

Functional Roux-en-Y Gastric Bypass (F-RYGB), with Preservation of Duodenal Access: Report of Two Revisional Cases of Sleeve Gastrectomy

Victor Ramos Mussa Dib¹, Carlos Augusto Scussel Madalosso², Paulo Reis Esselin de Melo^{3,4}, Rui Ribeiro⁵, Paula Volpe⁶, Carlos Eduardo Domene⁶

¹Victor Dib Institute, Manaus, Brazil

²Gastrobese Clinic, Passo Fundo, Brazil

³Paulo Reis Institute of Bariatric Surgery, Goiânia, Brazil

⁴Alfredo Nasser University Center (UNIFAN), Goiânia, Brazil

⁵Lusíadas Amadora Hospital, Lisboa, Portugal

⁶Integrated Center for Advanced Medicine (CIMAMED), São Paulo, Brazil

Email: victormussadib@gmail.com

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Abstract

Objective: This case report aimed to demonstrate a possible neuromuscular effect of Latarjet nerves transection or truncal vagotomy, in association with sleeve gastrectomy plus antrojejunostomy, in order to reproduce a Roux-en-Y gastric bypass (RYGB) mechanistic principles, in patients with previous Sleeve Gastrectomy (SG) who had had weight regain, with or without concomitant gastroesophageal reflux disease (GERD). **Background:** Sleeve gastrectomy (SG) is one of the most frequently performed bariatric operations worldwide. Nevertheless, weight regain and gastroesophageal reflux disease (GERD) have been consistently demonstrated, in association with this technique, which may require a revisional procedure. RYGB is an option in such a situation but, implies in gastrointestinal exclusions, which represents a shortcoming of this revision. Surpassing this inconvenient would be of great value for the patients. **Methods:** We describe herein two cases of SG revision for weight regain and GERD, with a follow-up of one year. Gastroesophageal reflux disease was evaluated by validated questionnaire, upper endoscopy, seriography, high resolution manometry (HRM) and impedance pHmetry (I-pHmetry), in the pre and postoperative periods. A re-Sleeve Gastrectomy with antrojejunal anastomosis was done in both cases, after informed consents. The Latarjet nerves were transected in one case, due to a bleeding in the left gastric vessels and a truncal vagotomy was required in the other, to appropriately treat an associated hiatal hernia. **Results:** In the postoperative evaluation it was observed a pyloric spasm in both cases, during seriography and endoscopy, kept

until the one-year follow-up. There was unidirectional contrast flow to the gastrointestinal anastomosis, filling the jejunal limb, in radiologic contrast study. No contrast passed through the pylorus. Nonetheless, the duodenum was kept endoscopically accessible. In the one-year evaluation, weight loss was adequate and GERD resolution was obtained in both cases, confirmed by endoscopic and functional esophageal assessment, together with symptoms questionnaire. **Conclusion:** The association of Latarjet nerves sectioning or truncal vagotomy with re-sleeve gastrectomy plus gastrointestinal anastomosis (antrojejunal), in a revision for a failed sleeve, can represent a technical approach, to reproduce RYGB results, without exclusions and with duodenum endoscopic accessibility maintenance. It maybe could be applied for primary surgeries. Additional studies are necessary to confirm this hypothesis.

Keywords

Roux-en-Y Gastric Bypass, Sleeve Gastrectomy, Jejunum Gastric Bypass, Vagus Nerve, Vagotomy, Bariatric Surgery

1. Introduction

Obesity has been growing worldwide and bariatric surgery is the most effective and durable treatment for patients with this disease [1]. There are a variety of surgeries, with it is proper mechanisms of action [2] [3]. Sleeve Gastrectomy (SG) and Roux-en-Y Gastric Bypass (RYGB) are the most frequently adopted operations [4] [5].

SG can increase gastroesophageal reflux disease (GERD) incidence [6] [7] [8], but carries the advantage of keeping intact the entire intestinal tract, diminishing nutritional problems and preserving peroral endoscopic and radiological access to it [9]. It has good metabolic effects and weight loss results in the mid-term, but concerning weight regain (WR), in the long-term [10]. There are some options of revisional surgeries after a failed sleeve gastrectomy [11]. Re-sleeve gastrectomy maybe applied, mainly if there is pronounced gastric tube dilation, with no severe GERD [12] [13]. If GERD is an important issue, this option is not advisable, since some authors have demonstrated high indices of GERD after revising a failed SG to Re-SG [14] [15] [16]. On the other hand, conversion to RYGB seems to bring similar results, compared to re-sleeve, in terms of weight loss, adding protection mechanisms against GERD [11]. One drawback of converting to RYGB is the diversion of the remnant stomach, the duodenum and the proximal jejunum that it promotes, which can cause some nutritional deficiencies and hinder peroral gastroduodenal endoscopic evaluation [17]-[22]. Recently we published a paper showing the association of SG with antrojejunal anastomosis, keeping the pylorus intact, in an obese patient with GERD. The with a 3-year follow-up showed good results in terms of weight loss and GERD control, surpassing the issues related to gastrointestinal diversions [23]. These principles could be applied as a revisional option, after a failed SG.

