



Marked improvement of severe reflux esophagitis following proximal gastrectomy with esophagogastrostomy by the right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion

Yudai Hojo¹ · Tatsuro Nakamura¹ · Tsutomu Kumamoto¹ · Yasunori Kurahashi¹ · Yoshinori Ishida¹ · Yoshitaka Kitayama² · Toshihiko Tomita² · Hisashi Shinohara¹

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Abstract

Duodenogastroesophageal reflux (DGER) following esophagectomy or gastrectomy can cause severe esophagitis, which impairs patients' quality of life and increases the risk of esophageal carcinogenesis. It is sometimes resistant to medical treatment, and surgical treatment is considered effective in such cases. However, an optimal operative procedure for medical treatment-resistant reflux esophagitis (RE) after proximal gastrectomy (PG) with esophagogastrostomy (EG) has not yet been established. We performed the right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion in a 70-year-old man with medical treatment-resistant severe esophagitis caused by DGER following PG with EG for esophagogastric junction cancer. The postoperative course was uneventful, and esophagogastroduodenoscopy performed on the 19th postoperative day showed marked improvement in the esophageal erosions. The patient reported symptomatic relief. The right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion were considered safe and feasible for medical treatment-resistant RE following PG with EG.

Keywords Reflux esophagitis · Duodenogastroesophageal reflux · Proximal gastrectomy · Esophagogastrostomy · Biliary diversion

Introduction

Reflux esophagitis (RE) is a major postoperative complication following proximal gastrectomy (PG) with esophagogastrostomy (EG) that significantly impairs patients' quality of life. According to evidence-based clinical practice guidelines for gastroesophageal reflux disease in the Japanese Society of Gastroenterology [1], surgical treatment can be effective for medical treatment-resistant RE after esophagectomy or gastrectomy. However, there have been few detailed reports on surgical treatment for RE after PG with EG. Here, we report a case of severe RE following PG with EG that

was successfully treated with the right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion.

Case report

A 70-year-old man was referred to our institution due to severe heart burn and weight loss; the patient's body mass index (BMI) decreased from 24.4 to 14.6 kg/m² in a year. He had undergone open PG with EG for esophagogastric junction cancer at another hospital approximately a year before his first visit to our hospital. According to the operative record, EG was performed using a 25-mm circular stapler, and anterior 180-degree partial fundoplication was added for anti-reflux. Esophagogastroduodenoscopy (EGD) performed 2 months after the operation revealed RE, and oral intake was limited because of reflux symptoms. Medical treatment using a gastric acid secretion suppressor, prokinetic agent, protease inhibitor, and gastric mucosal protectant was not effective enough to relieve the symptoms. At the time of the first visit to our hospital, the patient had severe malnutrition

✉ Hisashi Shinohara
shinohara@hyo-med.ac.jp

¹ Division of Upper GI, Department of Gastroenterological Surgery, Hyogo Medical University, 1-1 Mukogawa-cho, Nishinomiya, Hyogo 663-8501, Japan

² Division of Gastroenterology, Department of Internal Medicine, Hyogo Medical University, 1-1 Mukogawa-cho, Nishinomiya, Hyogo 663-8501, Japan

with geriatric nutritional risk index (GNRI) [2] of 68.9 (major nutrition-related risk).

EGD performed at our institution demonstrated severe RE (modified Los Angeles classification [3]: Grade D) with bile pigmentation in almost the entire esophageal

mucosa (Fig. 1a). Bile reflux gastritis was also observed (Fig. 1b). The esophagogastric anastomosis was widely patent (Fig. 1a), and computed tomography (CT) revealed that it was located in the lower mediastinum (Fig. 1c). Component analysis of the esophageal fluid revealed highly

