

Gastrobronchial fistula after sleeve gastrectomy and gastric bypass: endoscopic management and prevention

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Abstract Gastrobronchial fistula (GBF) is a serious complication following bariatric surgery, whose treatment by thoracotomy and/or laparotomy involves a high morbidity rate. We present the outcomes of endoscopic management for GBF as a helpful technique for its healing process. This is a multicenter retrospective study of 15 patients who underwent gastric bypass ($n=10$) and sleeve gastrectomy ($n=5$) and presented GBF postoperatively (mean of 6.7 months). Ten patients developed lung abscess and were treated by antibiotic therapy ($n=10$) and thoracotomy ($n=3$). Abdominal reoperation was performed in nine patients for abscess drainage ($n=9$) and/or ring removal ($n=4$) and/or nutritional access ($n=6$). The source of the GBF was at the angle of His ($n=14$). Furthermore, 14 patients presented a narrowing of the gastric pouch treated by 20 or 30 mm aggressive balloon dilation ($n=11$), stricturotomy or septoplasty ($n=10$) and/or stent ($n=7$). Fibrin glue was used in one patient. We performed, on average, 4.5 endoscopic sessions per patient. Endotherapy led to a 93.3% (14 out of 15) success rate in GBF closure with an average healing time of 4.4 months (range, 1–10 months), being shorter in the stent group

(2.5×9.5 months). There was no recurrence during the average 27.3-month follow-up. A patient persisted with GBF, despite the fibrin glue application, and decided to discontinue it. GBF is a highly morbid complication, which usually arises late in the postoperative period. Endotherapy through different strategies is a highly effective therapeutic option and should be implemented early in order to shorten leakage healing time.

Keywords Bariatric surgery · Gastrobronchial fistula · Bronchogastric fistula · Lung abscess · Gastric fistula · Sleeve gastrectomy · Endoscopy · Balloon dilation · Stents

Introduction

Gastric fistula (GF) following bariatric surgery occurs in up to 8.3% of the cases [1]. It is a severe complication that often results in abdominal sepsis and respiratory alterations, especially in the left lung secondary to subphrenic abscess [2, 3]. Measures of clinical support, antibiotic therapy, and abdominal drainage may be sufficient to control systemic infection and to heal the leakage [4]. Nevertheless, some patients still evolve unsatisfactorily.

Due to proximity with the respiratory tract, an abdominal infection can result into a gastrobronchial fistula (GBF), although its occurrence after bariatric surgery has seldom been reported (Table 1) [5–11]. GBF treatment can be challenging when performed by means of major abdominal and thoracic operations [6–8, 11].

As a severe lung infection with a high morbidity–mortality rate [10], it is necessary to throw some light upon the predisposing factors and the clinical aspects of GBF, as well as to establish preventive, diagnostic, and minimally invasive approach strategies. Thus, we aim to report a

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Table 1 Studies involving patients with gastrobronchial fistula (GBF) after bariatric surgery: analysis of clinical and therapeutic aspects

| Author/year | Number | Bariatric surgery | Onset of respiratory symptoms (months) | Respiratory symptoms | Diagnosis of GBF | Source of the leakage | Treatment of GBF | Nutrition access | Healing time of GBF (months) |
|-----------------------------------|--------|-------------------|----------------------------------------|-----------------------------------------------------------|---------------------------|-----------------------|-----------------------------------------------------|----------------------------------|------------------------------|
| Serra C, Obes Surg 2006 [7] | 1 | ODS | 14 | Lung abscess | UGIS | DIA | Total gastrectomy | | 2 |
| Campos J, JBP 2007 [5] | 2 | RYGB LSG | 3 2.5 | Lung abscess, vomica, cough, dyspnea, fever | CT, UGIS | His | Endoscopic dilatation+ stenostomy+fibrin glue | Gastrostomy, nasointestinal tube | 6 8 |
| Campos J, JACS 2007 [9] | 1 | RYGB | 20 | Vomica, cough, dyspnea, fever | CT, UGIS | His | Endoscopic dilatation+ stenostomy | Gastrostomy | 1 |
| Eisendrath P, Endoscopy 2007 [10] | 1 | LSG+LDS | – | – | – | Pouch | SEMS+SEPS+fibrin glue | Parenteral | Death (3 m) |
| Chin P, SOARD 2008 [6] | 1 | LAGB | 7 | Recurrent pneumonia | Clinical, UGIS, endoscopy | Pouch | Laparoscopic band removal+ interposition of omentum | – | 1 |
| Fuks D, Obes Surg 2009 [8] | 1 | LSG | 5 | Hemoptysis, recurrent pneumonia, cough, dyspnea, fever | Methylene blue, CT | His | Total gastrectomy+thoracotomy+ lobectomy | Jejunostomy | 1 |
| Garrett KA, Obes Surg 2009 [11] | 1 | LAGB | 6 | Recurrent pneumonia, empyema, hemoptysis, purulent sputum | CT, UGIS | Paraesophageal hernia | Open band removal+ thoracotomy+ lobectomy | – | 1 |

