sutures; 1g. posterior wall anastomosis with continuous suturing of the entire esophageal section and the mucosal and submucosal layers of the remnant stomach; 1h. continuous suturing of the antral pulpy muscle flap in a “ \sqcap ” shape around the anastomosis; 1i. formation of an Overlap single muscle flap.

3. Observation Indicators: (1) intraoperative conditions: including operation time, intraoperative bleeding and conversions to laparotomy; (2) Postoperative conditions: including postoperative exhaust time, postoperative anastomotic leakage and anastomotic stenosis, fluid diet time and postoperative hospitalization days; (3) Postoperative pathological conditions: including the number of lymph node dissections and tumor pathological staging, the latter was staged according to the 2017 American Joint Commission on Cancer TNM staging standard (8th Edition) [9].

4. Statistical Method: descriptive statistical method is adopted. The measurement data are expressed in average (range) and the counting data are expressed in absolute numbers

Results

- i. Intraoperative condition: All patients underwent smooth operation, with an average operation time of 270 (240-280) min and an average intraoperative blood loss of 35 (20-60) ml. No patient was conversions to laparotomy.
- ii. Postoperative situation: The average exhaust time of the patients was 2(2-3) d, the upper digestive tract water-soluble angiography was performed on the 6th postoperative day to rule out anastomotic leakage and anastomotic stenosis, and oral feeding was resumed, the nutrient tube was removed. The average fluid diet time was 6 (6-7) d, and the average postoperative hospitalization was 8 (8-9) d.
- iii. Pathological conditions: An average of 21 (20-23) lymph nodes were dissected. Postoperative pathological stages were T3N1M0, T2N1M0, T3N2M0, T1bN1M0, T3N2M0.

Discussion

As the main treatment for esophagogastric junction carcinoma and upper gastric carcinoma, surgery is essential to the therapeutic effect. However, the choice between proximal gastrectomy and total gastrectomy has remained controversial in such patients. Compared with total gastrectomy, proximal gastrectomy can maintain the physiological functions of gastric storage and digestion by preserving the residual stomach, and has great advantages in nutritional absorption, so it has been extensively carried out in Asian countries [5]. However, as proximal gastrectomy destroys the barrier against reflux and damages the angle of His, the incidence of anastomotic stricture and reflux esophagitis increases significantly [10,11]. Therefore, in order to improve the postoperative quality of life, it is critical to determine the suitable reconstruction method of digestive tract after proximal gastrectomy. Nakamura et al. [12] reported that with fundoplication, the incidence of postoperative reflux esophagitis decreased from 22% to 4%. In addition, Yasuda et al. [13] found that the reconstruction of a structure similar to angle of His by using the diaphragm can also achieve the effect of reducing reflux. Masuzawa et al. [14] found that the jejunal interposition group has significantly fewer gastrointestinal symptoms such as heartburn and choking after eating than the esophagogastric anastomosis group. Whereas, the operation of jejunal interposition is more complicated. Moreover, jejunal interposition requires to determine the length of jejunal interposition, but no clinical standard of the optimal length of jejunal interposition has formed, which puts forward higher requirements for operators. Compared with jejunal interposition, the operation of jejunal pouch interposition is more complicated, nonetheless, Takagawa et al. [15] showed that compared with jejunal interposition, jejunal pouch interposition has certain advantages in reducing early postoperative gastrointestinal symptoms.

Double tract reconstruction is a commonly used method of digestive tract reconstruction in clinic at present. In recent years, it has been widely used in both laparotomy and laparoscopic surgery. Ahn et al. [16] found that the incidence of reflux esophagitis and anastomotic stenosis after double tract reconstruction is lower than after esophagogastric anastomosis. Noteworthy, this reconstruction method has a large number of anastomoses, which increases the risk of anastomotic leakage. Compared with other anastomosis methods, Kamikawa anastomosis wraps and reconstructs the anastomotic stoma of esophageal remnant stomach with two free muscle flaps of remnant stomach, so as to increase the pressure at the lower end of esophagus, and then plays a one-way valve role similar to the cardiac structure, which can available increase the effect of anti-reflux. Furthermore, patients treated by this anastomosis method can routinely undergo endoscopic examination of postoperative remnant stomach [7]. In 2016, Kuroda et al. [7] confirmed for the first time that it is safe and feasible to complete the Kamikawa anastomosis under laparoscopy, and the patient did not have reflux esophagitis during the 1-year follow-up. Although the Kamikawa anastomosis is completed by manual suture with low cost, the operation of double muscle flap anastomosis is complex, the muscle flap is easy to ischemia, the requirements for suture technology are high, the operation time is long, and it is possible to increase the incidence of anastomotic stenosis [17].

In view of the shortcomings of the Kamikawa anastomosis, our research team improved the anastomosis method, changed the double muscle flap to the single muscle flap, and applied the new operation method in practice. We believe that unlike the collar structure of double muscle flap, the suture of single muscle flap is similar to the tunnel effect, when using barb-wire to close the single muscle flap, which can avoid over tightening to ensure the anti-reflux effect and avoid anastomotic stenosis. All of the 5 patients underwent tubular gastroesophageal anastomosis because their tumors belonged to Siewert II type well/moderately-differentiated adenocarcinoma located at the esophagogastric junction, and the esophageal resection margin was high. Ronellenfitsch et al. [18] reported that 30% of patients had reflux symptoms after tubular gastroesophageal anastomosis, but the symptoms were mild. Due to the high location of the tumor, the traditional anastomosis requires a long epigastric incision, which is difficult to expose, and the risk of the anastomosis is high. Therefore, we adopt a small incision near the umbilicus for reverse puncture anastomosis, and use a single muscle flap to embed the anastomosis on the basis of the tubular stomach, so as to further reduce the risk of reflux. Our experience is such that making single muscle flap of tubular stomach is safer and simpler, and the anastomosis is more complete. The reverse puncture anastomosis through sub-umbilical incision has a better field of vision than laparotomy, which is suitable for patients with high tumor location.