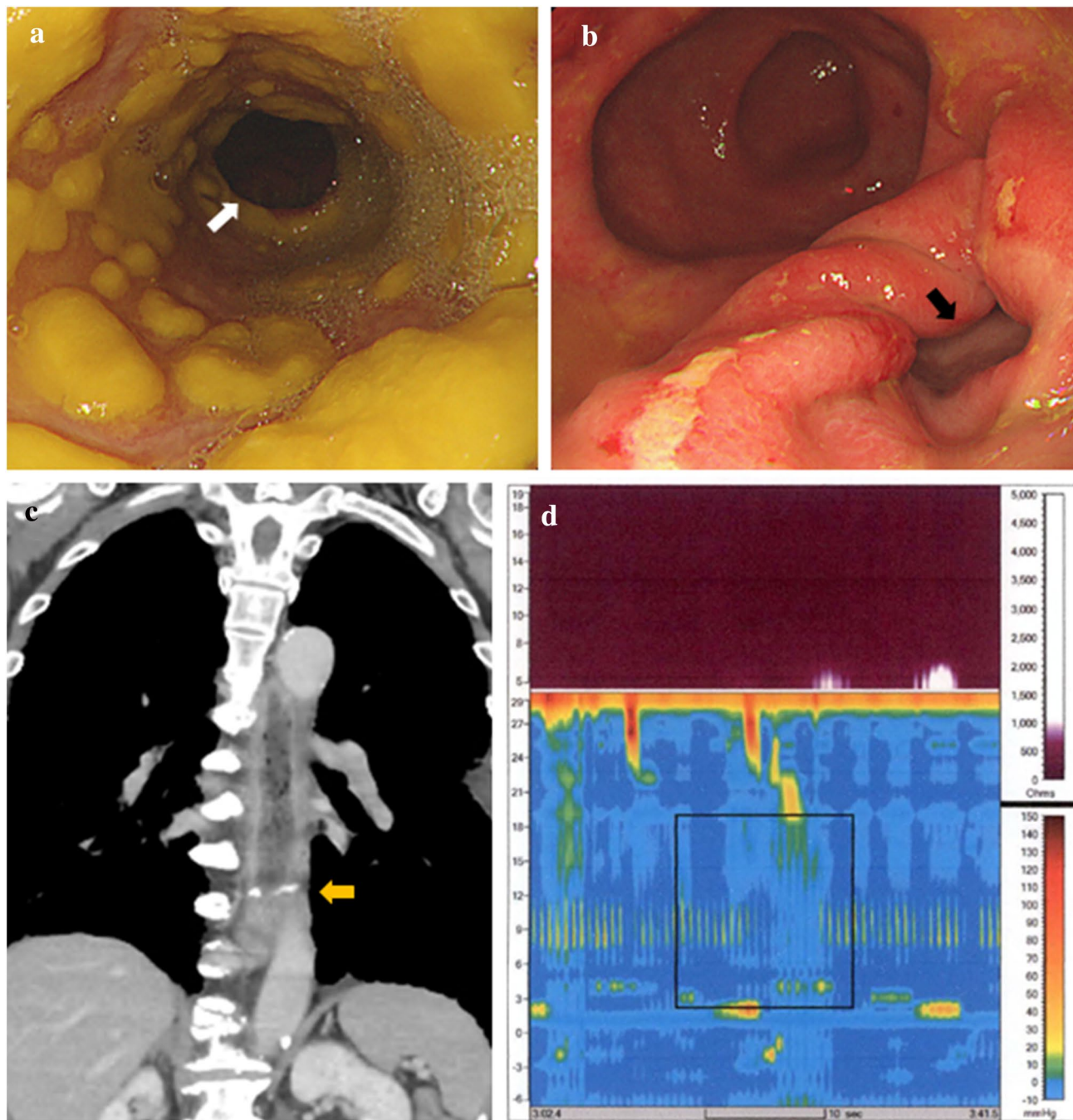


Fig. 1 Preoperative findings. **a, b** Esophagogastroduodenoscopy (EGD) showing severe esophageal erosion and erythematous gastric mucosa with bile reflux. Bile pigmentation was observed in almost the entire esophageal mucosa, and the esophagogastric anastomosis was widely patent (white arrow). There was a pocket in the remnant