CT computed tomography scan, UGIS upper gastrointestinal X-ray series, ODS open duodenal switch, RYGB Roux-en-Y gastric bypass, GBF gastrobronchial fistula, LSG laparoscopic sleeve gastrectomy, LDS laparoscopic duodenal switch, LAGB laparoscopic adjustable gastric band, DIA duodenal–ileal anastomosis, SEMS self-expanding metal stent, SEPS self-expanding plastic stent

multicenter experience on the clinical features, endoscopic treatment results of GBF, and its prevention.

Methods

Fifteen patients (9 women, 6 men; mean age 36 years), with an average body mass index of 43 kg/m², who underwent either open ($n=5$) or laparoscopic ($n=5$) Roux-en-Y gastric bypass (RYGB) and laparoscopic sleeve gastrectomy (LSG) ($n=5$) at 14 Brazilian bariatric surgery institutions took part in this study, from 2003 to 2010. A silicon ring was used in RYGB ($n=7$) and LSG ($n=2$) (Table 2; Fig. 1).

This is a retrospective study to evaluate the management of GBF in three institutions of gastrointestinal endoscopy and surgery in Brazil, with extensive experience in the management of bariatric surgery postoperative complications. From 2004 to 2010, we enrolled 15 patients who were referred to us and presented with persistent gastric leaks and radiologic confirmation of GBF, despite intensive measures in the original institution, such as antibiotic therapy, nutritional support, and treatment of the abdominal and thoracic infection by reoperation or computed tomography-guided aspiration. The following radiologic images were used in this study: chest and abdominal computed tomography (CT) scan, upper gastrointestinal series, and/or fistulography (Figs. 2, 3 and 4).

After signing terms of informed consent, patients underwent endoscopic procedures to promote fistula closure. The first aim of our approach was to delineate through a detailed endoscopic and fluoroscopic study whether upper gastrointestinal anatomic alterations in the vicinity of the fistula orifice were present. If positive, we would propose the appropriate intervention (Fig. 1).

Endoscopic Procedures

The procedures were carried out in endoscopy units with fluoroscopy under deep sedation or general anesthesia. A standard one-channel gastroscope (Pentax Medical, Montvale, NJ) was used in all the procedures and a transnasal gastroscope EG-530N® (Fujinon, Yokohama, Japan) was used once in the diagnostic fistuloscopy of case 10.

The choice of the specific endoscopic intervention was based on the following variables: type of bariatric surgery, presence of the ring, location of the gastric stricture, presence of perigastric abscess, and anatomy of the gastric pouch and fistula. Each patient underwent more than one type of endoscopic procedure (Fig. 1). The principle of the treatment was the correction of both the distal gastric stricture and the anatomic defect near the internal orifice of the fistula (Fig. 5). The following endoscopic interventions were performed according to the type of bariatric surgery:

