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ORIGINAL CONTRIBUTIONS

Surgical Management of Gastrogastric Fistula After Roux-en-Y Gastric Bypass: 10-Year Experience

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Abstract
Background Gastrogastric fistula (GGF) occurs in 1–6% of patients who undergo Roux-en-Y gastric bypass (RYGB) for morbid obesity. The pathophysiology may be related to gastric ischemia, fistula, or ulcer.
Objectives The purposes of the study are to describe the principles of management and to review the literature of this uncommon complication.
Setting The setting of this study is University Hospital, France.
Materials and Methods We conducted a retrospective review of all patients' records with a diagnosis of GGF after RYGB between January 2004 and November 2014.
Results During the study period, 1273 patients had RYGB for morbid obesity. Fifteen patients presented with a symptomatic GGF (1.18%). The average interval from surgery to presentation was 28 months (22–62). A history of marginal ulcer or anastomotic leak was present in nine patients (60%). The most common presentation was weight regain (80%), followed by pain (73.3%). Two types of fistulas were identified, an exclusively GGF (high) and a gastro-jejuno-gastric fistula (low). High GGF, frequently associated with dilatation of the gastric pouch, was treated by a sleeve of the pouch and sleeve resection of the remnant stomach (nine patients). Low GGF was treated with gastric resection coupled with a revision of the gastrojejunal anastomosis (six patients). All patients were treated laparoscopically with no conversion to laparotomy. The average length of postoperative hospital stay was 5.2 days (range 3–10).
Conclusion GGF after RYGB is a rare complication. Its pathophysiology remains unclear. Surgical management is the definitive treatment.

Keywords Gastrogastric fistula · Gastric bypass · Marginal ulcer · Fistula · Bariatric · Obesity · Laparoscopy

Introduction

Bariatric surgery is currently considered the best long-term treatment for morbid obesity. The Roux-en-Y gastric bypass (RYGB) is a commonly performed procedure that achieves significant long-term weight loss in most patients [1]. Despite the dramatic decrease in the incidence of postoperative complications during the past decade, morbidity and mortality associated with RYGB are still of concern. Symptomatic gastrogastric fistula (GGF) occurs in up to 6% of RYGB [2–5]. GGF is an abnormal communication between the gastric pouch and the excluded gastric remnant. Although GGF may be treated conservatively, patients with symptomatic GGF will require technically challenging revisional procedures.

The purpose of our study was to summarize our experience in the diagnosis and surgical management of GGF in a series of 1273 consecutive patients who underwent divided laparoscopic RYGB at three institutions.

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Materials and Methods

We performed a retrospective chart review of 1273 consecutive patients who underwent divided RYGB between January 2004 and November 2014. The local *Research Committee* granted its approval of the study protocol. Data were obtained from the surgical, clinical, endoscopic, and radiologic reports. The patients' demographics, surgical outcomes, and significant complications are summarized in Table 1. Preoperative upper gastrointestinal endoscopy was routinely performed, including screening for *Helicobacter pylori* infection. When positive, patients were treated preoperatively with 14 days of omeprazole, clarithromycin, and amoxicillin. Postoperatively, all patients were given proton pump inhibitors (PPIs) for 90 days. The patients were routinely reviewed at 1, 3, 6, and 12 months postoperatively and yearly thereafter. Follow-up visits included weight measurement, thorough anamnesis, physical exam, and laboratory screening for blood nutritional deficiencies.

The Bypass Technique

The operative technique used was similar to that described by Schauer et al. [6]. All RYGB procedures were done laparoscopically. A 20–30-ml gastric pouch was created. A side-to-side, gastrojejunal anastomosis was then confectioned using 30-mm linear cartridge with a 150-cm Roux limb. The opening was closed using running, 2.0, absorbable sutures. The gastrojejunal anastomosis was tested for leaks using methylene blue injected through a nasogastric tube. A side-to-side, jejuno-jejunal anastomosis was then performed, using two 45-mm linear cartridges. At postoperative day (POD) 1 or 2, all patients underwent an upper gastrointestinal contrast study to test for leaks or obstructions. Patients were scheduled for systematic postoperative visits at 1, 3, 6, and 12 months and annually thereafter.