stomach created by the procedure in the primary operation (black arrow). **c** Computed tomography (CT) demonstrating esophagogastric anastomosis located in the lower mediastinum (yellow arrow). **d** Absent contractility observed using high-resolution manometry

concentrated duodenal contents, including bilirubin, bile acid, trypsin, lipase, pancreatic phospholipase A2, and elastase 1 (Table 1). An upper gastrointestinal series showed gastroesophageal reflux in the upright position. Twenty-four-hour esophageal multichannel intraluminal impedance and pH (MII-pH) monitoring under a potassium-competitive acid blocker (P-CAB; vonoprazan 20 mg) demonstrated frequent weakly acidic and weakly alkaline reflux events (Table 2). The total fraction time at a pH below 4.0 was 0%. High-resolution manometry indicated absent contractility in Chicago classification version 4.0 (Fig. 1d) [4]. Considering the findings of the preoperative examinations, antrectomy and Roux-en-Y biliary diversion were thought to be the best surgical regimen to treat esophagitis caused by the combined reflux of gastric and duodenal juices in this patient.

A laparotomy was performed with a midline incision from the xiphoid process to the umbilicus. The remnant stomach was mobilized, as shown by the three-dimensional image reconstructed from the preoperative CT using SYNAPSE VINCENT (FUJIFILM Holdings Corporation, Tokyo, Japan) (Fig. 2a). The right gastroepiploic vessels were carefully separated from the antrum and pylorus to preserve the blood flow of the remaining stomach, while the infrapyloric and right gastric arteries were ligated and divided. The duodenum and stomach were transected using a linear stapler, and antrectomy was completed (Fig. 2b). For transection of the stomach, a stapler was fired across the staple line at the anterior wall of the lower gastric body, which was created by closing the entry hole of a circular stapler in the primary operation. Blood supply to the remaining stomach from the right gastroepiploic artery was confirmed using the Medical Imaging Projection System (Mitaka Kohki Co., Ltd., Tokyo, Japan) (Fig. 2c) [5]. The jejunum was transected 20 cm distal to the ligament of Treitz, and Roux-en-Y reconstruction with a 50-cm Roux limb was performed (both gastrojejunostomy and jejunojejunostomy were performed using a 45-mm linear stapler) (Fig. 2d, e). Jejunostomy was performed for supplementary nutrition in case the postoperative oral intake was inadequate. The operative time was 277 min, and blood loss was 50 mL.

The postoperative course was uneventful, and oral intake increased as the reflux symptoms improved. All medications, except P-CAB (vonoprazan 20 mg), were discontinued after the operation. EGD performed on the 19th postoperative day showed marked improvement in esophagitis (modified

Table 2 The number of reflux events in 24-h esophageal multichannel intraluminal impedance and pH monitoring

	Acidic	Weakly acidic	Weakly alkaline	All
<i>Pre-operation</i>				
Upright	0	94	21	115
Recumbent	0	13	14	27
Total	0	107	35	142
<i>Post-operation</i>				
Upright	8	154	6	168
Recumbent	0	13	5	18
Total	8	167	11	186

Los Angeles classification: Grade M) and gastritis (Fig. 3a, b). The duodenal contents were no longer detected in the esophageal fluid (Table 1). The patient was discharged on the 20th postoperative day. The esophageal reflux symptom score in the PGSAS-37 questionnaires [6] a month after the operation significantly improved with a postoperative score of 2.0 from 5.25 pre-surgery. Twenty-four-hour esophageal MII-pH monitoring under P-CAB (vonoprazan 20 mg) performed 2 months after the operation showed a significant decrease in weakly alkaline reflux events and an increase in acidic and weakly acidic reflux events (Table 2). The total fraction time at a pH below 4.0 was 1.3%. The improvement in RE was maintained as seen on EGD performed at 3 months after the operation, and P-CAB was replaced with a proton-pump inhibitor (PPI; lansoprazole 30 mg). The dose of lansoprazole was reduced to 15 mg after 3 months. Oral intake increased to fulfill nutritional requirements without enteral nutrition. The BMI and GNRI increased from 14.6 to 19.3 kg/m² and from 68.9 (major nutrition-related risk) to 94.3 (low nutrition-related risk), respectively, at 6 months after the operation.

