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Double H-flap Technique, an Anti-reflux Adjunct to Esophagogastrostomy After Proximal Gastrectomy for Gastric Leiomyoma: A Case Report

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A significant challenge after performing resection of the esophagogastric region, is the reconstruction that follows. Esophagogastrostomy is a simple and direct method to restore gastrointestinal continuity using a single anastomosis but is associated with reflux esophagitis and anastomotic stenosis. This case report presents a 29-year-old man with a bleeding gastroesophageal junction leiomyoma who underwent a proximal gastrectomy and an esophagogastrostomy reconstruction with a double H-flap technique to reduce the incidence of gastric reflux. This illustrative description of the double H-flap technique created a valve mechanism that mimicked the function of the resected sphincter and cardia. This anti-reflux adjunct technique is reproducible and effective in preventing gastroesophageal reflux symptoms after an esophagogastrostomy.

Key words: proximal gastrectomy, esophagogastrostomy, double flap technique, reflux esophagitis

The extent of resection for proximal gastric tumors depends on tumor histology, disease stage, involvement of the gastroesophageal junction (GEJ), and the resultant residual gastric volume.[1] The oncologic outcomes between a proximal gastrectomy (PG) and a total gastrectomy (TG) for early gastric cancer are equivalent.[2-4] Proximal gastrectomy as a function-preserving procedure is preferred as it maintains the gastric reservoir leading to less nutritional and hematologic deficiencies and better quality of life.[5-8] PG with reconstruction via an esophagogastrostomy (EG) is also technically simpler requiring only a single anastomosis. The main disadvantage of PG with EG is the higher incidence of reflux and anastomotic stricture compared to TG reconstructed using a Roux-en-Y esophagojejunostomy.[9] The Japanese Gastric Cancer Association has recommended three reconstruction options following PG: esophagojejunostomy (EG), jejunal interposition (JI) and double-tract reconstruction (DTR)10. While JI and DTR take care of the reflux and stricture problems encountered with the usual EG, they are technically demanding procedures. Several modifications in the manner of EG reconstruction have been proposed to minimize the risk of reflux while maintaining the technical simplicity of this reconstruction method. Gastric tube creation by Adachi, et al., a side overlap with fundoplication by Yamashita, et al. and a double-flap (H-Flap) technique by Kamikawa ,et al. are modifications added to the EG reconstruction.[11-13] The double-flap technique is a valvuloplastic EG technique that implants the distal esophagus into a submuscular tunnel in the stomach to create a one-way valve.[14] This technique was applied in the EG reconstruction of a patient with submucosal tumor in the cardia involving the GEJ that required a proximal gastrectomy. This is the first time this technique was used in the institution and there is no published literature describing the application of this technique locally. This paper aimed to provide an account of the authors' initial experience and insights in performing the procedure to avoid reflux esophagitis associated with EG.

The Case

A 29-year-old male presented with a two-month history of recurrent melena associated with burning epigastric pain. No reported weight loss or chest pain. The patient received multiple transfusions with packed RBCs. No family history of gastric cancers. He is a non-smoker and an occasional alcoholic beverage drinker. Physical examination showed no evidence of pallor or a palpable abdominal mass. An esophagogastroduodenoscopy

revealed a 6-7 cm, round, submucosal mass with a deep, central ulceration located at the cardia. The ulcer had an overlying white exudate, some erythema but no signs of active bleeding (Figure 1). Biopsy of the mass showed adenoma with focal high-grade dysplasia in a background of acute inflammation. Slide review revealed moderate chronic, severe active inflammation, mild intestinal metaplasia, and changes indefinite for dysplasia. CT scan of the abdomen showed a 39mm x 31mm x 45mm (AP x T x CC) homogenously enhancing intraluminal mass with well-defined borders along the gastric cardia partly extending to the distal esophagus (Figure 2). There were no enlarged abdominal lymph nodes nor liver masses. Chest radiograph showed no masses. The preoperative clinical impression was a bleeding submucosal gastroesophageal tumor likely a gastric Gastrointestinal Stromal Tumor (GIST). Due to the risk of re-bleeding and the high clinical suspicion for GIST, surgical resection was planned despite the absence of a definitive histopathologic diagnosis.

