

Surgical Management of Gastro–Gastric Fistula After Divided Laparoscopic Roux-en-Y Gastric Bypass for Morbid Obesity

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Abstract

Background Gastro–gastric fistula (GGF) formation is uncommon after divided laparoscopic Roux-en-Y gastric bypass (LRYGB) for morbid obesity. Optimal surgical management remains controversial.

Methods A retrospective review was performed of a prospectively maintained database of patients undergoing LRYGB from January 2001 to October 2006.

Results Of 1,763 primary procedures, 27 patients (1.5%) developed a GGF and 10 (37%) resolved with medical management, whereas 17 (63%) required surgical intervention. An additional seven patients requiring surgical intervention for GGF after RYGB were referred from another institution. Indications for surgery included weight regain, recurrent, or non-healing gastrojejunal anastomotic (GJA) ulceration with persistent abdominal pain and/or hemorrhage, and/or recurrent GJA stricture. Remnant gastrectomy with GGF excision or exclusion was performed in 23 patients (96%) with an average in-hospital stay of 7.5 days (range, 3–27). Morbidity in six patients (25%) was caused by pneumonia, $n=2$; wound infection, $n=2$; staple-line bleed, $n=1$; and subcapsular splenic hematoma, $n=1$. There were no mortalities. Complete resolution of symptoms and associated ulceration was seen in the majority of patients.

Conclusion Although uncommon, GGF formation can complicate divided LRYGB. Laparoscopic remnant gastrectomy with fistula excision or exclusion can be used to effectively manage symptomatic patients who fail to respond to conservative measures.

Keywords Complications · Roux-en-Y gastric bypass · Morbid obesity · Fistula · Remnant gastrectomy

Abbreviations

AA antecolic antegastric
BMI body mass index
CT computed tomography
GE gastroesophageal

GUGI gastrograffin upper gastrointestinal study
GGF gastro–gastric fistula
EGD Esophagogastroduodenoscopy
LRG laparoscopic remnant gastrectomy
LRYGB laparoscopic Roux-en-Y gastric bypass
POD postoperative day
PPI proton pump inhibitor
RG remnant gastrectomy
RR retrocolic retrogastric
RYGB Roux-en-Y gastric bypass

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Introduction

Surgery is the preferred technique to achieve weight loss and resolution of comorbidity in the morbidly obese.¹ However, surgery is not without its complications, and a

wide variety of approaches have been developed over the last three decades in an attempt to reduce morbidity and improve outcome. Laparoscopic Roux-en-Y gastric bypass (LRYGB) is currently the most commonly performed bariatric procedure worldwide.^{2–6} Despite advances in technology and improvements in surgical technique, adverse events contributing to serious morbidity and mortality are seen after LRYGB. Fistula formation is an uncommon but potentially significant complication. The most common type encountered is a gastro-gastric fistula (GGF) with an abnormal communication between the gastric pouch and the excluded stomach, which can result in failure of weight loss, weight regain, intractable marginal ulceration with recurrent upper gastrointestinal hemorrhage, pain, and stricture formation.

Historically, the technique of gastroplasty, its subsequent modification to the vertical banded gastroplasty, and the early open RYGB procedures involved the creation of a non-divided or partially divided gastric pouch.^{7–9} GGF rates of 49% were reported after primary RYGB when the pouch and stomach were stapled in continuity or partially divided.¹⁰ Following complete transection of the gastric segments, Capella and Capella¹⁰ reported a significant reduction in the incidence of GGF to 2.6%, with further reduction with the use of jejunal limb interposition.¹¹ These surgical techniques minimize the incidence of GGF formation but do not eliminate it. GGF continue to occur with a reported incidence of up to 6%.^{10,12,13} We have previously reported a 1.2% incidence of GGF in our series of patients after divided LRYGB.¹⁴

The optimal management of GGF remains controversial, and reports of surgical treatment of this complication are infrequent.^{10,12,15} We wished to determine the incidence of GGF in our patient population of 1,763 morbidly obese patients who underwent primary divided LRYGB to determine the indications for intervention and to evaluate a novel surgical approach to symptomatic GGF. We present our results on laparoscopic remnant gastrectomy (LRG) with tract excision or exclusion without interference with the gastrojejunostomy in the management of patients with symptomatic GGF after LRYGB.