The current article reports two cases of obese patients who regained weight after SG and developed GERD (“De Novo GERD”). They had dilated sleeve tubes and were scheduled to a re-sleeve, associated with RYGB in the antrum [23]. The main intention in this proposal was to keep the rationale that led to the indication of primary SGs. In one case the Latarjet nerve was cut, due to a bleeding in the small gastric curvature and in the other, it was necessary to do a truncal vagotomy to facilitate hiatal hernia correction. The vagotomies led to pylorus spasm, which were identified in the postoperative endoscopic and radiologic evaluation. These findings raise a possibility of adding a selective vagotomy to a sleeve gastrectomy, with the intention to “close” the pylorus, associated with “Roux-en-Y” antrojejunal anastomosis, as a drainage procedure, mimicking a RYGB. This arrangement would avoid exclusions and allow duodenal access and could be applied in revisional or primary bariatric surgeries. To confirm this hypothesis, further investigation is necessary.

2. Patient Consent

The patients signed a Free and Informed Consent Form (FICF) and were informed about the procedure they would be undergoing, which would be a Re-sleeve Gastrectomy with a Roux-en-Y antrojejunal anastomosis. All their queries about the procedures were answered, in the presence of a companion. It was explained about possible intra and postoperative complications, as well as the possibility of changes in surgical planning, in case of intraoperative unexpected findings or intercurrents. An informed consent was signed by the patients, giving permission to use these cases details and images of the surgeries by the surgeon, for scientific purposes, preserving their identities. All the human data was performed, in accordance with the Declaration of Helsinki.

3. Cases Presentation

In this case report, two patients with previous SG had total weight regain and developed GERD (“De Novo GERD”), confirmed by validated questionnaire, upper endoscopy, upper gastrointestinal contrast study, HRM and I-pHmetry. In the primary operation, the choice for SG was done based on family history of gastric cancer (case one) and personal preferences (case two). Gastric tube dilation (more than 300 ml) was diagnosed in both cases by upper gastrointestinal contrast series and endoscopic evaluation, in both patients. The proposed surgical revision for them was a re-sleeve gastrectomy, associated with a gastric tube “drainage” procedure (Roux-en-Y antrojejunostomy). The aim of the gastroenterostomy was to reduce intragastric pressure, possibly helping in GERD control.

4. Case One

In the first case, the time span between the primary operation and the revision procedure was 6 years. In this case, the first operation was made by laparotomy. During the revisional surgery, due to dense adhesions between left hepatic lobe

and stomach, a bleeding occurred on the level of the left gastric vessels, which required in-block hemostasis by electrical and ultrasonic coagulation. A complete cross sectioning of vessels and gastro-hepatic ligament were done at the mid small gastric curvature. The already scheduled antrojejunostomy gave us the confidence not to worry about Latarjet's nerves cutting. The surgery was completed by laparoscopy without other interurrences. No transfusion was required. The postoperative evolution was uneventful and the patient was discharged from hospital on the day after the surgery.

In **Table 1**, the overall characteristics of the first clinical case are presented.

5. Patient Overall Characteristics, Preoperative Evaluation and Surgical Technical Description in Case One

1) Patient demographics and preoperative evaluation are described in **Table 1**.

1) **Trocars, patient and surgical team position**—these are described in **Table 2** and shown in **Figures 2-4**.

2) **Surgical steps** on the first case are described in **Table 3**.

Table 1. First patient characteristics.

Demographics:

- Patient MCS
- Female
- 35 years old
- Weight—108 Kg
- Height—1.59 m
- BMI on revision—42.7 Kg/m²
- History of progressive obesity for the last 10 years
- Open Sleeve Gastrectomy 6y before revision
- BMI on first surgery—38.3 Kg/m²
- Nadir—29.5 Kg/m² (1y after sleeve)
- Started weight regain on the third year after surgery.

Patient's habits

- No alcoholism or smoking
- No physical activity.
- Food habit—preference for snacks and junk food.
- Tried some medications after weight regain (Sibutramine, Semaglutide).

Current Comorbidities:

- Hypertension in the last 2 years—Losartan 160 mg a day
- Snoring
- Moderate Hepatic Steatosis
- GERD—pyrosis and dysphagia (validated questionnaire) developed after primary operation (“De Novo GERD”)
- Previous open SG (6 y ago)
- Previous open cholecystectomy (10 y ago)
- One cesarean section

Family History:

- Obesity history—father's family
- Hypertension—father and mother
- Gastric cancer—uncle from father's family

Continued

Preoperative workup

- Preoperative UPPER DIGESTIVE ENDOSCOPY:
 - Erosive esophagitis grade A (LA classification)
 - Sleeve tube dilation, allowing endoscope retroflexion—approximately 5 cm wide
 - Mild antral gastritis
 - Histopathology—chronic inactive gastritis/H. pylori-negative
- Preoperative UPPER RADIOLOGICAL GASTROINTESTINAL CONTRAST SERIES:
 - Gastroesophageal reflux
 - Dilated sleeve (more than 300 ml) (**Figure 1**)
- Preoperative HRM:
 - Normal inferior esophageal sphincter pressure
 - Normal esophageal motility
 - Good esophageal functional reserve
- Preoperative IMPEDANCE PHMETRY:
 - Pathological orthostatic acidic reflux
 - DeMeester Score—48.4
- Preoperative Abdominal ULTRASOUND:
 - Hepatic steatosis grade II
 - Cholecistectomy
- Preoperative POLYSOMNOGRAPHY:
 - No sleep apnea
- Preoperative LABORATORY TESTS:
 - B12 and Vitamin D deficiencies (supplemented)
 - Other laboratory tests were normal