The planned surgical procedure was a wide excision of the gastric GIST possible proximal gastrectomy, frozen section, esophagogastrostomy with a double-flap technique as an anti-reflux procedure. (Figure 3) Intraoperatively, there was a 5cm x 4 cm mass in the gastric cardia extending to the right side of the GEJ. The overlying serosa was intact and the mass was predominantly intraluminal on palpation. There were no ascites, peritoneal implants, or liver masses. A proximal gastrectomy with a distal esophagectomy with at least 1 cm margin, with no lymphadenectomy was performed. On opening the surgical specimen, there was a 5cm x 4 cm

Figure 1. Esophagogastroduodenoscopy findings A. retroflex view showing the mass located at the cardia. B. central ulceration found at the submucosal mass with friable mucosa but no active bleeding. C. rest of the stomach showing normal mucosa.

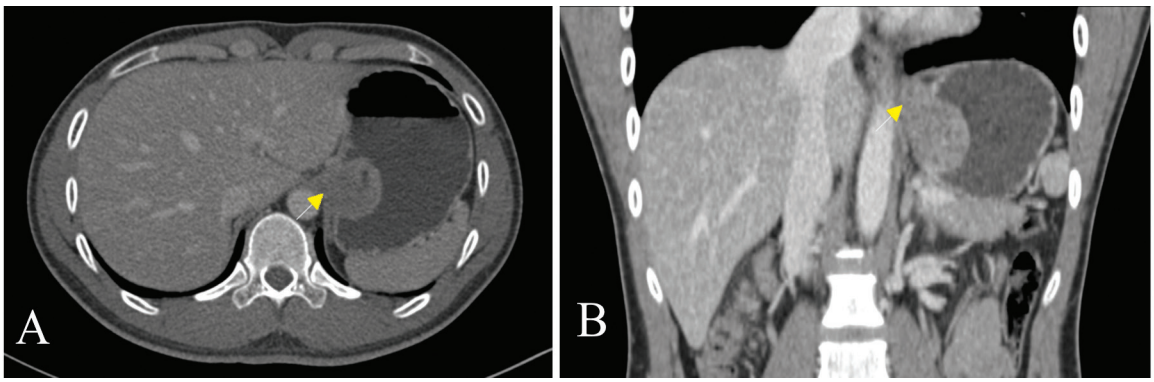

Figure 2. Contrast enhanced computed tomography cuts (A. axial B. coronal) showing the gastroesophageal junction mass (yellow arrow).

mass with central ulceration along the cardia extending minimally to the GEJ and with grossly negative surgical margins (Figure 3). Frozen section revealed a spindle cell neoplasm, and the resection margins were negative for tumor. Esophagogastrostomy reconstruction was made according to the technique described by Kuroda, et al. in 2016.[14]

An H-shaped flap measuring 2.5 cm x 3.5 cm (transverse x longitudinal arms) was outlined on the anterior wall of the gastric remnant 3 cm from the proximal end (Figure 4). From the central longitudinal line, a seromuscular flap was created towards the ends of the transverse lines, similar to opening a book. The plane of dissection was created between the muscular and submucosal layers of the stomach using electrocautery (Figure 5). Using 4-point interrupted silk 3-0 sutures, the posterior wall of the esophagus 5 cm proximal to its distal end while on slight traction was fixed to the gastric remnant at the upper edge of the flap (Figure 6). Kuroda, et al. emphasized that this length is a key technical component of the reconstruction because this esophageal length implanted under the flap creates the one-way valve necessary for the anti-reflux mechanism.[14] Regardless of the extent of the esophageal resection due to the tumor, this length of the esophagus tunneled under the seromuscular flap should be maintained.[14] Only a centimeter of abdominal esophagus had to be included in the resection to achieve tumor-free margins, and minimal transhiatal mobilization of the distal esophagus was needed.