Methods

Review of a prospectively maintained database and medical records of consecutive patients undergoing primary LRYGB from January 2001 to October 2006 was undertaken. All procedures were performed by two surgeons (S. S. and R.J.R.) in accordance with the National Institute of Health consensus criteria.¹⁶ Study permission was obtained from the Institutional Review Board. All patients had a Gastrograffin upper gastrointestinal study (GUGI) on

postoperative day (POD) 1, and oral intake commenced if normal. Patients were discharged on POD 2 to 4 on a 3-month course of a proton pump inhibitor (PPI). Patients were reviewed at 2 weeks, 2 and 6 months, and yearly thereafter. All data including demographic data, weight, body mass index (BMI), co-morbidities, prior surgery, reason for revision, complications, and outcome, including mortality, morbidity, readmission rate, and weight loss, were analyzed.

Surgical Technique of Laparoscopic Roux-en-Y Gastric Bypass

A standard seven-trocar LRYGB was performed.¹⁷ A 15- to 20-ml pouch was created with a linear stapler with reinforcement of the last three vertical firings with bovine pericardial strips. A 50-cm biliopancreatic and >100-cm antecolic antegastric (AA) alimentary limb determined by BMI were fashioned. GJA and pouch staple-line integrity was confirmed by air insufflation, methylene blue instillation, and esophagogastroduodenoscopy (EGD).

Diagnosis and Management of Patients with GGF

Patients with persistent nausea, vomiting, failure of weight loss, weight regain, intractable GJA ulceration, persistent epigastric pain, recurrent upper gastrointestinal hemorrhage, and GJA stricture underwent surgeon-performed EGD, GUGI, barium contrast study with supine and lateral decubitus views, and/or double contrast abdominal CT (Fig. 1). All patients with a GGF were treated with a PPI regardless of symptoms, with the addition of sucralfate for concomitant marginal ulceration and/or stricture. Indications for surgery were failed medical management in a symptomatic patient, weight regain with non-resolution of comorbidity, recurrent or non-healing GJA ulceration with persistent abdominal pain and/or hemorrhage, and recurrent GJA stricture.

Surgical Technique of Laparoscopic Remnant Gastrectomy

Trocar site placement was identical to primary LRYGB.¹⁷ The greater curve vessels were divided to the GEJ, the postgastric space entered with remnant mobilization, and a window was created separating pouch and remnant. Intraoperative EGD was performed to delineate the fistula. The distal antrum was transected with a linear stapler proximal to the pylorus. The pouch was vertically transected medial to the GGF over an Ewald tube with a linear stapler. In the presence of a small pouch, the remnant was vertically transected lateral to the GGF, leaving a narrow stomach margin. All staple lines were over-sewn. Repeat EGD was performed to confirm fistula excision or exclusion, fol-

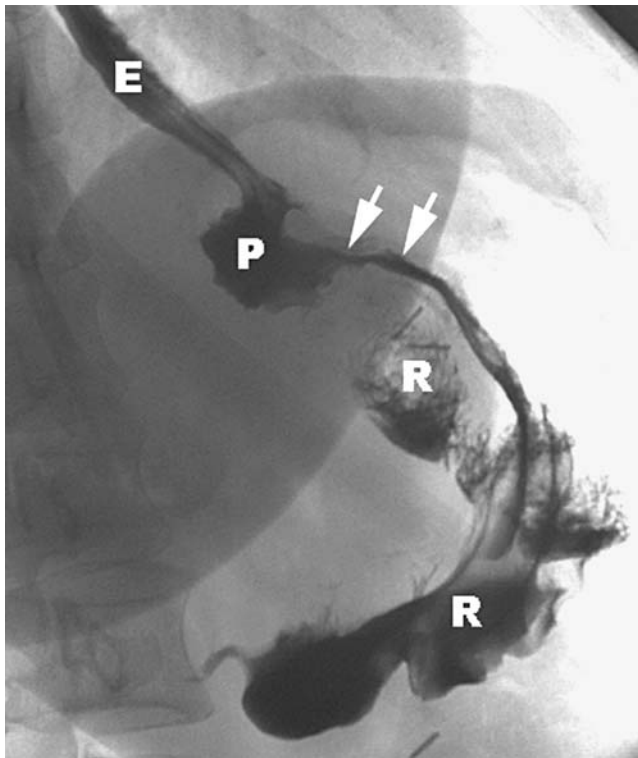


Figure 1 Gastrograffin upper gastrointestinal contrast study demonstrating contrast extravasation from the lateral aspect of the gastric pouch (P) through a fistulous tract (arrows) into the remnant stomach (R) after laparoscopic Roux-en-Y gastric bypass; E esophagus.

lowed by air insufflation to check staple-line integrity. The gastric remnant was extracted through the umbilicus.

