

Original article

Management of gastrogastic fistulas after divided Roux-en-Y gastric bypass surgery for morbid obesity: analysis of 1292 consecutive patients and review of literature

Lester Carrodegua, M.D., Samuel Szomstein, M.D., F.A.C.S., Flavia Soto, M.D.,
Oliver Whipple, M.D., Conrad Simpfendorfer, M.D., John Paul Gonzalvo, M.D.,
Alexander Villares, M.D., Natan Zundel, M.D., F.A.C.S., Raul Rosenthal, M.D., F.A.C.S.*

Bariatric Institute and Division of Minimally Invasive Surgery, Cleveland Clinic Florida, Weston, Florida

Received February 16, 2005; revised June 24, 2005; accepted July 7, 2005

Background: Laparoscopic Roux-en-Y gastric bypass (RYGB) is the most commonly performed bariatric operation in the United States. Although rare, gastrogastic fistulas are an important complication of this procedure.

Methods: We report a series of 1292 consecutive patients who underwent a divided RYGB procedure at our institution between January 2000 and November 2004. Of the 1292 patients, we identified 15 (1.2%) who presented with gastrogastic fistulas after surgery.

Results: The mean age, weight, and body mass index of these patients was 39.5 years, 377.5 lb, and 54.9 kg/m², respectively. The mean postoperative follow-up was 17.6 months. The overall follow-up success rate in this series at 1 and 2 years postoperatively was 85% and 77%, respectively. Of the 15 patients, 12 (80%) presented with symptoms of nausea, vomiting, and epigastric pain. Esophagogastrosocopy revealed marginal ulcers in 8 (53%) of these symptomatic patients. The most sensitive test for the diagnosis of gastrogastic fistula was an upper gastrointestinal contrast study. The mean time to fistula diagnosis was 80 days. Four patients (27%) had had a known leak before their diagnosis of gastrogastic fistula. In all cases, the leaks were managed nonoperatively with drainage, parenteral nutrition, and bowel rest. In this subset of patients, the mean time to fistula diagnosis was 25 days. Four patients (27%) presented to the clinic unsatisfied with their weight loss. The mean excess percentage of weight loss was 60.9%. Of the 15 patients with a diagnosed gastrogastic fistula, 8 (53.3%) presented with concomitant marginal ulcers. When present, marginal ulcers were managed with chronic acid suppressive therapy consisting of proton pump inhibitors and sucralfate. Revisional surgery was performed in 5 (33.3%) of 15 patients because of the combination of constant pain and ulceration refractory to optimal medical treatment and in 1 patient (7%) because of refractory pain unresponsive to medical therapy and weight regain. All revisional procedures (100%) were performed laparoscopically.

Conclusion: Gastrogastic fistulas are an uncommon, but worrisome, complication after divided RYGB. Most symptoms of gastrogastic fistula are related to epigastric pain and ulcerations around the anastomotic site, but the fistula can occur anywhere along the divided segment of the gastric wall. They can initially be managed with a conservative, nonoperative approach as long as the patient remains asymptomatic and weight regain does not occur. Refractory ulcers and pain are the main indications for revisional surgery. Weight loss failure or weight regain is an uncommon short-term finding with gastrogastic fistulas after divided RYGB that requires surgical revision as the definitive treatment option. Although we present one of the largest series to date, longer

follow-up is needed to better define the management of this patient population and provide a more accurate incidence of its occurrence. © 2005 American Society for Bariatric Surgery. All rights reserved.

Keywords: Gastrogastric fistulas; Roux-en-Y gastric bypass; Complications; Bariatric surgery; Morbid obesity; Review

The Roux-en-Y gastric bypass (RYGB) is the most frequently performed operation for the treatment of morbid obesity in the United States. The incidence of postoperative complications observed after RYGB has decreased dramatically during the past decade, in part because of the improved technological advances and modifications that have been introduced since its inception [1,2]. Despite these efforts, important complications are still prevalent, and the morbidity and mortality associated with this procedure is of concern. Although rare, gastrogastric fistulas are an important complication after this procedure.