Other information:

- Pre op workup ok, with due care;
 - Pre op multidisciplinary team counseling;
 - Proposed surgery—Re-Sleeve Gastrectomy with Roux-en-Y antrojejunal anastomosis;
 - Surgery performed on 03/02/22;
 - Surgical time—125 min;
 - Length of hospital stay—24 hours;
 - Uneventful postoperative recovery.
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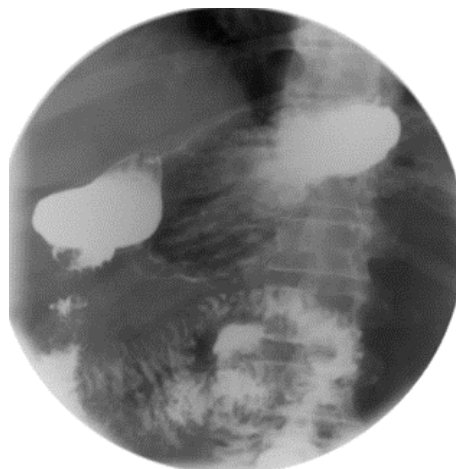


Figure 1. Dilated sleeve—radiological image.

Table 2. Surgical team, patient and trocars positions.

- Patient in horizontal dorsal decubitus, in lithotomy position;
- Surgical table in 30° anti-Trendelenburg during all the surgery, except during small bowel counting 20° Trendelenburg and slight lateralization to the left. Only on this moment, the surgeon stays on the left side of the patient and the camera holder, between the legs);
- Surgeon between the patient's legs, first assistant on the patient's left, camera holder on the patient's right, scrub nurse on the patient's left, anesthesiologist at the bedside and video set at the level of the patient's right shoulder;
- First 12 mm trocar is inserted under direct vision, 20 cm bellow the xiphoid process, 2 cm to the left of the midline, for the camera;
- Second 12 mm trocar is inserted 15 cm bellow the left costal margin, at the anterior axillary line;
- Third 12 mm trocar is inserted 15 cm bellow the right costal margin, at the anterior axillary line;
- First 5 mm trocar is inserted 5 cm bellow the left costal margin, at the anterior axillary line;
- Second 5 mm trocar is inserted 2 cm bellow the xiphoid process, 1 cm to the left.



Figure 2. Trocars position.



Figure 3. Patient position.

Table 3. Surgical steps in case one.

- Pneumoperitoneum (set to 14 mmHg) is performed with a Veress needle, at Palmer's point;
- The first trocar is inserted near the umbilicus; the others four trocars are inserted under optic view;
- The abdominal cavity is inspected;
- Adhesions are takendown;
- Hard adhesions were found in the upper abdomen (**Figure 5**). Adhesiolysis was carefully done with blunt dissection, scissors, electrocautery and ultrasonic device, to expose the gastric pouch;
- A bleeding occurred in the mid small gastric curvature (**Figure 6**);
- The hemostasis was achieved using electric cautery and ultrasonic energy, ending up with sealing of left gastric vessels at this level and horizontal sectioning of the gastro-hepatic ligament;
- The vascularization of gastric pouch was checked and confirmed, observing its preserved reddish color.
- After total gastric release from adherences, dilated gastric pouch were confirmed (**Figure 7**);
- A 32Fr Fouchet bougie was introduced down to the stomach;
- Longitudinal gastric stapling began 3 cm proximal to the pylorus, over a 32Fr Fouchet tube, positioned in the small gastric curvature until the level of pylorus. It was used 60 mm J&J Echelon GST (7 shots), separating the dilated part of the previous gastric sleeve, longitudinally; for this, one black, two greens, one gold and three blues cartridges were used, from distal to proximal stomach, finalizing the stapling 1 cm to the left of His angle (**Figure 8**);
- The staple lines were oversewn with 3-0 polypropylene continuous suture;
- The posterior wall of gastric tube was fixed to the base of the transverse mesocolon, at the level of the incisura angularis, with three separate 3-0 polypropylene sutures;
- The entire small bowel was measured, using both trocars positioned in the left abdomen, starting the counting from ileocecal valve (ICV) and putting a mark with a clip at a point 3 meters proximal to the ICV (to ensure at least this minimum length of common channel);
- The Treitz ligament was identified;
- A 180 cm jejunal segment (biliopancreatic limb—BPL) was counted distally from the Treitz ligament and transected with a 60 mm staple, loaded with a white cartridge, separating the alimentary limb (distal) from the biliopancreatic one (proximal);
- The mesentery between these two limbs was opened vertically 4 cm long, in direction to its root, with ultrasonic scalpel;
- The alimentary limb was brought up to be anastomosed with the antrum, manually. A 3 cm antrojejunal anastomosis was done on the greater curvature of the antrum, just proximal to the pylorus, after removing a semilunar specimen of the anterior gastric wall, 1 cm large, with a curved convex shape. This anastomosis was done with total layer running suture, using two 3-0 PDS thread (**Figure 9**);
- An 80 cm long alimentary limb was measured distally, from the antrojejunal anastomosis and a 3 cm longitudinal linear opening was made at this level;
- The staple line of the biliopancreatic limb was resected, leaving an 3 cm wide opening;
- An end-side entero-enteric, seromuscular running suture was done between these two jejunal limbs, creating a Roux-en-Y configuration (**Figure 10**);
- The mesenteric space between jejunal limbs (alimentary and biliopancreatic) was closed with a 3-0 polypropylene running suture;
- The mesenteric space between the alimentary limb and the transverse colon (Petersen space) was closed with a 3-0 polypropylene running suture;
- The integrity of both anastomoses was tested with methylene blue;
- The Fouchet bougie was removed;
- The resected stomach segment was placed inside an endobag and extracted through the 12 mm incision on the left side of the abdomen;
- The trocars were removed, with aponeurosis closure at the 12 mm trocars sites, with 2-0 Vicryl thread;
- The skin wounds were closed with intradermic sutures, using 3-0 Monocryl thread;
- The schematic final aspect of the surgery is demonstrated in **Figure 11**.