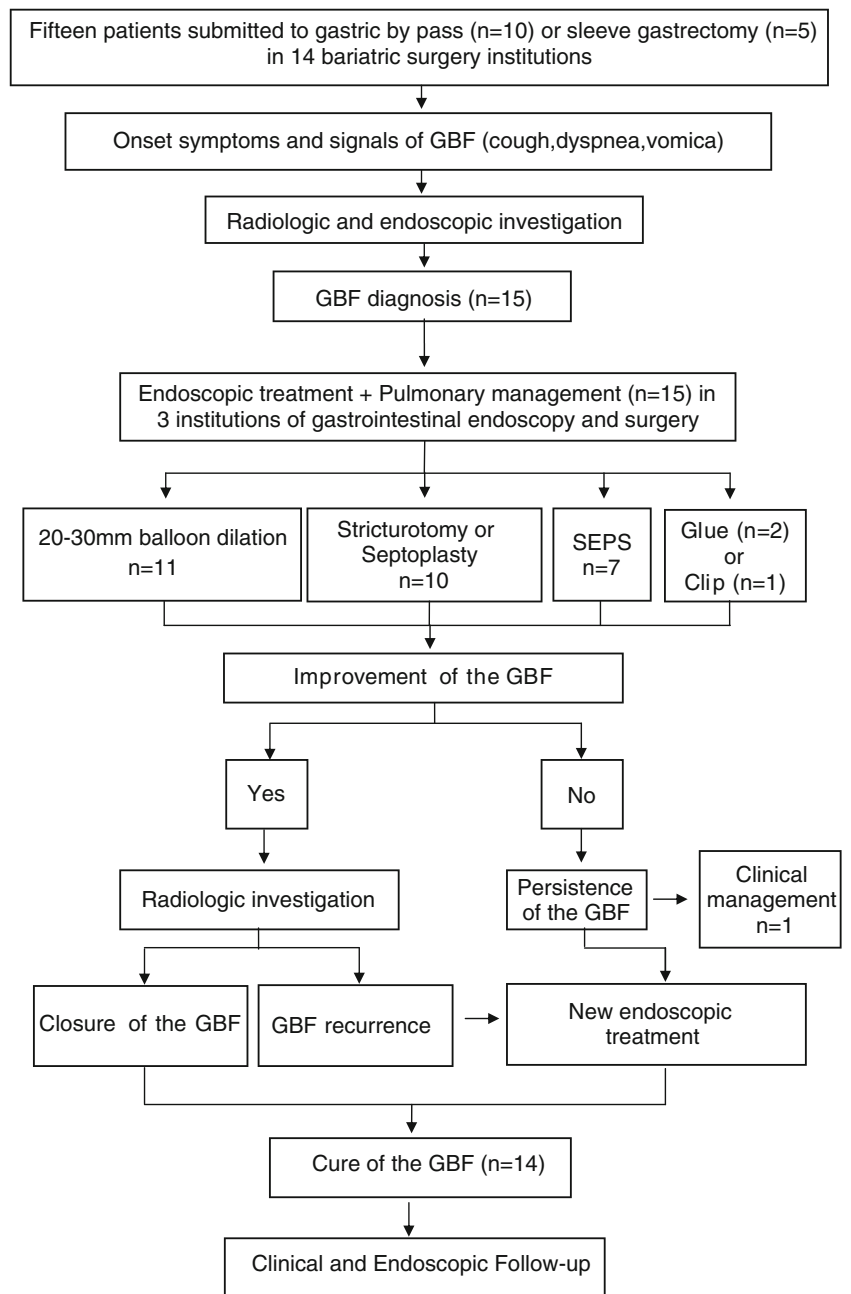
Table 2 Demographic data and clinical conditions of patients with gastrobronchial fistula (GBF)

| Patient number | Age | Sex | BMI preop. kg/m ² | Bariatric surgery | Ring | Onset of respiratory symptoms (PO months) | Lung abscess | Source of the GBF | Narrowing of the stomach (level) |
|----------------|-----|-----|------------------------------|--------------------|------|-------------------------------------------|--------------|-------------------|----------------------------------|
| 1 | 32 | W | 49 | LSG | Y | 1.5 | Y | Angle of His | Ring |
| 2 | 44 | M | 44 | LRYGB | N | 3 | Y | Angle of His | Anastomosis |
| 3 | 44 | W | 37 | LSG | Y | 8 | Y | Angle of His | Angular incisure |
| 4 | 22 | W | 43 | ORYGB | Y | 30 | Y | Angle of His | Pouch |
| 5 | 38 | W | 39 | LRYGB | Y | 2 | N | Angle of His | Ring |
| 6 | 41 | M | 45 | LRYGB | Y | 1 | Y | Angle of His | Ring |
| 7 | 28 | M | 42 | LRYGB | Y | 5 | N | Angle of His | Pouch |
| 8 | 18 | M | 42 | ORYGB | Y | 1 | Y | Angle of His | Pouch |
| 9 | 37 | W | 41 | ORYGB | Y | 6 | N | Angle of His | Anastomosis |
| 10 | 43 | W | 40 | ORYGB | Y | 18 | Y | Angle of His | Ring |
| 11 | 39 | M | 46 | LSG | N | 1 | Y | Angle of His | Angular incisure |
| 12 | 23 | M | 45 | LSG | N | 2 | Y | Gastric body | Angular incisure |
| 13 | 53 | W | 35 | LSG ^a | N | 15 | N | Angle of His | Angular incisure |
| 14 | 32 | W | 42 | ORYGB | N | 6 | Y | Angle of His | No |
| 15 | 45 | W | 55 | LRYGB ^a | N | 2 | N | Angle of His | Pouch |

W women, M men, BMI body mass index, preop. preoperative, PO postoperative, LRYGB laparoscopic Roux-en-Y gastric bypass, ORYGB open Roux-en-Y gastric bypass, LSG laparoscopic sleeve gastrectomy, Y yes, N no, GBF gastrobronchial fistula

^a Revisional surgery

Fig. 1 Flowchart of endoscopic treatment of gastrobronchial fistula (GBF). *SEPS* = self-expandable plastic stent



1. Aggressive endoscopic dilation:

RYGB without ring: The gastrojejunal anastomotic stricture was dilated up to 20 mm, using a CRE® balloon (Boston Scientific, Natick, MA), during 3 min [12].