Results

Over a 70-month period from January 2001 to October 2006, 1,763 patients underwent LRYGB for morbid obesity. Of the 1,763 procedures performed, 27 patients (1.5%) developed a GGF. All LRYGB procedures in these 27 patients were performed in a standard fashion with an AA approach, and all were completed laparoscopically. All 27 patients were prescribed a treatment course of a PPI. In addition, sucralfate was commenced in patients with concomitant GJA ulceration and/or stenosis. Ten patients (37%) with GGF after LRYGB responded to medical treatment with symptom resolution. The remaining 17 patients (63%) had persistent symptoms despite maximum medical treatment and required surgical intervention.

Of the 17 patients who required surgical intervention, the majority were women with a male/female ratio of 1:5. At the time of their primary LRYGB, their mean age was 42 years (range, 30–58), with a mean weight of 325 lb (range 215–570), and a mean BMI of 49.7 kg/m² (range, 35–61; Table 1). Three patients had a history of previous abdominal surgery. One patient had a prior open cholecys-

tectomy, appendectomy and two previous caesarian sections; the second, had a laparoscopic cholecystectomy and bilateral tubal ligation; and the third, had a total abdominal hysterectomy with bilateral salpingoophorectomy. Concomitant surgery was performed at the time of LRYGB in two patients, umbilical hernia repair in one, and laparoscopic cholecystectomy in the other. All procedures were completed laparoscopically (100%). The mean length of hospital stay was 3.7 days (range, 3–5). During follow-up, three patients (18%) developed acute cholecystitis requiring laparoscopic cholecystectomy.

The indications for surgery were failure of medical management in 17 (100%), weight regain in 9 (53%), persistent epigastric pain in 10 (59%), vomiting in 5 (29%), persistent GJA ulceration in 13 (76%) with significant hemorrhage in 3 (18%), and non-resolving GJA stenosis in 8 (47%) patients (some patients had more than one indication). Surgery was performed at a mean of 24.9 months after primary LRYGB (range, 4–57). LRG was performed in all 17 patients and completed laparoscopically in 16 (94%). One patient required conversion (6%) because of excess intraluminal air in the gastrointes-

Table 1 Patient Characteristics at Primary Laparoscopic Roux-en-Y Gastric Bypass

Patients with gastro-gastric fistula requiring surgery (n)	17/27 (63%)
Gender (n)	
Male	14 (82)
Female	3 (18)
Age (year)	
Mean	42
Range	30–58
Weight (lb)	
Mean	325
Range	215–570
BMI (kg/m ²)	
Mean	49.7
Range	35–61
Comorbidities (n)	
Hypertension	13 (76)
Ischemic heart disease	2 (12)
Hyperlipidemia	8 (47)
Diabetes	7 (41)
Osteoarthritis	9 (53)
Chronic muscle and joint pain	7 (41)
Obstructive sleep apnoea	11 (65)
Gastroesophageal reflux	7 (41)
Deep venous thrombosis	2 (12)
Pulmonary embolus	2 (12)
Depression	4 (23)
Hypothyroidism	1 (6)
Others	4 (23)

Data in parentheses are percentages.
BMI Body mass index

tinal tract after an intraoperative EGD. Remnant gastrectomy with pouch trimming and GGF excision was performed in 12 patients (71%); four (23.5%) of these patients required GJA excision and reanastomosis for stomal obliteration secondary to longstanding marginal ulceration. LRG without pouch trimming was performed in 5 patients (29%) for exclusion of GGF. Five of 17 (29.4%) patients developed early postoperative complications that delayed discharge. One patient required 3 days of intravenous antibiotics for a wound infection. A second patient developed unexplained pyrexia, nausea, and tachycardia. A GUGI and abdominal CT scan were normal with no evidence of a leak or collection, and the patient responded to conservative treatment. The third patient discharged purulent fluid from his surgical drain on POD 7. An anastomotic or staple-line leak was suspected, but a GUGI and abdominal CT were entirely normal. He was discharged home on oral antibiotics with the drain in situ, remained well, and the drain was subsequently removed in the outpatient clinic. Hemorrhage from the gastric staple line occurred in a single patient who was taking an oral anticoagulant before surgery. This patient underwent an urgent exploratory laparoscopy that required conversion to an open approach to achieve hemostasis with over-sewing of the pouch staple line. A fifth patient developed pneumonia, which responded to oral antibiotics. The mean length of stay for the 17 patients was 6.1 days (range, 3–10).