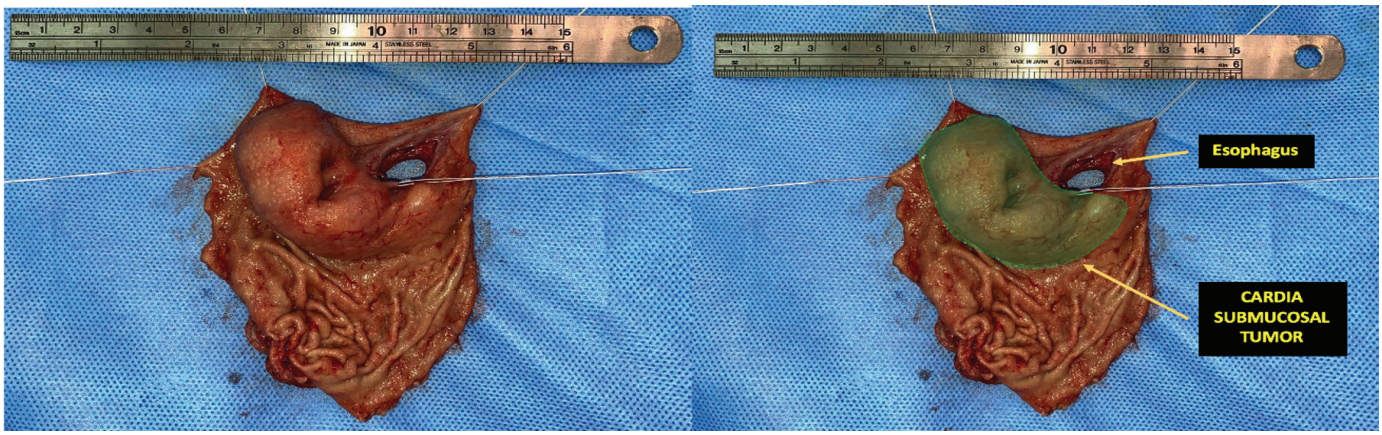

Figure 3. Proximal gastrectomy with distal esophagectomy specimen showing the submucosal tumor (green overlay) along the cardia and part of the GEJ.

Figure 4. H-shaped flap measuring 2.5 cm x 3.5 cm (transverse x longitudinal axis of the stomach) marked on the anterior wall of the gastric remnant. Proximal transverse line is placed 3-4 cm from the top of the remnant stomach.