Discussion

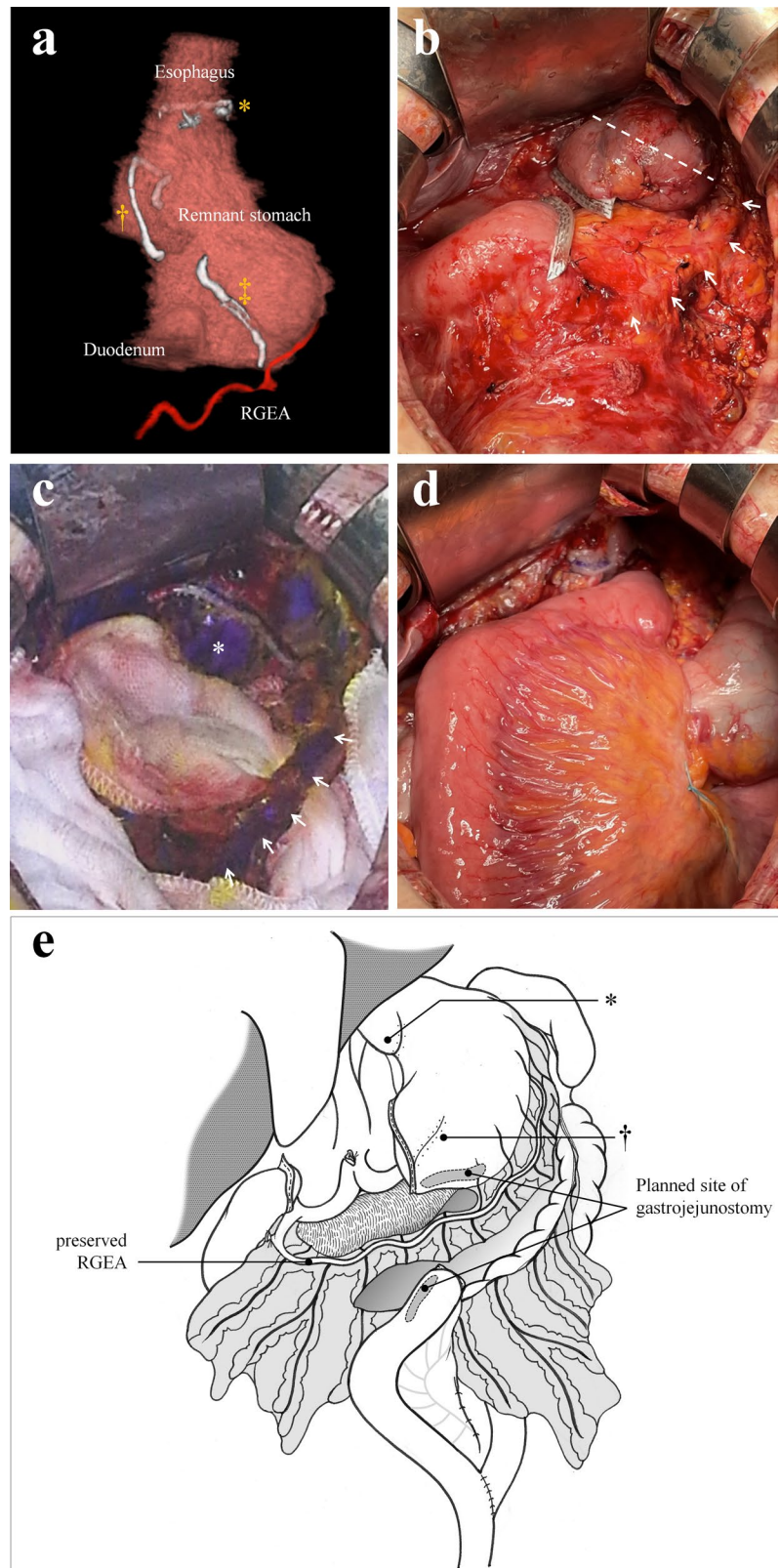
PG is indicated for esophagogastric junction and upper-third gastric cancers. EG is a commonly performed reconstruction method after PG, and various anti-reflux techniques have been developed to prevent postoperative RE [7–10]. Although the development of EG using a linear stapler has