An additional seven patients were referred for surgery from other centers with symptomatic GGF after open RYGB in five (71%), and LRYGB in two (29%). Four patients had a RYGB with GJA ring reinforcement (57%) and two a non-divided RYGB with staple-line disruption (28.5%). All patients were female. Incomplete data was available for weight, BMI, and comorbidity at the time of primary RYGB, and this data, was not included. The patients presented for surgery at a mean of 7.8 years (range, 2–20) from the time of primary RYGB at a mean age of 42 years (range, 27–52). Indications for surgery were intractable epigastric pain in four (57%), non-resolving GJA stenosis in one (14%), recurrent GJA ulceration in three (43%) with hemorrhage in one (14%), coexistent jejuno-gastric fistula in one (14%), and vomiting in four (57%). Six of the seven patients underwent RG (86%). The remaining patient had a prior ring reinforcement of an open retrocolic retrogastric (RR) RYGB. At laparotomy, pouch outlet obstruction with ring erosion and GGF was evident. The eroded ring was removed, the GJA was excised and reanastomosed, the GGF transected, and a tube gastrostomy inserted. LRG was attempted in four patients and completed successfully in two (50%). An open approach was used in the remaining two patients. Remnant gastrectomy with pouch trimming and GGF excision was performed in five

patients (71%). In four (57%) patients, the gastric bypass was converted from a RR to an AA RYGB with excision and reanastomosis of the GJA, and insertion of a tube gastrostomy in addition to pouch trimming and GGF excision. Remnant gastrectomy with GGF exclusion was performed in one patient. In addition, an appendicectomy was performed in one patient. Three complications were observed, a subcapsular splenic hematoma, pneumonia, and a superficial wound infection. The mean duration of hospital stay was 9.4 days (range, 3–27).

Our incomplete follow-up is promising with symptom resolution in the majority of patients (87%), resolution of GGF and GJA ulceration in all 24 patients, and further weight loss of an average of 27 lb in 21 patients (87%). Four patients required surgical intervention for late complications after LRG, including open adhesiolysis for small bowel obstruction at 1 month, laparoscopic adhesiolysis for small bowel obstruction at 4 months, incarcerated umbilical port site hernia repair at 13 months, and a converted procedure for an internal hernia at the jejunojejunal anastomosis at 21 months.

Discussion

There are many factors responsible for GGF formation after LRYGB (Table 2). Non-divided RYGB procedures have been associated with an unacceptably high incidence of GGF because of breakdown of the staple line with reestablishment of continuity between the gastric seg-

Table 2 Pathogenesis of Gastro-Gastric Fistula After Laparoscopic Roux-en-Y Gastric Bypass

	Description
Iatrogenic	Poor surgical technique Incomplete gastric transection
Anastomotic Leak	Pouch staple line disruption Gastrojejunal anastomotic disruption Coagulation injury Ischemic necrosis due to foreign body: VBG, LAGB
Operation type	Incomplete gastric transection Non-divided gastric bypass
Marginal ulcer, perforation	Tissue ischemia Staple migration
Foreign body erosion	Use of non-absorbable suture material Preanastomotic rings in banded gastric bypass Bovine pericardial strips
Natural tendency	Natural gastric migration to reattach to the remnant

LAGB Laparoscopic adjustable gastric banding, *VBG* vertical banded gastroplasty

ments.¹⁰ In our series, two patients referred to us for surgical management of symptomatic GGF from other centers had a prior non-divided RYGB with staple-line disruption (28.5%). Subsequent technical variations with reinforcement of divided RYGB procedures with bands or rings to increase restriction and prevent stomal and pouch dilation were also plagued with a high incidence of GGF.^{7,10} Intra-gastric migration of the band or ring with erosion of the staple line was implicated in the evolution of GGF in these procedures.^{7,10} Four of the patients referred to us from other centers with symptomatic GGF had a prior RYGB with GJA ring reinforcement (57%). At laparotomy, two of the four rings had completely eroded through the gastric staple line, whereas the other two were densely adhered to the gastric wall. Ischemic necrosis because of the presence of a constricting ring or band may have been responsible for GGF in the latter two cases.