RYGB with ring: The stricture of the ring in the gastric pouch was dilated up to 30 mm, using a Rigiflex® (Boston Scientific, Natick, MA), which was gradually inflated until either rupturing or stretching the thread running inside the ring to widen the luminal diameter. The duration of each dilation session ranged from 5 to 30 min [13].

LSG with or without ring (Figs. 2 and 6): The narrowed spot of the gastric pouch (ring or angular incisure) was dilated using a 30-mm pneumatic dilator (Fig. 5) [14], following the technique for RYGB. The ideal way to detect the angular incisure stenosis is through the upper gastrointestinal series. However, the gastroscope may also identify a longitudinal fold at this area. So, for the endoscope to pass and reach the antrum, the tip must be well angled up.

2. Strictureotomy:

RYGB with or without ring: The stenosis of gastrojejunal anastomosis with persistent fibrotic stricture or

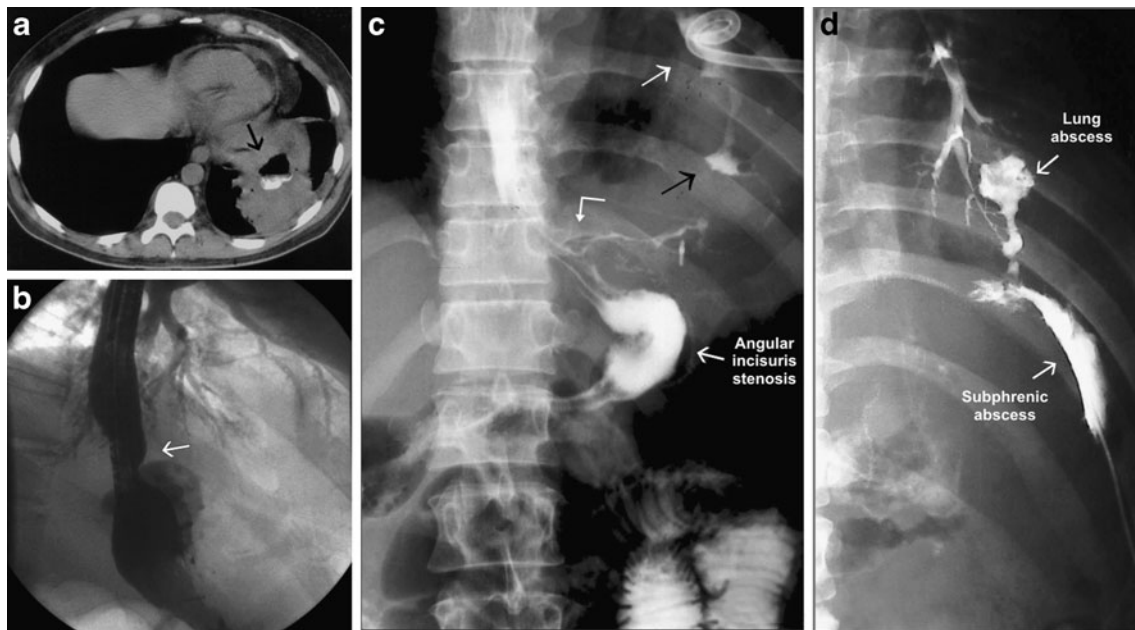


Fig. 2 Images of gastrobronchial fistula (GBF): **a**) Tomography showing lung abscess - Case 2; **b**) Contrast radiography showing a GBF from the angle of His after sleeve gastrectomy - Case 3; **c**) Contrast radiography showing lung (*white arrow*) and subphrenic

abscess (*black arrow*) due to GBF at the angle of His (*bent arrow*) after sleeve gastrectomy - Case 11; **d**) Contrast injection through the subphrenic drain revealing the bronchial tree - Case 4

recurrence was treated by stricturotomy, using Micro-knife XL® (Boston Scientific, Natick, MA). Afterwards, 20 mm balloon dilation was performed. When the diameter of the pouch was smaller than the esophagus, a stricturotomy was also performed, followed by dilation with a 30-mm balloon.

LSG with or without ring: The stenosis in the angular incisure was treated similarly to the strictur-

otomy technique described for RYGB, followed by balloon dilation up to 30 mm (Fig. 5).