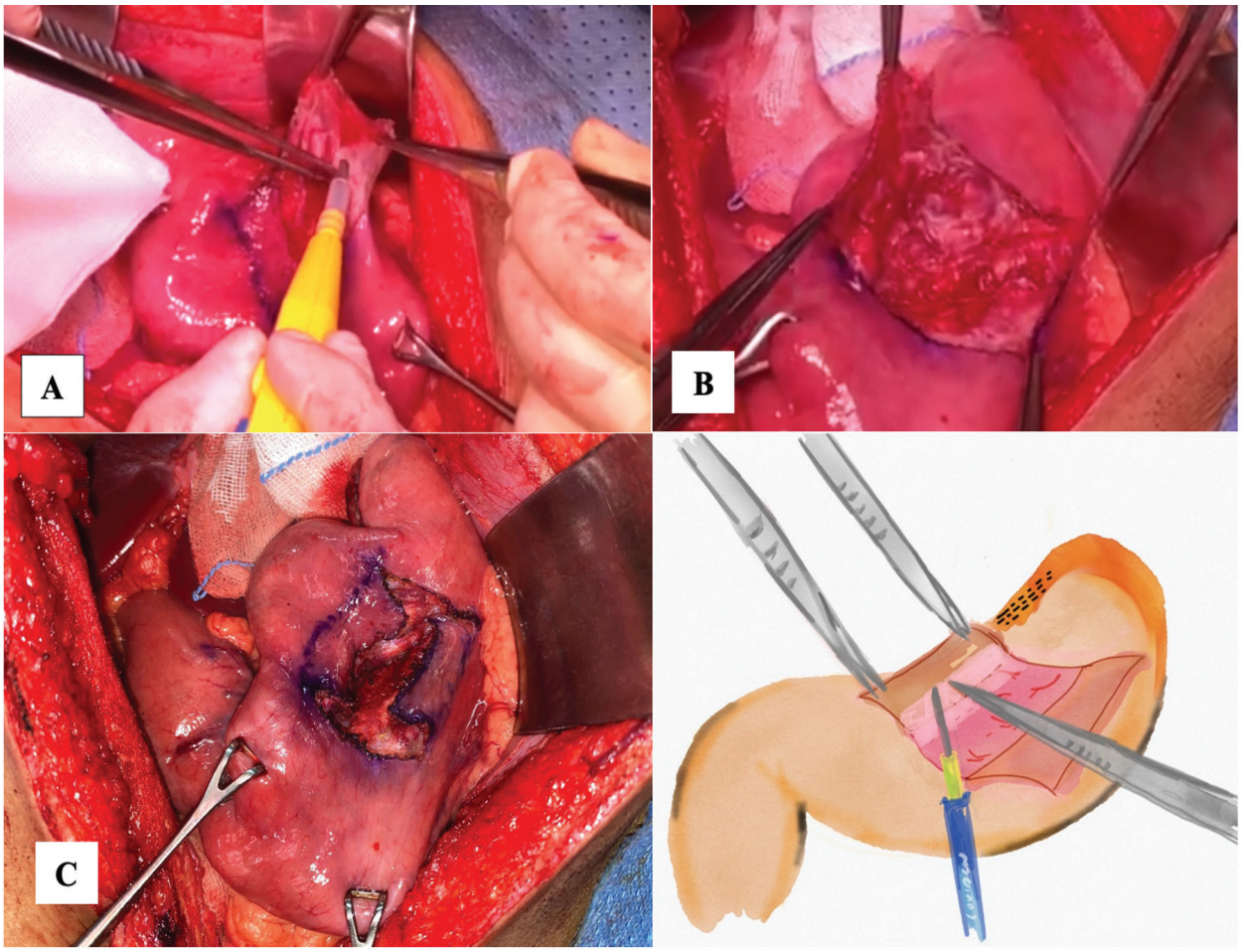

Figure 5. A. The seromuscular flaps created with coordinated appropriate traction between surgeon and surgical assist. The dissection plane was maintained between the muscular and submucosal layers. B. Completed H-flap with flaps retracted. C. Completed H-flap with flaps not retracted.

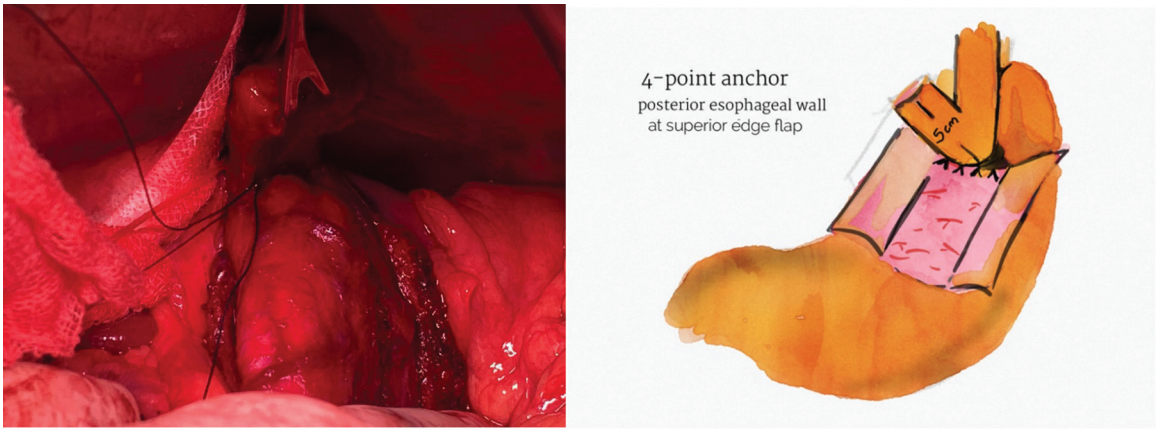

Figure 6. The posterior esophageal wall 5 cm from the distal end anchored to the superior edge of the flap on the remnant stomach.

A gastrotomy for anastomosis was opened 10 mm proximal to the lower edge of the flap (Figure 7). To prevent anastomotic stricture, the gastrotomy length was made a little larger than the width of the esophageal stump. Anastomosis of the posterior wall was prepared by placing three-point stay sutures at both ends and at the middle of the anastomosis site (Figure 8). The stay sutures served as a good traction technique to maintain the anastomotic line while performing a single layer of continuous suturing technique using absorbable, 4-0 monofilament suture between the posterior lip of the esophagus and the superior lip of the gastrotomy. The full thickness of the esophagus was apposed to the mucosa-submucosal layer of the stomach. (Figure 9A). The anterior wall was anastomosed by layer-to-layer suturing. First, the mucosa-submucosal layer of the anterior wall of the esophagus was anastomosed to the mucosa-submucosal layer of the stomach by continuous technique using an absorbable 4-0 monofilament suture. The second layer was approximated by interrupted sutures using silk 4-0 between the muscular layer of the esophagus and the seromuscular layer of the stomach (Figure 9B). The reconstruction was completed by approximating the seromuscular flaps over the esophagus in a Y-shaped configuration via interrupted non-absorbable 4-0 sutures (Figure 10). This effectively covered the EG anastomosis