Historically, bariatric operations, such as the vertical banded gastroplasty and RYGB, were performed by maintaining the gastric pouch and remnant stomach stapled in continuity, but not divided [3,4]. Over the years, this technique has been associated with an unacceptably high incidence of gastrogastric fistula formation. The consensus is that the key etiologic factors include breakdown of the staple line reestablishing the continuity between the pouch and gastric remnant, intragastric migration of the propylene band, and disruption of the staple line. In addition, this complication has been associated with a large percentage of marginal ulceration and weight loss failure [5–7]. During the past decade, as enthusiasm for and the necessity of the divided RYGB has increased, a dramatic reduction in the incidence of gastrogastric fistula formation has occurred; this is mainly due to better instrumentation and innovative techniques and increased experience among the surgeons performing this technically challenging procedure. The incidence of gastrogastric fistulas reported in the literature is extremely wide, ranging from 0% to 46%, highlighting the number of factors that may influence their formation [8]. Despite the significance of this complication, published data are sparse and inconsistent regarding the etiology, diagnosis, treatment, and sequelae of patients with gastrogastric fistulas after divided RYGB. The purpose of our study was to summarize our experience with the diagnosis and treatment of gastrogastric fistulas in a series of 1292 patients, one of the largest reported thus far, who underwent divided laparoscopic RYGB (LRYGB) at our institution. We present the incidence and our own diagnostic algorithm and management approach to this challenging complication from our experience with this patient population.

Methods

After internal review board approval, the medical records of 1292 consecutive patients who underwent divided LRYGB between January 2000 and November 2004 were

Table 1
Patient characteristics

Patients with gastrogastric fistulas (n)	15/1292 (1.2)
Gender (n)	
Male	6 (40)
Female	9 (60)
Age (yr)	
Mean	39.5
Range	19–60
Preoperative weight (lb)	
Mean	352.7
Range	229–526
BMI (kg/m ²)	
Mean	53.4
Range	38–79
Excess weight loss (%)	
Mean	65.3
Range	32–89.8
Follow-up time (mos)	
Mean	17.1
Range	3–45
Comorbidities (n)	
Smoking	6 (43)
Diabetes	3 (20)
Hypertension	8 (57)
Osteoarthritis	5 (36)
OSA	7 (50)
GERD	3 (20)
Hypercholesterolemia	3 (20)
Deep venous thrombosis	1 (7)
Depression	3 (20)
Symptoms (n)	
Pain	13 (87)
Food intolerance	14 (93)
Weight gain	4 (26.6)
Anastomotic leaks (n)	4 (26.7)
Marginal ulcers (n)	8 (53.3)

BMI = body mass index; OSA = obstructive sleep apnea; GERD = gastro esophageal reflux disease.

Data in parentheses are percentages.

retrospectively reviewed. In this period, 15 of these patients (1.2%) presented with gastrogastric fistula postoperatively. Data were obtained from the surgical, clinical, endoscopic, and radiologic reports. Follow-up data were obtained by patient correspondence, telephone interviews, and clinic appointments. The patient demographics, surgical outcomes, and significant complications are summarized in Table 1. Two surgeons, both of whom used the same series of steps throughout the operation, performed all the procedures.

The stapling and transection of the stomach for the creation of the neopouch was performed with a 45–60-mm, 3.5-mm linear stapler (Ethicon EndoSurgery, Cincinnati, OH). All staple-lines were buttressed with bovine pericar-

Table 2
Characteristics, estimated weight loss, follow-up, and surgery date of patients with gastrogastroic fistulas

Patient	Age (yr)	Gender	Height (inches)	IBW	Init WT/BMI	Last WT/BMI	Actual WT Loss (LBS)	BMI Loss	EWL %	Follow-up (mo)	Date of follow-up	DOS
1	19	F	68	154	526/79	332/50	194	29	52	45	8/20/04	11/12/01
2	31	F	62	127	326/60	153/29	173	31	86.9	19	8/3/04	1/6/03
3	55	M	73	175	405/52	245/32	160	20	69.5	8	11/17/03	3/3/03
4	32	F	67	150	379/57	192/29	187	28	81.6	17	8/2/04	3/2/03
5	28	F	61	123	283/54	169/30	114	24	76.2	14	5/10/04	3/10/03
6	34	F	66	145	253/40	156/25	97	15	89.8	9	5/12/04	8/29/03
7	40	F	66	145	392/57	274/44	119	13	48.8	7	6/25/04	11/24/03
8	38	F	66	145	246/38	138/22	108	16	106.9	10	3/25/04	6/24/03
9	40	M	67	150	280/45	238/37	42	3	32.3	3	4/9/04	1/19/04
10	55	F	63	132	229/40	164/30	65	10	67.6	16	6/8/04	2/3/03
11	40	M	72	171	470/57	344/46	126	11	30.1	6	8/20/04	2/12/04
12	60	M	66	145	356/53	240/38	116	15	54.9	30	4/12/04	10/30/02
13	48	M	74	180	498/64	372/48	126	16	39.6	44	9/7/04	1/8/01
14	23	F	56	103	256/56	143/32	113	24	73	20	6/30/04	10/15/02
15	57	M	71	167	392/54	245/34	147	20	65.3	9	11/17/03	3/3/03