3. Gastric septoplasty for internal drainage of abscess:

RYGB or LSG: the septum near the internal orifice of the fistula at the angle of His facilitated the passage of secretion through the leakage. It was a contributing factor to abscess formation and hindering the GF healing process. Therefore, the septum was incised with a Micro-

Fig. 3 Contrast radiographic images after gastric bypass: **a**) Fistulography of the subphrenic region and bronchial tree - Case 7; **b**) Contrast swallow showing esophagus (*white arrow*), GBF from the angle of His and reduced diameter of the gastric pouch - Case 15

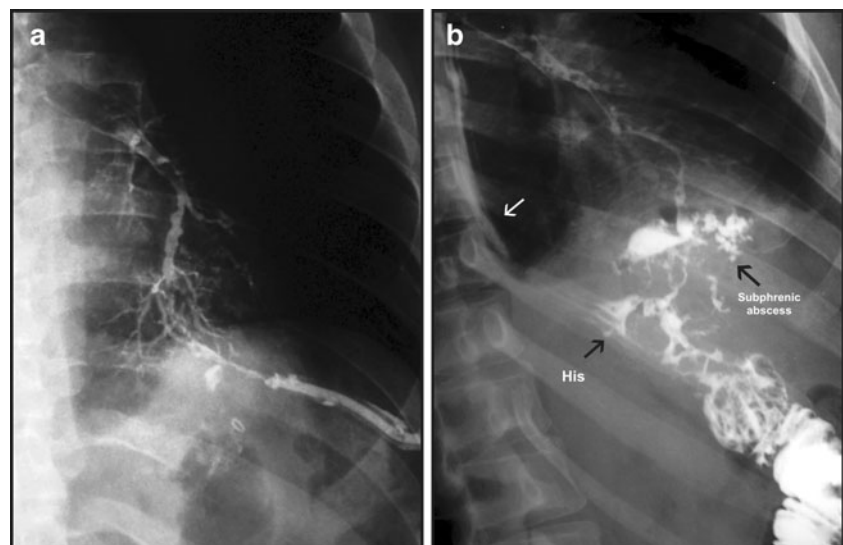
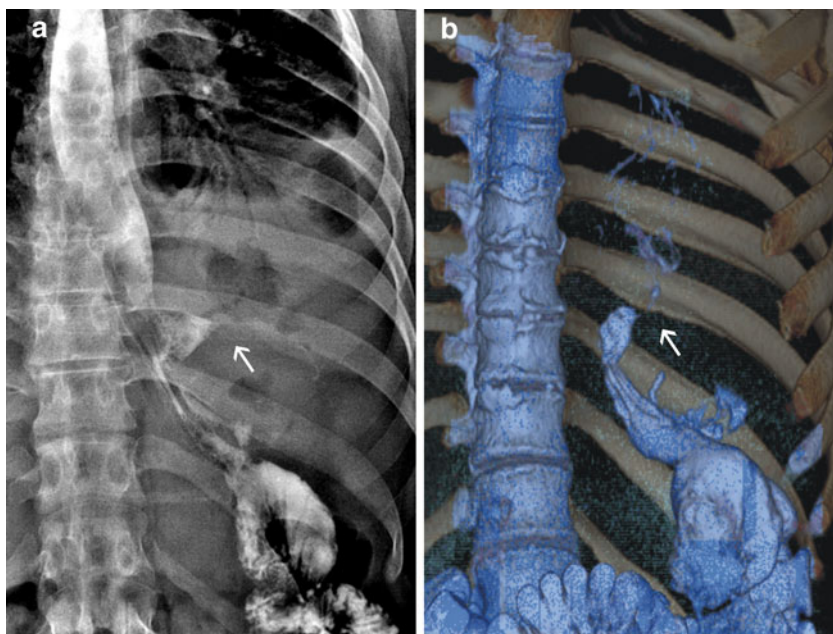


Fig. 4 Images of patient 14 after gastric bypass: **a)** Contrast radiography showing a GBF from the angle of His, **b)** Computerized tomographic reconstruction showing a clearer image of the GBF



knife XL® (Boston Scientific, Natick, MA), followed by a 30-mm balloon dilation. This technique allows the internal drainage of the abscess, which leads to the closure of the fistula, since the gastric outlet is now restored.

4. Placement of self-expandable plastic stent (SEPS):

A Polyflex® (diameter, 25×21 mm; length, 150 mm) (Boston Scientific, Natick, MA) was indicated mainly when the diameter of the fistula was >10 mm and/or distal stenosis of the gastric pouch was persistent.

As soon as the endoscopic treatment was initiated, the patients received the following additional measures:

- Enteral nutrition either by gastrostomy, jejunostomy, or nasoenteral tube, as substitutes for the total parenteral nutrition.

- Early discharge from the hospital.
- Therapeutic endoscopy sessions whenever necessary; it was carried out in the endoscopy suite in an outpatient setting. LSG patients underwent additional endoscopic dilation sessions every 30 days, during 3 months to prevent GBF recurrence.