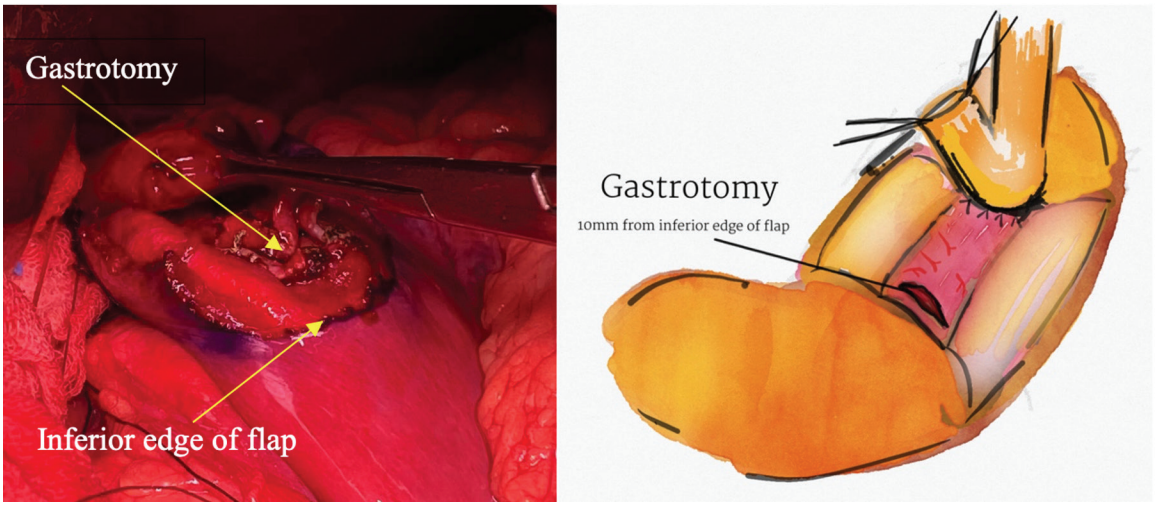

Figure 7. Gastrotomy created 10mm from the inferior edge of the flap.

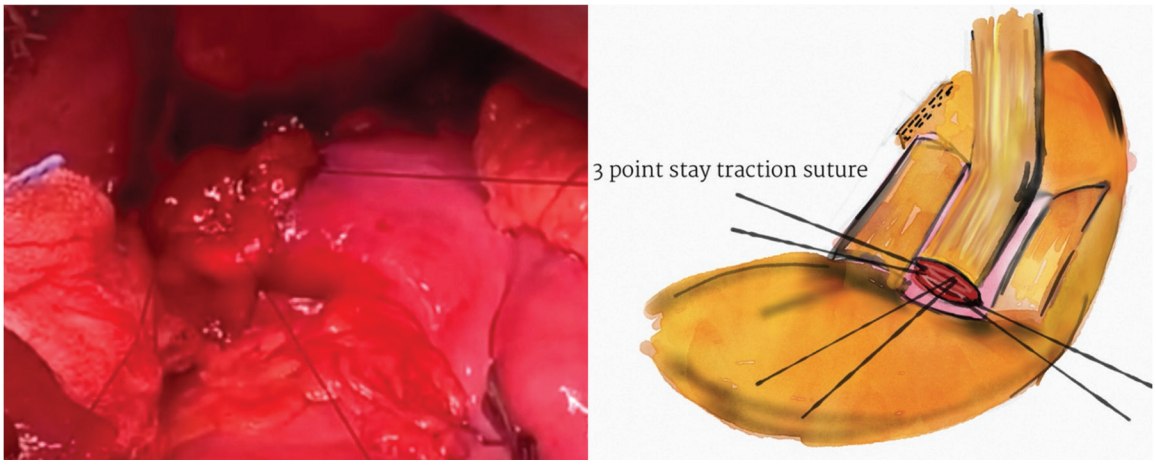

Figure 8. Three-point stay traction suture placed at both ends and middle of the anastomotic line.

while creating the one-way valve mechanism, a new angle of His, and a pseudo-fornix. The pseudo-fornix, the part of the gastric remnant proximal to the EG anastomosis, became the new fundus and contributed to the anti-reflux mechanism by serving as a reservoir. The pseudo-fornix was placed in the left subdiaphragm and anchored by interrupted sutures to the left diaphragmatic crus. No pyloroplasty was done.

The patient had an unremarkable intraoperative course. The operating time was three hundred minutes including the frozen section, with an estimated blood loss of 100 ml. He was placed on parenteral nutrition for five days after surgery. An upper gastrointestinal series was done on postoperative day six which showed smooth flow of contrast across the anastomosis and absence of extravasation. A water challenge test was performed while the patient was in the Trendelenburg position for 10 minutes with no reflux of contrast material into the esophagus (Figure 11). Diet was progressed and he was discharged ten days after the surgery. He had no postoperative complications.

Histopathology showed a spindle cell neoplasm favoring GIST with all surgical resection margins free of tumor. Immunohistochemistry panel was consistent with gastric leiomyoma based on positivity of SMA and negative S100, CD34, CD117 and DOG1 staining.