Diagnosis of the Fistula

As part of our approach to weight regain or pain after RYGB, all patients had both a computerized tomography (CT) scan and an upper GI endoscopy.

The Fistula Repair Technique

Adhesions from the previous surgery were completely released using sharp dissection and LigaSure® (ValleyLab, Inc., Boulder, Colorado, USA). Dissection delimitated the gastric pouch, the gastrojejunal anastomosis, and the gastric remnant. A fibrotic zone was visualized between the gastric pouch and the gastric remnant with the help of the Goldfinger dissector (Blunt Dissectors, OBTECH Medical SARL, Johnson & Johnson, Le Locle, Switzerland).

Table 1 Patient characteristics demographics, surgical outcomes, and significant complications

Patients with gastrogastric fistulas (*n*)	15/1273 (1.18)
Gender (*n*)	
Male	6 (40)
Female	9 (60)
Age (year)	
Mean	38
Range	27–51
Fistula diagnosis (months)	
Mean	28
Range	22–62
BMI (kg/m^2)	
Mean	38.1
Range	31–52
Follow-up time (months)	
Mean	36
Range	24–72
Comorbidities (*n*)	
Smoking	6 (40)
Diabetes	9 (60)
Hypertension	6 (40)
Osteoarthritis	5 (33.3)
SAS	7 (46.6)
GERD	3 (20)
Hypercholesterolemia	3 (20)
Deep venous thrombosis	1 (7)
Depression	4 (26.6)
Symptoms (*n*)	
Pain	11 (73.3%)
Increase food intake	14 (93)
Weight gain	12 (80%)
Marginal ulcers (*n*)	9 (60%)

Depending on the operative findings, the GGF was classified as follows:

Type 1: located in the higher part of the gastric pouch more than 1 cm above the gastrojejunal anastomosis
Type 2: located in the lower part of the gastric less than 1 cm from the gastrojejunal anastomosis

In type 1 GGFs, simple resection of the gastric pouch tract was performed using reinforced (GORE® SEAMGUARD® Bioabsorbable Staple Line Reinforcement, W.L. Gore & Associates, Elkton, MD, USA) linear stapling (Tristaple® technique, black cartridges, Medtronic, Minneapolis, MN, USA) using an orally inserted, 36-French calibration tube. The other end of the fistula, with the gastric remnant, was also sleeved using the same technique. Reducing the volume of the gastric remnant avoids retained gastric antrum syndrome

(RGA) [7]. Omentoplasty was also performed to maintain separation of the gastric pouch and gastric remnant.

In type 2 fistulas, en bloc resection of the gastrojejunal anastomosis was done. A new, side-to-side, gastrojejunal anastomosis was then created using a 30-mm purple cartridge of the same endoGIA stapler. The opening was closed using running, 2.0, absorbable sutures.

Regardless of the procedure, a leak test with methylene blue was always performed by injection through the orogastric tube.

A closed, suction drainage system was always placed next to the gastric pouch and brought out through the left subcostal port site. No gastric drainage was used.

Statistical Analysis

Categorical variables are reported as frequencies (%). Continuous variables are expressed as the mean and range. Weight loss after revisional surgery for GGF was analyzed using Student's paired *t* test. A *p* value of less than 0.05 was considered statistically significant.

Results

Between January 2004 and November 2014, 1273 consecutive patients had divided RYGB, of whom 15 (1.18%) were diagnosed with symptomatic GGF postoperatively. The patients' demographics, including height, pre- and postoperative weight, body mass index, follow-up, and surgery, are summarized in Table 2. Nine patients (60%) were women, and six (40%) were men. The mean age was 38 years (range, 27–51). The mean preoperative weight was 115 kg (range, 89–145). The mean body mass index (BMI) was 38.1 kg/m^2 (range, 31–52).

The presenting symptoms that led to a diagnosis of GGF were nausea (13/15), weight regain (12/15), epigastric pain (11/15), gastroesophageal reflux disease (GERD) (6/15), and diarrhea (2/15). Six patients (40%) previously had an endoscopically confirmed marginal ulcer. In the subset of patients with weight regain (80%), the mean percentage of excess weight loss (% EWL) at 1 year was 27.79% (range, 0–59.8). The % EWL pattern is summarized in Table 3.