Results

Symptoms and signs suggestive of GBF (cough, dyspnea, chest pain, hemoptysis, fever, or vomit of pus from the lungs—vomica) appeared, on average, 6.7 months (range, 1–30 months) after the bariatric surgery (Table 2).

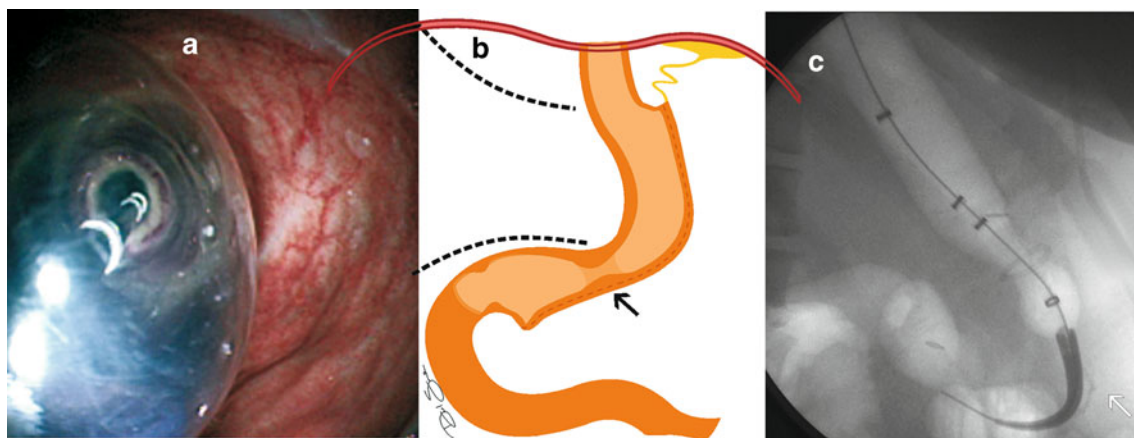
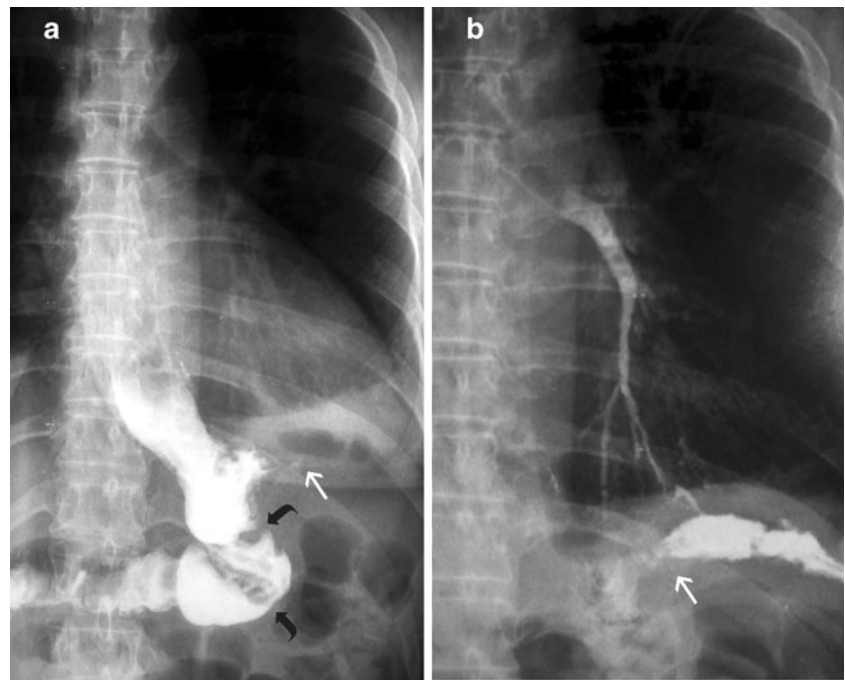


Fig. 5 Images of angular incisure stenosis (arrow) and fistula after sleeve gastrectomy: **a)** Endoscopic balloon dilation - Case 1; **b)** Schematic image showing a fistula from the angle of His; **c)** Radiography showing balloon dilation - Case 3

Fig. 6 Contrast radiographic images of patient 13 after sleeve gastrectomy showing a GBF (white arrows) from the angle of His; **a**) Gastric pouch in spiral with a proximal stenosis and another at the angular incisure (curved arrows); **b**) GBF and subphrenic abscess



Chest CT diagnosed lung abscess, with diameters ranging from 4 to 10 cm (Fig. 2), in the lower left lung in ten patients; three of them were treated by thoracotomy (Fig. 7).