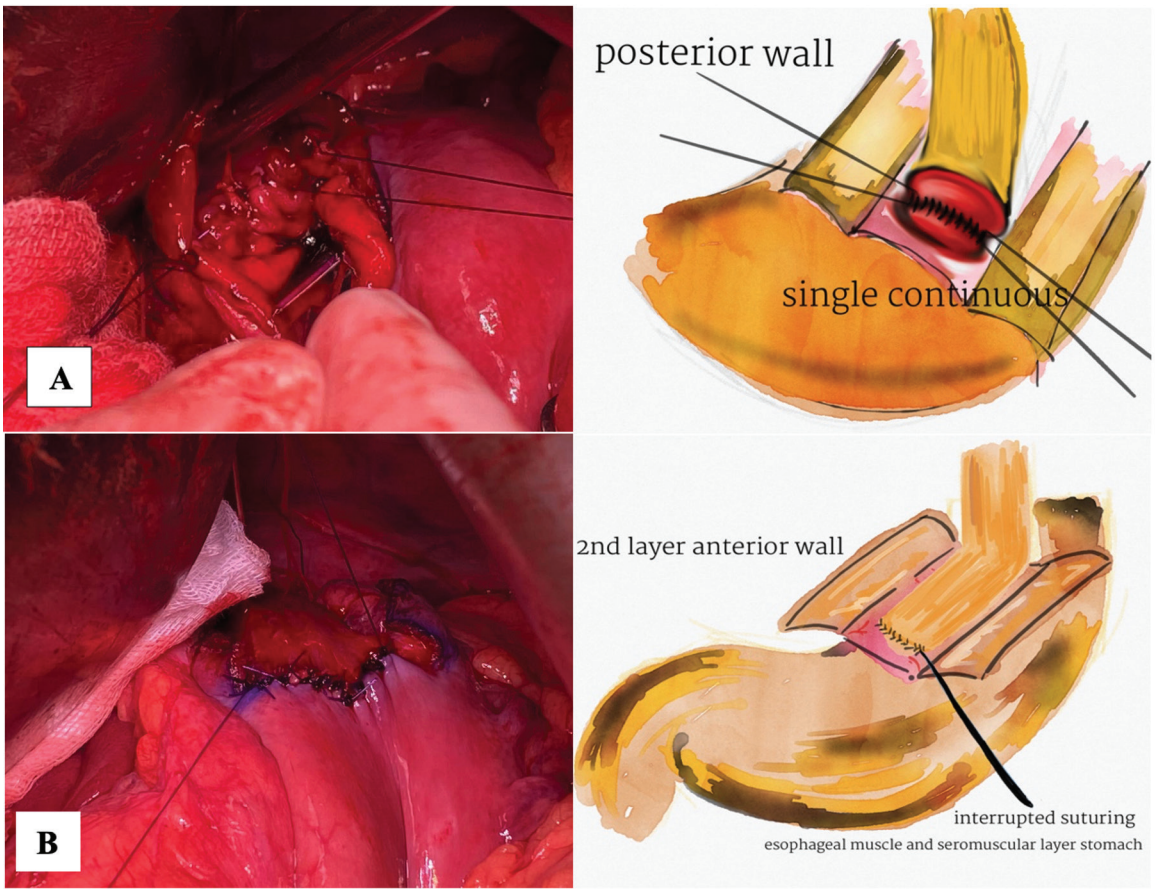

Figure 9. Esophagogastric anastomosis A. Posterior wall single continuous suturing of all layers of esophagus and mucosa-submucosal layer of the stomach B. Anterior wall two-layer suturing. First layer continuous suturing between mucosa-submucosa of esophagus and stomach. Second layer interrupted suturing of esophageal muscle layer and seromuscular layer of the stomach.