Figure 4. Team position.



Figure 5. Abdominal cavity adhesions.

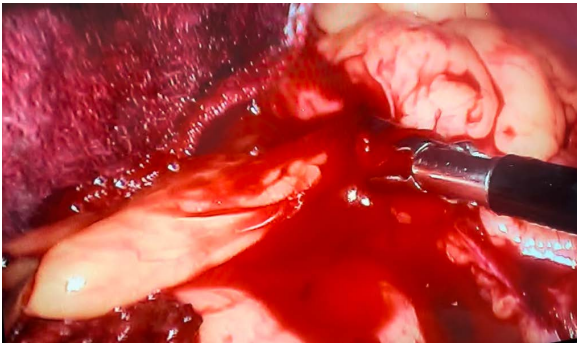


Figure 6. Left gastric vessels bleeding.



Figure 7. Dilated sleeve—laparoscopic view.

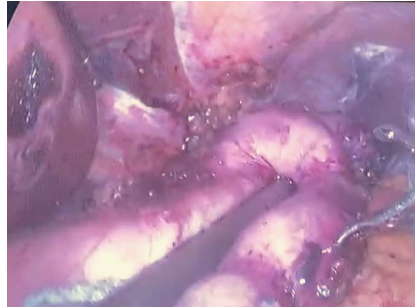


Figure 8. Resizing gastric tube.

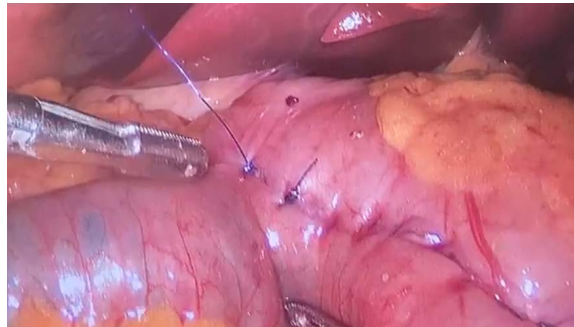


Figure 9. Manual antrojejunal anastomosis.

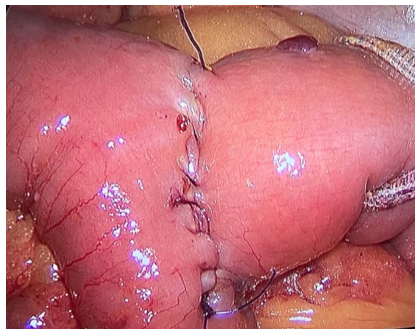


Figure 10. Manual jejunum-jejunal anastomosis.

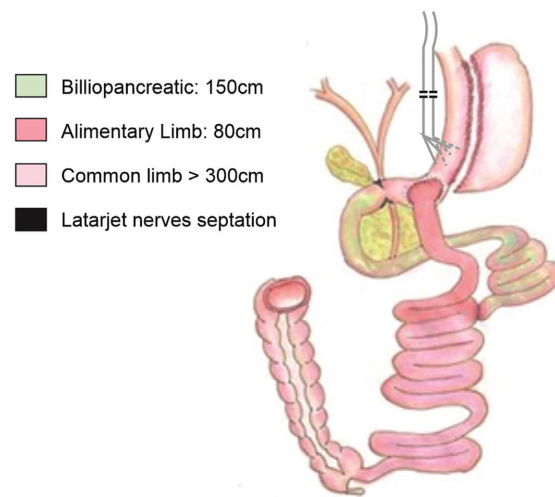


Figure 11. Schematic aspect of the surgery with Latarjet nerves septation.

6. Postoperative Evolution in Case One

One year follow-up:

- Weight—64 kg
- Weight loss—44 Kg
- BMI—25.3 Kg/m²
- %TWL—40.74%
- No antihypertensive medications, since the second postoperative month
- Snoring resolution
- Free of GERD symptoms (Validated Questionnaire)
- Hepatic steatosis resolution (Ultrasound)
- Good nutritional status
- Endoscopy—no hiatal hernia/no esophagitis/narrow sleeve tube/good aspect of 3 cm wide antrojejunal anastomosis, 1 cm proximal to the pylorus/spastic pylorus (**Figure 12**);
- Upper gastrointestinal contrast series—no hiatal hernia/no gastroesophageal reflux/narrow sleeve tube/contrast flows only to the jejunum (**Figure 13**).