Before referring the patients to our institution for endoscopic treatment, several abdominal and thoracic operations were attempted to close the GBF and to manage its secondary complications (Table 3). Abdominal reoper-

ation was done in nine patients for the following procedures: drainage and cleansing of the abdominal cavity ($n=9$), ring removal ($n=4$), and to create a nutritional access ($n=6$). CT-guided aspiration of subphrenic abscess was performed in five cases, which avoided reoperation in three patients. The abdominal drainage tube placed during the initial bariatric surgery also avoided reoperation in three other cases. Ten patients developed lung abscess and were treated by the following procedures: antibiotic therapy ($n=10$) and thoracotomy ($n=3$).

The source of the leakage was seen at the angle of His ($n=14$) and gastric body ($n=1$) by gastroscopy. Those 14 patients developed a narrowing of the gastric pouch at different spots: at the gastrojejunal anastomosis ($n=2$), at the ring ($n=4$), at the gastric pouch ($n=4$), and at the angular incisure ($n=4$) (Table 2; Figs. 3 and 4).

The following endoscopic procedures were undertaken: SEPS placement ($n=7$), balloon dilation ($n=11$), stricturotomy or septoplasty ($n=10$), and application of clip ($n=1$) and fibrin glue ($n=2$) (Fig. 5). There were, on average, 4.5 endoscopic sessions per patient. Patients 5 and 6 received a SEPS after RYGB with ring that were both purposely removed by endoscopy due to intragastric ring erosion 1 month later on average (Tables 2 and 3).

Minor complications occurred in two patients; case 4 presented a self-limited upper digestive hemorrhage after a septoplasty, and case 15 presented a distal migration of SEPS in the post-RYGB gastric pouch, undergoing a new endoscopy to adjust it (Table 3).

The overall average healing time of the GBF was 4.4 months (range, 1–10 months), after the beginning of



Fig. 7 Patient 10 with scars due to major abdominal and thoracic surgery and a gastrobronchial-cutaneous fistula. She was the only patient who persisted with GBF

Table 3 Endoscopic and surgical treatment and results of patients with gastrobronchial fistula (GBF)

| Patient number | Reoperation before endoscopic procedures | Nutritional access | SEPS | Balloon dilation | Stricturectomy or septoplasty | Endoscopic sessions | Minor complication | Healing time of GBF (months) |
|----------------|------------------------------------------|--------------------|------|------------------|-------------------------------|---------------------|--------------------|------------------------------|
| 1 | – | Nasoenteral tube | N | Y | Y | 6 | – | 6 |
| 2 | Drain | Gastrostomy | N | Y | Y | 8 | – | 6 |
| 3 | Drain+ring removal | Nasoenteral tube | N | Y | Y | 6 | – | 8 |
| 4 | Drain+ring removal | Gastrostomy | N | Y | Y | 5 | Bleeding | 6 |
| 5 | – | Nasoenteral tube | Y | Y | N | 3 | – | 2 |
| 6 | – | Nasoenteral tube | Y | Y | Y | 3 | – | 3 |
| 7 | – | Nasoenteral tube | Y | Y | Y | 4 | – | 1.5 |
| 8 | Thoracotomy+drain+ring removal | Gastrostomy | Y | N | N | 3 | – | 2 |
| 9 | – | Nasoenteral tube | Y | Y | Y | 3 | – | 1 |
| 10 | Thoracotomy+drain+ring removal | Gastrostomy | N | N | N | 2 | – | – |
| 11 | Drain | Jejunostomy | N | N | N | 3 | – | 10 |
| 12 | Thoracotomy+drain | Nasoenteral tube | Y | N | N | 2 | – | 5 |
| 13 | Drain | Jejunostomy | N | Y | Y | 11 | – | 6 |
| 14 | Drain+leak suture | Nasoenteral tube | N | Y | Y | 5 | – | 2.5 |
| 15 | – | – | Y | Y | Y | 4 | Stent migration | 3 |

Drain drainage, SEPS self-expandable plastic stent, Y yes, N no, GBF gastrobronchial fistula

the endoscopic treatment. The group with SEPS presented a shorter recovery time (2.5 months), in comparison with the group submitted to other endotherapy (9.5 months).

Endotherapy led to a 93.3% (14 out of 15) success rate in GBF closure without recurrence after an average follow-up of 27.3 months (range, 2–72 months). The only patient (case 10) who persisted with a GBF (Fig. 7), despite the application of fibrin glue (one session), denied to undergo further treatment.

Discussion

After RYGB and LSG, the closure of GF can be hindered by the presence of distal stenosis and abdominal infection [8, 9, 15]. The spontaneous communication of the subphrenic abscess with the bronchial tree suggests the previous existence of a persistent GF, possibly secondary to a chronic difficulty in gastric emptying [5, 9]. The GBF of our patients occurred late in the postoperative period (5.7 months on average), consistent with other studies [5–9].