The upper GI endoscopy showed the GGF in only 11 patients (73.3%). However, all patients had their GGF confirmed by IV and oral-enhanced CT scan, which demonstrated an abnormal presence of contrast material in the gastric remnant.

The mean time interval from the initial RYGB to GGF diagnosis was 28 months (range, 22–62). All patients required revisional surgery either because of refractory symptoms or because of weight regain. All revisional procedures were performed laparoscopically with no conversion to laparotomy. The mean follow-up period was 36 months (range, 24–72). Table 4 summarizes the type of surgery performed in each patient.

Mortality was 0%. Two patients experienced postoperative complications (13.3%). The first was upper gastrointestinal

Table 2 Characteristics, BMI, follow-up, and surgery date of patients with gastrogastric fistulas

Pt. No	Age (years)	Gender	Height (cm)	IBW	BMI	Initial BMI	Actual WT loss (kg)	BMI loss	Follow-up till date for revision (months)	BMI after revision at the last follow-up	BMI loss after revision (kg/m^2)	Follow-up post revision (months)
1	27	F	168	70.56	31	40	25.4	09	45	31	0	20
2	31	F	162	65.61	34	38	10.5	04	24	28	6	25
3	42	M	173	74.8	36	42	18	06	28	28	8	28
4	45	F	167	69.7	38	45	19.5	07	32	29	9	24
5	28	F	161	64.8	39	40	2.59	01	36	27	12	50
6	36	F	178	79.2	32	49	53.86	17	45	31	1	21
7	40	F	172	74	45	48	8.9	03	48	30	15	60
8	38	F	166	68.9	43	46	8.2	03	35	29	14	36
9	39	M	167	69.7	38	48	27.9	10	32	33	5	31
10	36	F	163	66.4	39	45	16	06	48	31	8	30
11	34	M	182	82.8	37	40	9.9	03	45	29	8	34
12	36	M	166	68.9	48	52	11	04	30	34	14	40
13	48	M	174	75.7	34	38	12.1	04	72	30	4	29
14	46	F	156	60.8	36	38	4.8	02	36	27	9	35
15	51	M	171	73.1	52	52	0	00	29	35	17	42

Pt. No patient number, *F* female, *M* male, *IBW* ideal body weight, *BMI* body mass index, *WT* weight

Table 3 Characteristics, estimated weight loss, follow-up, and surgery

Pt. No	Age (years)	Gender	Height (cm)	IBW	WT loss after bypass (kg)	% EWL after bypass	% TWL after bypass	Follow-up (months) till revision	WT loss after revision at the last follow-up (kg)	% EWL after revision	Follow-up post revision (months)
1	27	F	168	70.56	25.4	59.8	22.4	45	25.4	59.8	20
2	31	F	162	65.61	10.5	30.5	10.5	24	26.5	77	25
3	42	M	173	74.8	18	35.15	14.4	28	42	82	28
4	45	F	167	69.7	19.5	35	15.6	32	44.5	79.75	24
5	28	F	161	64.8	2.59	6.6	2.5	36	34	86.7	50
6	36	F	178	79.2	53.86	71	34.75	45	57	75.2	21
7	40	F	172	74	8.9	13	6.2	48	53.25	78.3	60
8	38	F	166	68.9	8.2	14.11	6.5	35	47	80.9	36
9	39	M	167	69.7	27.9	41.45	20.8	32	42	65.3	31
10	36	F	163	66.4	16	29.85	13.3	48	37.6	70	30
11	34	M	182	82.8	9.9	20	7.5	45	36.5	73.4	34
12	36	M	166	68.9	11	14.8	7.69	30	49.5	66.6	40
13	48	M	174	75.7	12.1	30.7	10.5	72	24	61	29
14	46	F	156	60.8	4.8	15	5	36	26.8	84.5	35
15	51	M	171	73.1	0	0	0	29	50	63.2	42

Pt. No patient number, *F* female, *M* male, *IBW* ideal body weight, *BMI* body mass index, *WT* weight, *EWL* estimated weight loss, *TWL* total weight loss

bleeding requiring transfusion of three units of packed red blood cells. The second patient experienced postoperative pneumonia treated by antibiotics. None of the patients required reoperation. The mean hospital stay was 5.2 days (range, 3–10).