7. Case Two

In this case, the time elapsed between the two operations was 8 years. The patient



Figure 12. Endoscopic aspect (spastic pylorus).



Figure 13. Postop radiological aspect (all the contrast to the jejunum).

had a pathological dilated gastric tube associated with a moderate hiatal hernia, seen by upper radiologic gastrointestinal series and upper endoscopy. A strong inflammatory tissue in the hernia region and a stuck esophagus was found, during hiatal hernia repair, which hindered the dissection. A truncal vagotomy was done, to facilitate esophageal traction to the abdomen, without tension. The scheduled antrojejunostomy gave us the confidence to do the vagotomy, since a gastric drainage procedure was guaranteed.

In **Table 4**, the overall characteristics and preoperative evaluation of the second clinical case are presented.

Table 4. Second patient characteristics.

Demographics:

- Patient CMC
- Female
- 45 years old
- Weight—103 Kg
- Height—1.52 m
- BMI on revision—44.5 Kg/m²
- History of progressive obesity for the last 8 years
- Laparoscopic Sleeve Gastrectomy 5 years before reintervention
- BMI on first surgery—41.2 Kg/m²
- Nadir—33.5 Kg/m² (9 months after sleeve)
- Started weight regain on the second year after surgery.

Patient's habits

- Social alcoholism
- No smoking
- No physical activity.
- Food habit—preference for sweets
- Tried some medications after weight regain (Sibutramine, Topiramate).

Current Comorbidities:

- Hypertension in the last 4 years—Amlodipine 10 mg a day
- Sleep Apnea
- Moderate Hepatic Steatosis
- Dyslipidemia
- GERD—pyrosis, regurgitation and dysphagia (validated questionnaire). developed after primary operation (“De Novo GERD”)
- Previous laparoscopic SG (8 y ago)
- Previous laparoscopic hysterectomy (4 y ago)
- Three cesarean sections

Family History:

- Obesity history—father's and mother's family
- Hypertension—father's family

Preoperative workup

▪ Preoperative UPPER DIGESTIVE ENDOSCOPY:

- Axial hiatal hernia—4 cm
 - Erosive esophagitis grade B (LA classification)
 - Sleeve tube dilation, allowing retroflexion (approximately 6 cm wide)
 - Enlarged hiatus
 - Mild pangastritis
 - Histopathology—chronic active gastritis/*H. pylori*-negative
-

Continued

- Preoperative UPPER RADIOLOGICAL GASTROINTESTINAL CONTRAST SERIES:
 - Gastroesophageal reflux
 - Moderate hiatal hernia
 - Dilated sleeve (more than 350 ml) (**Figure 14**)
- Preoperative HRM:
 - Hypotonic inferior esophageal sphincter pressure
 - Esophageal hypomotility
 - Good esophageal functional reserve
- Preoperative IMPEDANCE-PHMETRY:
 - Pathological orthostatic and supine acidic reflux
 - DeMeester Score—87.4
- Preoperative Abdominal ULTRASOUND:
 - Hepatic steatosis grade II
 - Hysterectomy
- Preoperative POLYSOMNOGRAPHY:
 - Moderate sleep apnea
- Preoperative LABORATORY TESTS:
 - B12, Vitamin D and Zinc deficiencies (supplemented)
 - Glycemia—112 mg/dl, HbA1c—6.0 (Metformin 850 mg)
 - Total Cholesterol—260 mg/dl, Triglycerides—210 mg/dl
 - Other laboratory tests were normal.

Other information:

- Pre op workup ok, with due care;
- Pre op multidisciplinary team counseling;
- Proposed surgery—Re-Sleeve Gastrectomy with Roux-en-Y antrojejunal anastomosis;
- Surgery performed on 06/30/22;
- Surgical time—145 min;
- Length of hospital stay—24 hours;
- Uneventful postoperative recovery.



Figure 14. Dilated sleeve with hiatal hernia—radiological image.

8. Surgical Technical Description in Case Two

1) **Trocars, patient and surgical team position**—this is described in **Table 2** and shown in **Figures 2-4**.

2) **Surgical steps** on the second case are described in **Table 5**.

Table 5. Surgical steps on the second case.