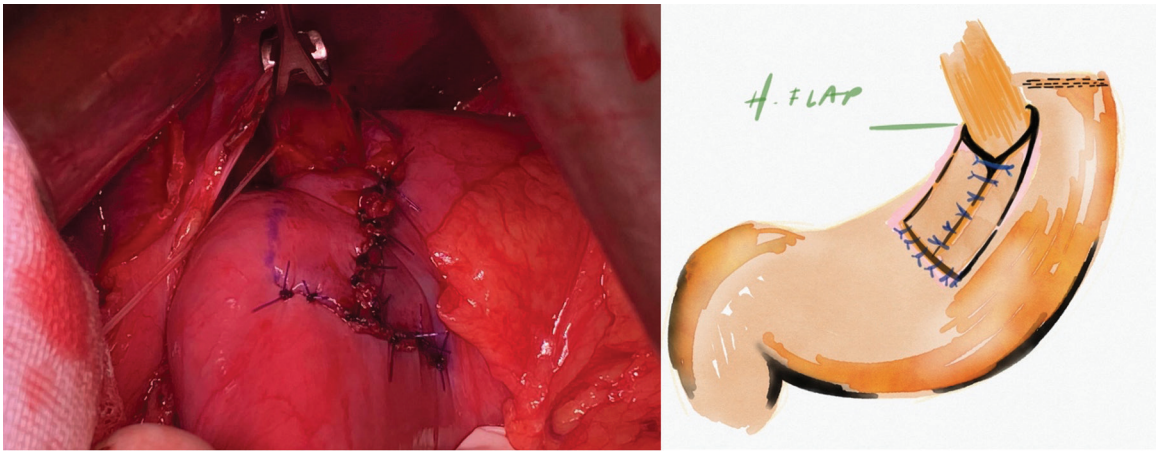

Figure 10. Completed Double H-Flap. Seromuscular flaps reapproximated over the segment of distal esophagus.

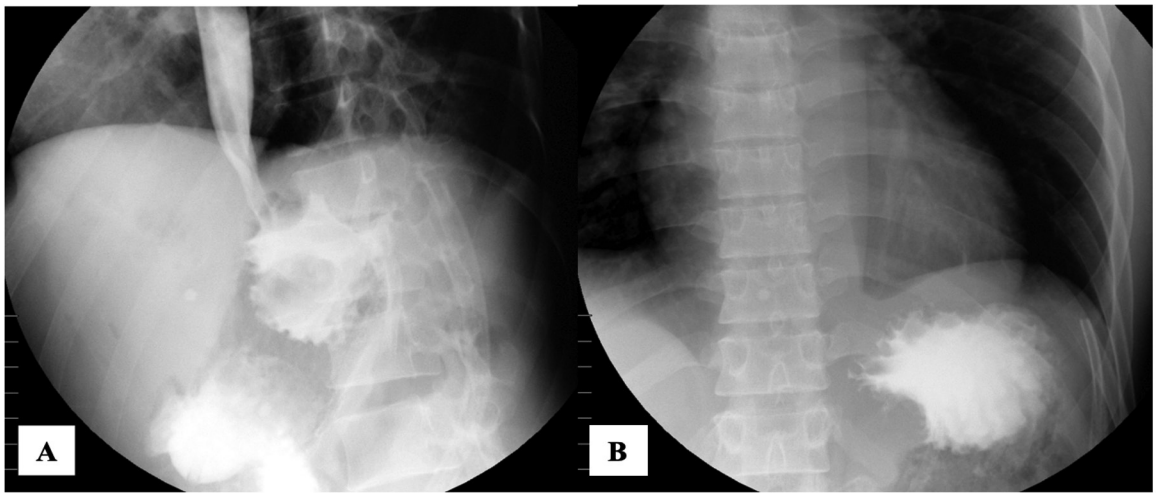

Figure 11. Postoperative Upper Gastrointestinal Series. A. Smooth flow along the good caliber esophagogastric anastomosis, absence of anastomotic leak B. Water Challenge Test absent backflow of contrast after 10 minutes in Trendelenburg position.

The patient reported no gastroesophageal reflux symptoms or dysphagia for the past 6 months after his surgery. Quality of life assessed by the European Organization for Research and Treatment of Cancer (EORTC) QLQ-OG25 (Oesophago-gastric module) at 6 months after surgery showed very low level of symptomatology or problems with a score of 19.4 (possible score 0 to 100 with 100 representing high level of symptomatology).[15] The patient's scores specific for the dysphagia and reflux scales were low at 0 and 16.7, respectively.

Discussion

An EG is the most straightforward method of reconstruction after PG. It offered the most direct route to re-establish intestinal continuity with just a single anastomosis. This procedure was mostly abandoned due to the observed high incidence of reflux esophagitis, anastomotic stenosis and residual food occurring in 20-65.2%, 0-52.2%, and 21% respectively.[16] The resection of the GEJ abolished the anti-reflux mechanism found at the sphincter and cardia. Reflux esophagitis resulted in

the development of anastomotic strictures and there is a risk of metaplasia which can develop into carcinoma.[17] Even if JI and DTR have less incidence of reflux esophagitis and anastomotic stenosis, the advantage of EG includes: the most physiologic reconstruction among the three options, subsequent endoscopic surveillance is easier, and requires only one anastomosis to be monitored after surgery.[18] JI and DTR, on the other hand, are technically demanding procedures associated with longer operating times and increased number of anastomoses.