In the current era of divided RYGB, the majority of GGF are caused by poor surgical technique with failure to completely divide the stomach during pouch creation with maintenance of continuity between the pouch and remnant. Cucchi et al.¹³ reported a 6% incidence in divided gastric bypass and recommended meticulous oversewing of staple lines, careful anastomotic technique with good bites of healthy tissue, avoidance of alimentary limb obstruction, and intraoperative confirmation of GJA integrity using methylene blue. Another common cause of GGF is an acute leak from the GJA or the pouch staple-line disruption, which is reported in up to 4.3% of patients after LRYGB.¹⁸ We have previously reported a 1.7% incidence of GJA leak, of whom 27% subsequently developed a GGF.¹⁴ Malfunctioning of linear staplers can also occur, although this complication has become uncommon with the advent of more sophisticated devices.¹⁹ Various techniques have been used to reduce the occurrence of pouch staple-line leak and GGF, including jejunal and/or omental interposition, suture reinforcement of the staple line, vapor-heated fibrin sealant, and more recently, bovine pericardial strips.^{20–23}

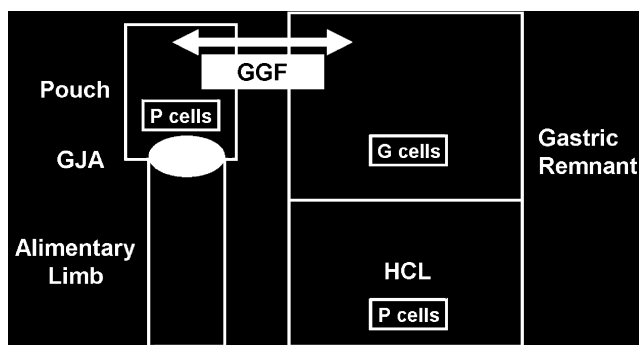


Figure 2 Schematic representation of a gastro-gastric fistula after laparoscopic Roux-en-Y gastric bypass; *GJA* gastrojejunostomy, *GGF* gastro-gastric fistula, *HCL* hydrochloric acid, *P cells* parietal cells, *G cells* gastrin cells.

Table 3 Surgical Management of Gastro-Gastric Fistula

n=24 patients	
Remnant gastrectomy, n=23 (96)	Remnant gastrectomy with GGF excision, n=9
	Remnant gastrectomy with GGF exclusion, n=6
	Remnant gastrectomy with redo GJA, n=8
Additional procedures	Gastrostomy, n=4
	Appendicectomy, n=1
	Conversion from RR RYGB to AA RYGB, n=4
Fistula transection, n=1 (4)	Removal of eroded ring, GGF transection, redo GJA, tube gastrostomy, n=1

Data in parentheses are percentages.

GGF Gastro-gastric fistula, *RR* retrocolic retrogastric, *AA* antecolic antegastric, *RYGB* Roux-en-Y gastric bypass

In our series, the incidence of symptomatic GGF of 1.5% after 1,763 primary LRYGB is relatively low compared to other published series.^{13,15,24} Of these 27 patients, 37% resolved without further intervention. We believe this is because of standardization of our surgical approach to LRYGB. At the beginning of the procedure, dissection commences high on the gastric fundus to expose the angle of His and the gastroesophageal junction. This exposure allows the creation of a small lesser curve-based pouch and ensures exclusion of the fundus with complete separation of the gastric segments under direct vision. Incomplete division of the apical portion of the stomach during pouch construction can predispose to GGF formation.²⁵ We routinely perform a posterior wall stapled GJA and close the anterior enterotomy in two layers with an absorbable suture creating a narrow 1.5-cm outlet. To reduce the risk of staple-line leak and hemorrhage, the lateral pouch staple line is reinforced with bovine pericardial strips. The integrity of the GJA and pouch staple line are then confirmed by a combination of intraoperative EGD, air insufflation, and methylene blue instillation. Non-absorbable suture use, staple migration, and tissue ischemia have all been implicated in the development of stomal ulceration.^{10,14,24} Although peristrips could act as a foreign body resulting in localized erosion and/or ulceration with subsequent GGF formation, no cases have been recorded in our series. We also use diathermy judiciously, as a localized coagulation injury may predispose to GGF formation. In our institution, we routinely perform GUGI study on POD 1, facilitating the detection of acute leaks and permitting early intervention.²⁶