- Pneumoperitoneum (set to 14 mmHg) is performed with a Veress needle, at Palmer's point;
- The first trocar is inserted near the umbilicus; the others four trocars are inserted under optic view;
- The abdominal cavity is inspected;
- Adhesions are takendown.
- Some adhesions were found between left liver lobe, stomach and crura, which were released with scissors and energy dissection (**Figure 15**);
- A large crura space and moderate hiatal hernia was found (**Figure 16**);
- The hernia sac detachment was started, facing big lipomas and dense adherences in the mediastinum. The esophagus was stuck and difficult to release; To get enough esophagus in the abdominal cavity and facilitates its mobilization, it was opted for a truncal vagotomy, making it possible to pull the esophagus down to the abdomen, without tension;
- After reducing the hernia and removing the hernia sac, the crura was closed by approximating right and left pillars with three figures of eight 2-0 ethibond sutures.
- After total gastric release from adherences, dilated gastric pouches were confirmed;
- A 32Fr Fouchet bougie was introduced down to the stomach;
- Longitudinal gastric stapling began 3 cm proximal to the pylorus, over a 32Fr Fouchet tube, positioned in the small gastric curvature until the level of pylorus. It was used 60 mm J&J Echelon GST (7 shots), separating the dilated part of the previous gastric sleeve, longitudinally; for this, one black, two greens, one gold and three blues cartridges were used, from distal to proximal stomach, finalizing the stapling 1 cm to the left of His angle (**Figure 17**);
- The staple lines were oversewn with 3-0 polypropylene continuous suture;
- The posterior wall of gastric tube was fixed to the base of the transverse mesocolon, at the level of the incisura angularis, with three separate 3-0 polypropylene sutures;
- The entire small bowel was measured, using both trocars positioned in the left abdomen, starting the counting from ileocecal valve (ICV) and putting a mark with a clip at a point 3 meters proximal to the ICV (to ensure at least this minimum length of common channel);
- The Treitz angle was identified;
- A 150 cm jejunal segment (biliopancreatic limb—BPL) was counted distally from the Treitz ligament and transected with a 60 mm staple, loaded with a white cartridge, separating the alimentary limb (distal) from the biliopancreatic one (proximal);
- The mesentery between these two limbs was opened vertically 4 cm long, in direction to its root, with ultrasonic scalpel;
- The alimentary limb was brought up to be anastomosed with the antrum, manually. A 4 cm antrojejunal anastomosis was done on the greater curvature of the antrum, just proximal to the pylorus, after removing a semilunar specimen of the anterior gastric wall, 1 cm large, with a curved convex shape. This anastomosis was done with total layer running suture, using two 3-0 PDS thread;
- An 80 cm long alimentary limb was measured distally, from the antrojejunal anastomosis and an 3 cm longitudinal linear opening was made at this level, in it is antimesenteric border;
- The staple line of the biliopancreatic limb was resected, leaving an 3 cm wide opening;
- An end-side entero-enteric, seromuscular running suture was done between these two jejunal limbs, creating a Roux-en-Y configuration;
- The mesenteric space between jejunal limbs (alimentary and biliopancreatic) was closed with a 3-0 polypropylene running suture;
- The mesenteric space between the alimentary limb and the transverse colon (Petersen space) was closed with a 3-0 polypropylene running suture;
- The integrity of both anastomoses was tested with methylene blue;
- The Fouchet bougie was removed;
- The resected stomach segment was placed inside an endobag and extracted through the 12 mm incision on the left side of the abdomen;
- The trocars were removed, with aponeurosis closure at the 12 mm trocars sites, with 2-0 Vicryl thread;
- The skin wounds were closed with intradermic sutures, using 3-0 Monocryl thread;
- The schematic final aspect of the surgery is represented on **Figure 18**.

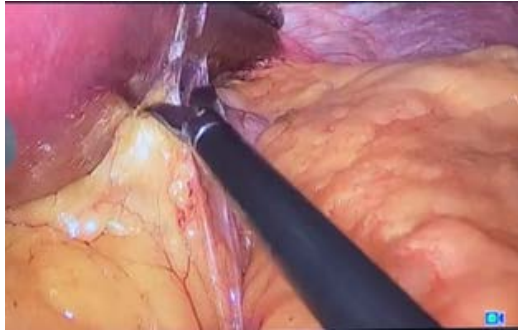


Figure 15. Adhesions between left hepatic lobe and stomach.



Figure 16. Enlarged hiatus.



Figure 17. Re-sleeved stomach, cruroplasty and Hiatal hernia repair.

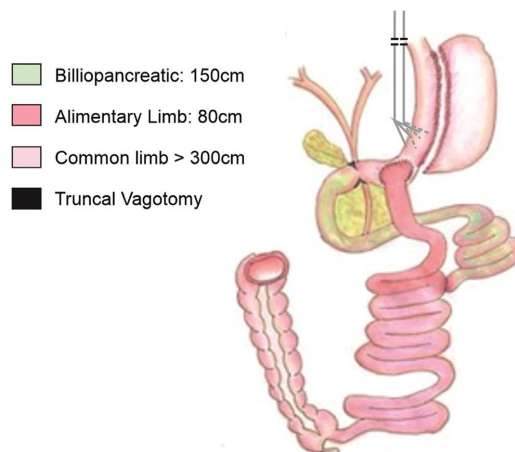


Figure 18. Schematic aspect of the surgery with truncal vagotomy.

9. Postoperative Evolution in Case Two

One year follow-up case two:

- Weight—57 kg;
- Weight loss—46 Kg;
- BMI—24.6 Kg/m²;
- %TWL—44.66%;
- No antihypertensive medications, since the fourth postoperative month;
- No antidiabetic medications since the surgery;
- Sleep apnea resolution;
- Free of GERD symptoms (Validated Questionnaire);
- Hepatic steatosis resolution (Ultrasound);
- Normalization of cholesterol, triglycerides;
- Good nutritional status;
- Endoscopy—no hiatal hernia/no esophagitis/narrow sleeve tube, good aspect of 4 cm wide antrojejunal anastomosis, 1 cm proximal to the pylorus (**Figure 19**);
- Seriography—no hiatal hernia/no gastroesophageal reflux/no sleeve dilation/contrast only flows to the jejunum (**Figure 20**).