Technical modifications and adjunct procedures to EG reconstruction were recommended to reduce the risk of reflux. Adachi, et al. proposed a gastric tube creation to lengthen the distance for the bile reflux but the postoperative morbidity, stenosis and reflux esophagitis were still considerable at 0-20%, 7.1-20% and 5.7-30.8%.[11,16] Another technique introduced by Yamashita, et al. in 2017 is the side overlap with fundoplication, where a linear stapler is used to create a slit-shaped anastomosis using side overlap anastomosis in the anterior wall of the residual stomach to serve as a backflow prevention mechanism.[12] This is a promising recently developed technique with preliminary report of 7.1% rate of reflux esophagitis in 1 out of 14 patients.[12]

Kuroda, et al. described the double-flap technique (DFT) in esophagogastrostomy after proximal gastrectomy, based on the valvuloplastic esophagogastrostomy originally reported by Kamikawa in 1998.[13,14] A one-way valve was created by implanting the anastomosis of the esophageal stump and the remnant stomach at the submucosal layer and the anastomosis was then embedded and wrapped within the seromuscular pocket created by the apposed flaps.[14] With the double-flap technique, a pseudofornix, which is the portion of the remnant stomach posterior to the distal esophagus and above the EG anastomosis, contributed to the gastric reservoir function. The angle of His was recreated and the ideal shape of the EG junction approximated the original cardia.[14] The flap also served to cover the anastomosis thereby decreasing the risk of leaks.[14] Adding the double-flap technique to EG, decreased reflux esophagitis from 20-65% to 0-8.3%.[16] A multicenter retrospective study by Kuroda et al. showed the feasibility and utility of the double-flap technique where the incidence of reflux esophagitis after one year of follow-up was 10.6% and 5.5% for anastomotic strictures.[19]

In a retrospective study comparing laparoscopic PG with double-flap technique (LPG-DFT) versus laparoscopic TG, the postoperative complication rate including anastomotic complications was lower for LPG-DFT although the results were not statistically significant.[21] LTG was associated with more severe reflux esophagitis and a longer hospital stay as compared with LPG-DFT.[20] Laparoscopic PG with double-flap technique had a higher mean operating time than LTG (386.5 vs. 316.3 mins, $p < 0.001$) owing to the tedious suturing technique when performed laparoscopically.[21] Open or robotic surgery was more suitable approaches when performing suturing when the double-flap technique was used as an anti-reflux procedure for esophagogastrostomy.[22]

This is the first time that the double-flap technique was performed by the authors and the faithful execution of the steps described by Kuroda, et al. allowed for a successful outcome for this patient. From this initial experience, key steps that helped the authors include 1) familiarization of the dissection plane and the coordination required between the surgeon and surgical assist by rehearsing flap creation in the free wall of the resected stomach, 2) precision in the esophageal length to be implanted under the seromuscular flap, and 3) preparation of the anastomosis by placing a three-point traction suture for better visualization of the anastomotic line. An intraoperative endoscopic assessment of the anastomosis and tightness of the flap would have improved the surgical management of this case. Given the benign nature of the patient's disease, follow-up of the patient is mainly to monitor for possible reflux esophagitis and anastomotic stricture in the future. At 6 months, the patient's quality of life in relation to his disease was good and there were minimal to no symptoms associated with dysphagia and reflux. A longer follow-up is needed to ascertain the advantage of this technique in the patient. An upper gastrointestinal endoscopy is planned at 1 year after surgery to assess the anastomosis and check for findings that may indicate reflux esophagitis.

Given that proximal gastrectomy is a viable alternative for early-stage PGA, this procedure may find increased application. Exploring different reconstruction

techniques can result in the improvement of functional outcomes and the quality of life of patients.

Conclusion

The double-flap (H-flap) technique is a reproducible anti-reflux procedure for esophagogastrostomy. This first experience effectively prevented gastroesophageal reflux symptoms in a patient who underwent proximal gastrectomy with esophagogastrostomy for a submucosal tumor at the cardia. Following the standard technique of the procedure, familiarization of the plane of dissection and coordination between the surgeon and assist, precision in the esophageal length to be implanted under the seromuscular flap, and preparation of the anastomosis by placing a three-point traction suture for better visualization of the anastomotic line are the essential steps in the flap technique.

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