Table 1 Component analysis of the esophageal fluid

	Bil [mg/dL]	TBA [μ mol/L]	TRY [ng/mL]	LIP [U/L]	PLA2 [ng/dL]	ELA1 [ng/dL]
Pre-operation	3.4	6.3	3590	44,790	578,000	14,600
Post-operation	0	<0.5	<30	<3	<50	<80

Bil bilirubin, *TBA* total bile acid, *TRY* trypsin, *LIP* lipase, *PLA2* pancreatic phospholipase A2, *ELA1* elastase 1

Fig. 2 Surgical findings. **a** Preoperative three-dimensional computed tomography (CT) reconstruction; RGEA: right gastroepiploic artery; *staple line of the esophagogastric anastomosis; †staple line of the proximal edge of the remnant stomach; ‡staple line for closure of the circular stapler entry hole. **b** The right gastroepiploic vessels were preserved (white arrows). The stomach was transected on the dashed line. **c** Medical Imaging Projection System showed blood supply from the right gastroepiploic artery (white arrows) to the remaining stomach (asterisk). **d** Roux-en-Y reconstruction with a 50-cm Roux limb was performed. **e** Schema of the completion image of the right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion; RGEA: right gastroepiploic artery; *anterior 180-degree partial fundoplication performed in the primary operation; †staple line created by closing the circular stapler entry hole in the primary operation



decreased the incidence of postoperative RE compared to a circular stapler [11], EG still carries a high risk of postoperative RE.

In the present case, duodenogastroesophageal reflux (DGER), which is the regurgitation of the gastric and duodenal juices into the esophagus, caused severe RE. Although