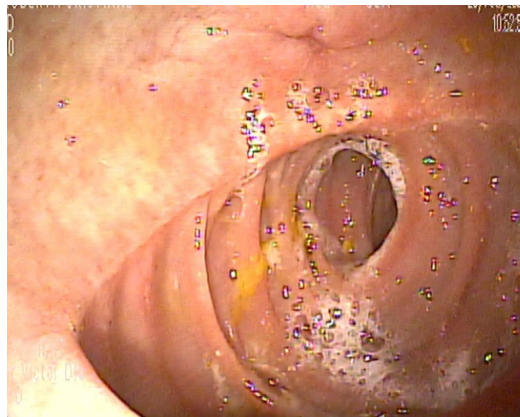


Figure 19. Postop endoscopy—spastic pylorus.



Figure 20. Postoperative radiological aspect—all the contrast flowing to the Roux limb.

10. Discussion

Sleeve gastrectomy is the most common bariatric surgery performed, worldwide [4]. Nonetheless, it has considerable indices of failure in the long term, that can reach 30% to 50% [11] [24]. Besides, many studies have demonstrated that SG has a potential for gastroesophageal reflux development, which can worsen a pre-existing GERD or lead to its new onset (“De Novo GERD”) [25] [26] [27] [28] [29]. In this case report, both patients were submitted to primary SL, regained weight and developed “De Novo GERD”. Increased intragastric pressure, loss of gastric complacency, disruption of crura structure, proximal gastric tube migration, fundus compression absence and gastric tube tortuosity are some of the factors involved in the pathophysiology of gastroesophageal reflux, after this operation [6] [30] [31] [32], which can limit its indication.

There are many possible causes related to WR after SG, but a dilation of gastric tube (more than 225 ml) in the first 2 to 3 years after surgery is frequently associated with it [12]. Upper gastrointestinal radiological contrast series and computed tomography with 3D gastric volumetry reconstruction are very useful tools in this diagnosis [33] [34] [35]. The two patients of this study had gastric sleeve dilation, diagnosed by upper gastrointestinal contrast series.

Not infrequently, WR and GERD are associated, after SG [36]. Interestingly, some of these patients have no complaints related to GERD and esophageal motility alterations are not an uncommon find [37] [38]. Based on that, it is very important to do a thorough preoperative evaluation of gastroesophageal reflux disease and esophageal motility disorders, including symptoms evaluation (validated questionnaires), endoscopy, HRM and impedance pHmetry, mainly in patients with WR, in whom a revisional surgery is being planned. This preoperative protocol was utilized herein, confirming GERD presence.

The presence of weight regains and GERD after SG can limit the surgical revisional options. Some techniques are more “potent” than SG and would achieve better weight loss, but could perpetuate GERD or even, worsen it [39]. Combining a gastrointestinal anastomosis with a sleeved pouch can improve reflux symptoms, by decompressing the pouch [40]. Some authors demonstrated this decompression effect in rodents and its protective action against gastroesophageal reflux after sleeve gastrectomy [41]. In this current study, where both patients developed GERD associated with WR, we observed a significant GERD improvement after revisional surgery, by adding an antrojejunal anastomosis in the re-sleeved gastric tube, which was confirmed either by symptoms relief (validated questionnaire), endoscopic assess and functional esophageal studies. This improvement is probably attributed to the gastric tube decompression, promoted by this gastrointestinal anastomosis.

The best approach to deal with reflux disease after SG, according to literature, is converting it to RYGB, but it’s not the best alternative to address weight regain [42] [43]. Some of the reasons related to the improvement of GERD after converting SG to gastric bypass are the low acidity of a small gastric pouch, the ex-

pedited gastric emptying and the absence of bile, due to the Roux-en-Y configuration [44] [45]. Although gastric bypass can add little in terms of weight loss, after a failed SG, it can achieve better metabolic results, showing higher resolution or control rates of diabetes, hypertension, dyslipidemia and other metabolic issues [46]. These results, including weight loss, can be improved by lengthening the biliopancreatic limb (BPL) [47] [48] [49] [50]. The same metabolic improvement has been shown with One Anastomosis Gastric Bypass (OAGB), which has a long biliopancreatic limb, compared to standard RYGB [51]. Based on that, in the current study, as the patients had WR and worsening of metabolic conditions, we opted for a longer BPL length to achieve a better weight loss and metabolic control.

Some authors described no correlation between gastric pouch size and total weight loss, at one year after RYGB, but call attention to the increased incidence of marginal ulcers in larger pouches [52]. On the contrary, Rui Ribeiro *et al.* [53], in a cohort of 300 patients, described a long tubular gastric pouch RYGB, with low incidence of marginal ulcers, which occurred in 1% of patients, in a 4-year follow-up. The low frequency of these ulcers could be attributed to the tubular and narrow gastric pouch, made over a 36Fr bougie, removing parietal cells. Still considering marginal ulcers, many studies have demonstrated the safety of antral-enteric anastomosis, with very low complication rates, which made us feel comfortable in doing it [54] [55] [56]. In this current case report, both patients had no marginal ulcers, which is in accordance with literature. Furthermore, it was already established a reduction in gastric acid production after vagotomies, due to inhibition of parasympathetic stimulus to parietal cells. This contributes to reducing gastroduodenal ulcers incidence as well as marginal ulcers in gastrointestinal anastomosis [57] [58]. In the revisional procedures studied herein, the addition of vagotomies, either truncal or selective, may have contributed for diminishing the already low incidence of marginal ulcers, seeing in SG associated with antrojejunal anastomosis.