In this study, barbed wire was used to continuously suture the common opening anastomosis and the single muscle flap embedding anastomosis. The results of our study showed that 5 patients had no anastomotic stenosis during gastroscopy and angiography on the 6th day after operation, and all showed smooth anastomotic stoma. Short-term follow-up showed that patients did not have adverse symptoms such as reflux after operation. The preliminary practice of 5 patients in our center proved that the short-term effect of laparoscopic proximal gastrectomy followed by single muscle flap plasty is satisfactory. During the recent follow-up, the patient did not have postoperative complications, such as reflux esophagitis, anastomotic leakage, anastomotic stenosis and dumping syndrome. Whereas, the long-term efficacy of this treatment regimen is needed to clarify by further gastroscopy and follow-up observation. Furthermore, in order to confirm whether single muscle flap plasty after laparoscopic proximal gastrectomy can be used as one of the best methods of digestive tract reconstruction after proximal gastrectomy, multi center, large sample, prospective studies are still needed in the future.

References

1. Smyth EC, Nilsson M, Grabsch HI, van Grieken NC, Lordick F (2020) Gastric cancer. *Lancet* 2020: 635-648.
2. Leers JM, Knepper L, van der Veen A, Schröder W, Fuchs H, et al. (2020) The CARDIA-trial protocol: a multinational, prospective, randomized, clinical trial comparing transthoracic esophagectomy with transhiatal extended gastrectomy in adenocarcinoma of the gastroesophageal junction (GEJ) type II. *BMC Cancer* 20: 781.
3. Deans C, Yeo MS, Soe MY, Shabbir A, So JBY, et al. (2011) Cancer of the gastric cardia is rising in incidence in an Asian population and is associated with adverse outcome. *World J Surg* 35: 617-624.
4. Chevallay M, Bollschweiler E, Chandramohan SM, Schmidt T, Koch O, et al. (2018) Cancer of the gastroesophageal junction: a diagnosis, classification, and management review. *Ann N Y Acad Sci* 1434: 132-138.
5. Kumamoto T, Sasako M, Ishida Y, Kurahashi Y, Shinohara H (2021) Clinical outcomes of proximal gastrectomy for gastric cancer: A comparison between the double-flap technique and jejunal interposition. *PLoS One* 16: e0247636.
6. Sun KK, Wu YY (2021) Current status of laparoscopic proximal gastrectomy in proximal gastric cancer: Technical details and oncologic outcomes. *Asian J Surg* 44: 54-58.
7. Kuroda S, Nishizaki M, Kikuchi S (2016) Double-flap technique as an antireflux procedure in esophagogastronomy after proximal gastrectomy. *J Am Coll Surg* 223: e7-e13.
8. Japanese Gastric Cancer Association (2021) Japanese gastric cancer treatment guidelines 2018 (5th edition) *Gastric Cancer* 24: 1-21.
9. Amin MB, Edge SB, Greene FL (2017) *AJCC cancer staging manual*. 8th ed. New York: Springer 2017.
10. Ji X, Jin C, Ji K, et al. (2021) Double Tract Reconstruction Reduces Reflux Esophagitis and Improves Quality of Life after Radical Proximal Gastrectomy for Patients with Upper Gastric or Esophagogastric Adenocarcinoma. *Cancer Res Treat* 53: 784-794.
11. Hojo Y, Nakamura T, Kumamoto T (2022) Marked improvement of severe reflux esophagitis following proximal gastrectomy with esophagogastronomy by the right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion. *Gastric Cancer* 2022.
12. Nakamura M, Nakamori M, Ojima T (2014) Reconstruction after proximal gastrectomy for early gastric cancer in the upper third of the stomach: an analysis of our 13-year experience. *Surgery* 156: 57-63.
13. Yasuda A, Yasuda T, Imamoto H (2015) A newly modified esophagogastronomy with a reliable angle of His by placing a gastric tube in the lower mediastinum in laparoscopy - assisted proximal gastrectomy. *Gastric Cancer* 18: 850-858.
14. Masuzawa T, Takiguchi S, Hirao M (2014) Comparison of perioperative and long - term outcomes of total and proximal gastrectomy for early gastric cancer: a multi - institutional retrospective study. *World J Surg* 38: 1100-1106.
15. Takagawa R, Kunisaki C, Kimura J (2010) A pilot study comparing jejunal pouch and jejunal interposition reconstruction after proximal gastrectomy. *Dig Surg* 27: 502-508.
16. Ahn SH, Jung DH, Son SY (2014) Laparoscopic double-tract proximal gastrectomy for proximal early gastric cancer. *Gastric Cancer* 17: 562-570.
17. Mine S, Nunobe S, & Watanabe M (2015) A Novel Technique of Anti-reflux Esophagogastronomy Following Left Thoracoabdominal Esophagectomy for Carcinoma of the Esophagogastric Junction. *World J Surg* 39: 2359-2361.
18. Ronellenfitch U, Najmeh S, Andaliab A, et al. (2015) Functional outcomes and quality of life after proximal gastrectomy with esophagogastronomy using a narrow gastric conduit. *Ann Surg Oncol* 22: 772-779.