At 1 month postoperatively, all patients were clinically asymptomatic, and repeat endoscopy confirmed the absence of anomalies in all patients.

At 1-year follow-up after the surgery, the mean % EWL was 73.57% (range, 59.8–86.7) (Table 3) and the mean % TWL was 31.32% (range 20.8–37.5) (Table 4).

The mean BMI loss was nine points (1–17 kg/m^2). The weight loss after the revisional surgery was statistically significant ($p < 0.05$), and the GGF was cured in all the cases.

Revision of the gastric pouch in RYGB allowed improvement of diabetes with respect to the number and doses of medications and the treatment in 77.7% (7/9) of patients with diabetes relapse after bypass.

No patient was lost to follow-up. At the last follow-up (mean 34 months, range 20–60 months), all the patients were asymptomatic with no use of PPI.

Table 4 Type of intervention by patient with EWL and TWL after revision

Patient	Age (years)	Gender	Height (cm)	Initial BMI	% TWL after revision	% EWL after revision	Type of revision
1	27	F	168	40	22.4	59.8	Fistulous tract resection
2	31	F	162	38	26.5	77	Fistulous tract resection
3	42	M	173	42	33.6	82	Fistulous tract resection
4	45	F	167	45	35.6	79.75	Fistulous tract resection
5	28	F	161	40	33	86.7	En bloc resection of GGF and GJ
6	36	F	178	49	36.77	75.2	En bloc resection of GGF and GJ
7	40	F	172	48	37.5	78.3	En bloc resection of GGF and GJ
8	38	F	166	46	37.3	80.9	Fistulous tract resection
9	39	M	167	48	31.3	65.3	En bloc resection of GGF and GJ
10	36	F	163	45	31.4	70	Fistulous tract resection
11	34	M	182	40	27.65	73.4	Fistulous tract resection
12	36	M	166	52	34.2	66.6	En bloc resection of GGF and GJ
13	48	M	174	38	20.8	61	Fistulous tract resection
14	46	F	156	38	29	84.5	Fistulous tract resection
15	51	M	171	52	32.9	63.2	En bloc resection of GGF and GJ

BMI body mass index, *EWL* estimated weight loss, *TWL* total weight loss

Discussion

Gastrogastric fistula (GGF) is an uncommon complication after RYGB for morbid obesity [7], with an incidence of 1 to 6% [5]. The incidence of a GGF is underestimated in the literature, as some patients might have an asymptomatic fistula, others might not have completed the diagnostic studies, and others are lost to follow-up.

In our retrospective series that included 1273 patients, the rate of documented GGF after divided RYGB was 1.18%. Most studies report a rate of GGF around 1% [8]; some have reported higher [5] or lower rates [9].

Recent publications reported postoperative confirmed leak or suspected micro leak, as well as marginal ulcer, as the main causes of GGF [7]. Cucchi et al. [5] reported a rate of 83% for documented leaks in patients diagnosed with GGF after RYGB. On the other hand, the incidence of GGF combined with marginal ulcers varies among studies and ranges from 0.6 to 16% [10, 11]. Preoperative *H. pylori* infection or use of NSAIDs may contribute to the postoperative development of marginal ulcer [4].

In our series, we did not find a correlation between elevated body mass index and incidence of leak formation or consequent development of gastrogastric fistulas. To increase our detection rate, we performed endoscopic and radiographic studies for patients presenting with weight loss failure, marginal ulceration, or persistent dyspeptic symptoms. In line with our experience and within 2 years postoperatively, we implemented a close follow-up plan for all our RYGB patients, reaching approximately 82% of the entire postoperative population. The follow-up schedule consisted of visits at 4 weeks and 3, 6, and 12 months after the surgery and annual visits afterward. The patients were encouraged to visit psychological and nutritional counselors trained to report any weight regain displayed by the patient.