A longer gastric pouch seems to protect against dumping syndrome and hyperinsulinemic hypoglycemia, due to a slower rate of gastric emptying, according to some authors [53]. In this current case report, both patients had no complaints of dumping syndrome or hypoglycemia, probably due to the reasons mentioned above.

One disadvantage of converting SG to RYGB for the treatment of WR or IWL, is the exclusion of gastric remnant, the duodenum and part of the jejunum. This precludes future peroral endoscopic evaluations of these segments and makes biliary tree and pancreatic ducts accessibility cumbersome [59]. These exclusions can make RYGB inappropriate for patients with previous gastroduodenal ulcers, gastric polyps, gastric dysplasia, strong family history of cancer, intractable *H. pylori*, among others [60]. Also, there are inferences of a cancer environment in the excluded gastric chamber [22]. Recently, we reported a case of a primary SG associated with Roux-en-Y antrojejunal anastomosis, in a morbidly obese patient

with GERD. This approach controlled both diseases, in a 3-years follow-up, avoiding exclusions and keeping duodenum accessibility, which could solve the issues related to RYGB [23]. These same principles were replicated in the revisional cases of this study, with the addition of either selective or truncal vagotomies, for the reasons already mentioned.

Back in the 70s and 80s, lots of studies demonstrated the effect of a vagotomy (truncal or selective) on the pylorus, causing its long-lasting spasm, which required a concomitant gastric drainage (pyloroplasty, pyloromyotomy, antrectomy or gastrointestinal anastomosis), as part of the operation [61] [62]. Based on that, we assumed during the surgeries of this study that a pyloric spasm would happen, because of the vagal nerve transection. As an antrojejunal anastomosis was scheduled in both cases beforehand, it would work as a gastric drainage procedure, which would be necessary. During the postoperative endoscopy and upper radiologic contrast study series it was confirmed a spastic pylorus in both cases, during the one-year follow-up, which was attributed to the vagotomies, leading to a deviation of all the contrast flow to the Roux limb. Noteworthy was the pyloric patency to the endoscope, in both patients, requiring a little pushing pressure on it. Due to the gastrointestinal anastomosis, there was no gastric stasis in neither case as well as, no symptoms of fullness.

There are some undesirable effects of truncal vagotomy, that are less frequent in selective ones. Dumping syndrome and chronic diarrhea can be cumbersome in truncal vagotomies, although there is a trend to improvement with time [63] [64] [65] [66]. In the patients operated in this study there were no complications attributed to the vagotomies, including diarrhea or dumping syndrome.

The revisional configuration showed in this case report could represent a “Functional RYGB” (F-RYGB), with a long gastric pouch and no exclusions, preserving peroral endoscopic duodenal and biliopancreatic tract accessibility. Greco *et al.* demonstrated a functional OAGB as a revisional procedure for a failed SG. The authors used a non-adjustable ring over the level of angular incisure of the sleeve tube, adding the intestinal anastomosis just above the ring. The purposes were to avoid dissections and stapling in the antral area. This operation also keeps endoscopic accessibility to the duodenum, as there is enough space for the endoscope to pass through the ring area. It was observed in contrast studies a preferential flow to the gastrointestinal anastomosis, instead of the antrum [67]. In the cases of the current study, we accomplished a F-RYGB without foreign bodies, due to a probable neuromuscular mechanism triggered by the vagotomies, that lead to pyloric spasm. A complete contrast flow to the gastrointestinal anastomosis was demonstrated in upper radiological contrast studies. This possibly discards a bipartition of the gastrointestinal transit and brings a probable replication of the well-known results of the RYGB, largely demonstrated in literature [24] [68]. In the period of 1-year follow-up, the two patients discussed herein achieved total disappearance of reflux symptoms, healing of esophagitis and adequate weight loss, results compatible and comparable with

the ones obtained with a Roux-en-Y gastric bypass, mainly if a longer BPL is employed, as it was in our study.

Some limitations of this study are related to the non-existence of a preoperative protocol in relation to vagotomy use, since the vagotomies weren't scheduled, the small number of patients, the absence of control group and the shortness of the follow-up period.

11. Conclusion

This case report demonstrates a surgical revisional strategy for a failed SG, that makes possible to keep the primary operation rational, in patients with insufficient weight loss, obesity recidivism and/or gastroesophageal reflux disease. By re-sleeving a dilated gastric sleeve pouch (if dilated) and adding an antrojejunal anastomosis, as a gastric drainage procedure, this could be achieved. The association of a Latarjet's nerve septation to this procedure can lead to a pyloric spasm, directing the ingested food entirely to the Roux limb, replicating the well-known results of RYGB. This operation could represent a functional RYGB (F-RYGB), without foreign bodies, which could be indicated as a primary bariatric surgery, either. This would bring the advantage of having no exclusions, with preservation of peroral endoscopic duodenal and biliopancreatic ducts access, while adding an anti-reflux mechanism to a gastric sleeved pouch, gathering the advantages of both techniques, SG and RYGB. Additional studies are needed to further evaluation of this hypothesis.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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