Persistent ulceration at the GJA predisposes to a localized perforation and subsequent GGF formation. We have previously reported a 4.2% incidence of marginal ulceration after LRYGB, with a significant increase up to

53.3% in patients with a demonstrable GGF.¹⁴ To reduce the risk of GJA ulceration, we preoperatively test and treat patients positive for *Helicobacter pylori*. Eradication of *H. pylori* has been demonstrated to significantly reduce the incidence of marginal ulceration.^{27,28} Patients are also encouraged to stop smoking. In addition, after LRYGB, patients are discharged on a 3-month course of a PPI.²⁹

A number of patients with symptomatic GGF will respond to conservative management.³⁰ The aim of medical treatment is to attenuate the increased acid production in the remnant stomach because of stimulation of parietal and antral G-cells by food entering through the fistula (Fig. 2). The acid from the remnant stomach spills over through the fistula into the pouch and contributes to marginal ulceration formation.³¹ Acid production, although significantly reduced, has been observed in the gastric pouch by stimulation of residual parietal cells.^{32,33} PPI significantly decrease acid production in the excluded gastric remnant. In our unit, patients are commenced on a 6-week treatment course of a PPI, with the addition of sucralfate in the presence of marginal ulceration. Sucralfate provides a protective barrier to the gastric pouch and jejunal mucosa, reducing damage by refluxed acid from the remnant stomach through the GGF.^{14,30} Patients are reevaluated after 6 weeks to assess symptoms, and a repeat EGD is performed. If patients fail to respond to maximal medical therapy and develop GGF-related complications, surgery is indicated. Currently, there is no accepted surgical technique to manage symptomatic GGF. In our unit, we favor a LRG with trimming of the gastric pouch and excision or exclusion of the fistulous tract. This approach does not interfere with the gastrojejunal anastomosis. In our series, 23 of 24 patients (96%) underwent a RG with GGF excision in 74% and GGF exclusion in 26% (Table 3). The pouch size determines the need for fistula excision or exclusion. In the presence of an adequately sized small pouch, we exclude the tract by vertical transection of the gastric remnant just lateral to the fistula. To date, there has been no evidence of ischemia of the narrow cuff of the stomach left in situ lateral to the GGF. It is important to excise as much of the antrum as possible to avoid the creation of a retained antrum and the theoretical risk of hypergastrinemia. Therefore, the distal stomach is transected just proximal to the pylorus. Remnant gastrectomy can be performed successfully by a laparoscopic approach in the majority of patients. In our series, a laparoscopic approach was attempted in 21 patients (91%) and completed in 18 (78%). As expected, the conversion rate for remnant gastrectomy was higher in patients referred from other centers, the majority of whom had a primary open RYGB. Excision of the GJA with reanastomosis is required in the presence of significant marginal ulceration with stomal stenosis or prior RYGB, where complete pouch revision is

required. Eight patients (35%) in our series required excision of the GJA with reanastomosis, of whom four (50%) were converted from a RR to AA RYGB. After RG, adverse events were observed in the early postoperative period in six patients (25%), and our surgical reintervention rate was 4.1%. A leak was suspected in one patient but not proven, and a second patient developed pyrexia of unknown origin. No deaths were recorded in this series.

Conclusion

In summary, GGF formation can complicate divided LRYGB. Asymptomatic GGF can be managed conservatively. There is no standardized surgical treatment approach for symptomatic GGF. Reports of surgical treatment for this complication are rare. In this study, we present a novel surgical procedure to treat GGF, which consists of a laparoscopic approach with RG with or without trimming of the gastric pouch and/or fistulous tract, while leaving the GJA intact in the majority of patients. Based on our early experience, we recommend LRG with fistula excision or exclusion as an effective option with a low morbidity and no mortality in the management of symptomatic GGF after LRYGB.

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