Patients with GGF may be asymptomatic; present with nonspecific symptoms, including nausea, vomiting, bloating, pyrosis, and abdominal pain; or develop symptoms related to associated marginal ulcer (pain, hemorrhage, or perforation) or stricture (gastric outlet obstruction). They may also seek medical advice for diabetes recurrence, suboptimal weight loss, and/or weight regain, and some patients achieve acceptable, durable weight loss despite the presence of the fistula [12–14].

The gold standard for diagnosis of GGF is endoscopic and radiologic imaging, such as upper GI series, CT scan with oral opacification, or EGD. CT scan shows the presence of contrast or air in the gastric remnant, an indirect sign of GGF. Although it is not the test of choice for some surgeons [5], CT scan detected 100% of the GGF in our series. With UGI, we were able to detect 60% of fistulas. We have found endoscopy a valuable tool in visualizing the location of the fistula and planning for surgery. Even if the diagnosis was made by a single test, we still ran all three tests, as we believe that they are complementary to each other.

In some studies, GGF was an incidental intraoperative finding during revision bariatric surgery for failed previous intervention. Corcelles et al. [15] diagnosed 27.7% (10/36) of their cases of GGF intraoperatively.

Not all patients with GGF are candidates for surgical treatment. The initial approach should always be medical. Conservative management consists of eradication of *H. pylori* if present, sucralfate and high-dose PPI (40 mg twice daily), analgesics in addition to NSAIDs and smoking cessation [16]. The aim of conservative management is to reduce gastric acid secretion. This may eliminate abdominal pain and reflux symptoms and may also permit small GGFs to close spontaneously [17]. The conservative approach was successful in 20% of cases in one study; all of these fistulas were small in caliber [16]. On the other hand, medical management serves as a bridge to a more radical surgical therapy, especially in patients with complicated GGF.

Several institutions have tried endoscopic management for GGF. Endoscopic repair can be attempted prior to surgical repair [18]. It is proven safe and feasible, with short-term success but a poor long-term outcome. Multiple methods of repair have been utilized, including fibrin sealant, endoclips, and endoscopic suturing systems. However, surgery remains the most definitive approach. Recent advances in surgical management of GGF have led to a reasonable classification of GGF into type 1 and type 2, with corresponding surgical interventions (see above):

> For type 1 GGF, excision of the fistula with preservation of the GJA, with or without calibration according to the size of pouch [4, 16].
> For type 2 fistulas, which are usually associated with persistent marginal ulcer or anastomotic stenosis, complete revision of the gastrojejunal anastomosis with fistula excision is done [15].

The extent of resizing of the remnant stomach is controversial and varies among surgeons. Resizing the remnant may decrease the fistula rate [19–21], but oversizing leads to retained gastric antrum syndrome, as described by Ribeiro-Parenti et al. [9]. Some surgeons have found better results with interposition of the omentum or the jejunum to support the closure [2, 22].

Our results show that surgical management of GGF yielded good results regarding weight loss and resolution of comorbidities. These results were similar to O'Brien et al., who showed that 4 months after GGF repair, weight loss resumed and yielded favorable changes in satiety and orexigenic gut hormones [23]. Fasting and postprandial ghrelin decreased and were strongly correlated with weight loss. The insulin response to glucose also tended to be increased after GGF repair.

Although we have presented a relatively large series of patients who underwent RYGB over 10 years, a subset of whom had GGF that was treated surgically, the study was limited by its retrospective design and the absence of guidelines for the diagnosis of GGF, meaning we could only report cases of GGF that were symptomatic.

Conclusion

Roux-limb-to-gastric-remnant fistulas and gastrogastric fistulas are rare complications of RYGB procedures. However, the determination of their true incidence should have mandated systematic postoperative upper gastrointestinal endoscopy. Their pathophysiology is unknown. CT scan should always be done in case of weight regain when looking for GGF. Laparoscopic management can be performed safely and successfully in symptomatic patients.

Compliance with Ethical Standards

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

Human and Animal Rights and Informed Consent Informed consent was obtained from all individual participants included in the study.

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