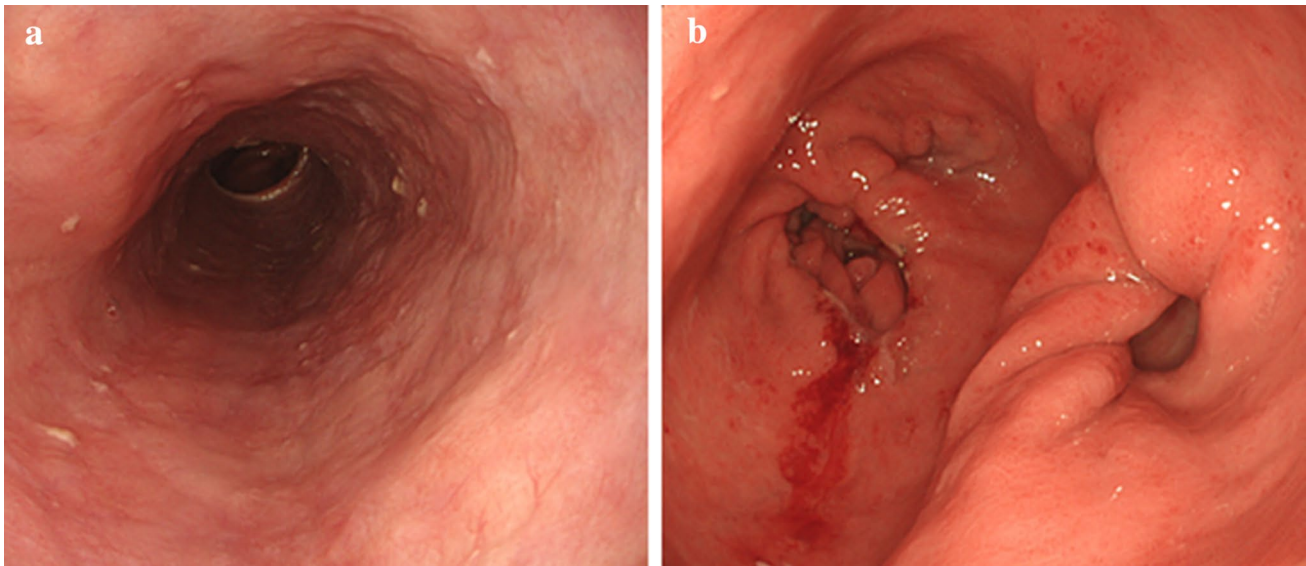


Fig. 3 Postoperative findings. **a, b** Esophagogastroduodenoscopy (EGD) performed on the 19th postoperative day showed marked improvement of esophagitis and gastritis

proximal gastrectomy should preserve the function of the pylorus to prevent duodenogastric reflux, when EG is performed in the lower mediastinum, DGER may occur due to negative pressure in the thoracic cavity. Usui et al. [12] reported that the risk of DGER significantly increased in patients after esophagectomy and esophagogastric tube reconstruction when the esophagogastric anastomosis was located lower in the mediastinum, especially below the bottom of the aortic arch. DGER causes adenocarcinoma in the esophagus through esophageal mucosal injury [13, 14]. Therefore, DGER must be treated appropriately and carefully to prevent esophageal carcinogenesis. However, an optimal operative procedure for medical treatment-resistant esophagitis caused by DGER after PG with EG has not yet been established.

The gold standard operation for RE is total or partial fundoplication; however, it cannot be simply applied to patients with RE after PG with EG. This is because the anti-reflux effect of wrapping the remnant stomach around the lower esophagus is uncertain, as it failed in the primary operation of the present case. Completion total gastrectomy with esophagojejunostomy is associated with a high risk of anastomotic leakage due to severe esophageal erosion and technical difficulties of intramediastinal anastomosis at a high location. Subtotal esophagectomy with cervical anastomosis is too invasive as a revision surgery, especially for patients with a poor general condition, as in this geriatric patient. Compared to these operative procedures, antrectomy and Roux-en-Y biliary diversion are technically easy and minimally invasive; therefore, they are applicable for most patients regardless of their

general condition. As a similar surgical strategy for RE after EG, D'Journo et al. [15] reported excellent results of the right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion for RE following subtotal esophagectomy and gastric reconstruction. In this case series, the esophagogastric anastomosis was located high in the neck or upper mediastinum. Although it was located in the lower mediastinum in the present case, a marked improvement in RE was obtained in a very short period after the operation.

This revisional approach, consisting of Roux-en-Y biliary diversion combined with antrectomy to control gastric acid secretion, had its limitations. Indeed, 24-h esophageal MII-pH monitoring at 2 months postoperatively showed that the alkaline reflux events decreased as planned, but the acid reflux events unexpectedly increased probably due to the decreased neutralization of gastric contents by the duodenal fluid. Therefore, it was not possible to confirm how much gastric acid secretion was actually reduced. However, we consider that antrectomy was worthwhile, given that the esophageal erosions eventually improved and the symptoms were relieved; these outcomes were further maintained when the patient was switched from P-CAB to PPI and the PPI dose was reduced.

In conclusion, the right gastroepiploic vessels-preserving antrectomy and Roux-en-Y biliary diversion were considered safe and feasible for medical treatment-resistant RE following PG with EG.

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Declarations

Conflict of interest The authors declare that they have no conflict of interest.

Informed consent for publication Informed consent was obtained from the patient for the publication of this report and the use of accompanying images.

Statement of human and animal rights This study was conducted in accordance with the Ethical Principles for Medical Researching Involving Human Subjects, as outlined in The Declaration of Helsinki.

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