GBF may have some possible predisposing factors such as recurrent abscesses in the upper abdomen without drainage or early withdrawal of the drain, with resultant chronic subphrenic inflammation [5, 7–9]. It also may have occurred after adjustable gastric band erosion [6].

Coughing with phlegm and fever are the main symptoms of GBF [5, 7, 8]. However, vomica, recurrent pneumonia, and/or lung abscess were observed mainly in patients with

late diagnosis, due to a delay in evaluation by a specialist in bariatric surgery [6, 9]. We observed a significant decrease in oxygen saturation during gastroscopy or contrast radiography due to the passage of air or contrast material into the airways through the GBF. Obtaining a precise diagnosis of GBF is a laborious process, requiring imaging exams with iodinated contrast media [5, 7–9]. The use of contrast with barium can cause severe bronchial reactions, which needs to be cleaned by bronchoscopy [6].

In our study, no patient was referred to bronchoscopy. Although this exam does not reveal the precise location of the fistula, bronchoscopy can suggest GBF by the observation of methylene blue in the bronchus after oral or drain administration [8].

Treatment with antibiotics was successful to manage the majority of our patients with lung infection. In cases of failure, CT-guided aspiration of the collection and surgical approach are other options for the management of GBF [8, 9]. In our series, six patients showed no lung infection on CT scan. Within this group, we adopted SEPS to bridge the fistula in three cases (5, 7, and 9), and we suppose that its early application may have prevented the development of lung abscess.

Upper digestive endoscopy does not diagnose GBF, but identifies its internal opening, evaluates the anatomy of the gastric pouch, and promotes therapy, minimizing the need of invasive surgery [5, 9]. Reoperation may provide little benefit because of the difficult access to the region of the upper abdomen with adhesions and fibrosis [5, 6, 8, 9]. In

addition to the complexity of major abdominal and thoracic reoperations with its high morbidity rate [7, 8], it is often not efficient to completely heal GBF, as it has shown to be true in three patients of the present series.

Fuks et al. [8] report the complex treatment of a patient with a GBF after LSG, which failed initially with the clinical and endoscopic approach. Usually, this may be secondary to a stenosis at the angular incisure, which increases the intragastric pressure and promotes the persistent GBF [14, 16]. In this case, the healing of the fistula was achieved only through a major abdominal and thoracic surgery [8].

Among our five LSG patients, only one had undergone a thoracotomy. The other four patients had been treated by antibiotics, combined with endoscopic correction of angular incisure stenosis. Thoracotomy for cleaning of the lung infection seems to bring little benefit to patients with GBF, whereas thoracoscopy is minimally invasive and could promote lung expansion, helping avoid invasive ventilatory support. However, most patients in the current series ($n=12$) and from other reports did not need thoracic surgery [5–7, 9].

Endoscopic stricturotomy and dilation are minimally invasive and effective techniques in resolving gastric stenosis [5, 9, 12]. In LSG, the angular incisure stenosis hinders the healing of the fistula at the angle of His and some authors have proposed total gastrectomy for the final settlement of the GBF [7, 8]. In the present series, healing of GBF was achieved by a combination of aggressive balloon dilation, SEPS placement, and stricturotomy or septoplasty. The systematic dilation every 30 days for a 3-month period, even in the absence of obstructive symptoms, prevented the recurrence of GBF.

The endoscopic use of SEPS in fistula related to trauma, perforation, or esophagogastrectomy has been reported [17, 18]. In the present series, SEPS prevented the passage of secretion for the GBF and also promoted expansion of the distal gastric stricture. This led to ring erosion in two cases, occurring when complete resolution of the stenosis was achieved, which has been described previously [19, 20]. Through the use of SEPS, the digestive tract is permanently patent, allowing early food intake and decreasing the number of endoscopic sessions [21]. The SEPS migration occurred in patient 15, which can be avoided by anchoring the distal end of the stent in the gastrojejunal anastomosis.

The use of endoscopic clip and fibrin glue for the closure of GBF was attempted only at the beginning of this study. It was discontinued due to unfavorable results [5, 8, 9]. We hypothesize that, most likely, this failure occurred because of persistence of the distal stenosis.

In conclusion, the present series demonstrates that GBF is a severe complication of bariatric surgery that usually presents late in the postoperative period. GBF can be healed with an endoscopic approach directed to

open up widely the lumen of the gastric pouch by a combination of aggressive dilations, SEPS, and stricturotomy or septoplasty. Early endoscopic intervention is important to shorten the healing time of the fistula and to prevent lung abscess, particularly with the early use of SEPS. Recurrence of GBF is avoided through the final resolution of gastric stenosis by balloon dilation and stricturotomy.

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