Pt. No. = patient number; IBW = ideal body weight; EWL = estimated weight loss; DOS = date of surgery; F = female; M = male; WT = weight.

dium (Peri-Strips, Synovis Surgical Innovations, St. Paul, MN) to help prevent bleeding and leakage. A side-to-side gastrojejunal anastomosis was constructed by using one half of the length of a 45-mm linear cutter for the posterior wall and a double-row of running 2-0 Vicryl sutures for the anterior wall. The anastomosis was tested for leaks using air insufflation and methylene blue tests and confirmed with intraoperative esophagogastroduodenoscopy (EGD). After the surgical procedure, all patients were admitted to the intensive care unit for a 24-hour observation period and then transferred to the surgical ward after a negative Gastrografin gastrointestinal study confirmed the absence of leaks and the patient demonstrated stable vital signs.

Results

Of the 1292 patients, 15 (1.2%) were diagnosed with gastrogastroic fistulas after divided RYGB. The patient demographics, including height, pre- and postoperative weight, body mass index, estimated weight loss, follow-up dates, and surgery dates, are summarized in Table 2. Of the 15 patients diagnosed with gastrogastroic fistulas, 5 (33.3%) required revisional surgery because of persistent pain stemming from refractory marginal ulcers unresponsive to medical therapy, nausea, and/or vomiting, which limited their daily activities. We acknowledge that this incidence of revisions was based on a relatively short follow-up period and that the revision rate may increase with time for refractory symptoms and weight gain. All revisional procedures were performed laparoscopically. Not included in the total number of gastrogastroic fistulas reported in this series were 3 patients who underwent their primary procedures at another institution, subsequently developed this complication, and required surgical revision at our institution. These three additional surgical revisions required an open approach be-

cause of excessive adhesions and difficult anatomy. Of the 3 patients who underwent an open approach, 1 required a conversion from a previous vertical banded gastroplasty procedure to a divided RYGB. The remaining 2 patients required an open procedure because of adhesions stemming from prior abdominal surgeries.

Of the 15 patients who developed gastrogastroic fistulas, 9 (60%) were women and 6 (40%) were men. The mean age, weight, and body mass index was 39.5 years (range 19–60), 352.7 lb (range 229–526), and 53.4 kg/m² (range 38–79), respectively. Patients returned for regular postoperative visits at 2 weeks, 2, 6, and 12 months, and once annually thereafter. Twelve patients (80%) were diagnosed with gastrogastroic fistulas after presenting to the clinic or emergency room with a new onset of characteristic, yet nonspecific, symptoms such as nausea (n = 11), vomiting (n = 9), and epigastric pain (n = 11). In addition to these symptoms, 1 patient presented with hematemesis and hematochezia. Twelve patients (80%) had their gastrogastroic fistula confirmed by upper gastrointestinal studies such as EGD and upper gastrointestinal Gastrografin series. In 2 patients, the initial diagnosis was made by abdominal computed tomography (CT), which demonstrated an abnormal presence of contrast material in the gastric remnant. In the remaining patient, the gastrogastroic fistula was found serendipitously during EGD. The mean time to fistula diagnosis was 80 days (range 3–384) from the date of surgery. Four patients (26.7%) had a previously diagnosed gastrojejunal anastomotic leak before the development of their gastrogastroic fistula. These anastomotic leaks were managed successfully with percutaneous drainage, parenteral nutrition, and bowel rest. In this subset of patients, the mean time to fistula diagnosis was 25 days (range 7–48) from the date of surgery. Four patients (26.7%) presented to the clinic unsatisfied with their weight loss after 14, 29, 44, and 45 months.

Table 3
Patient follow-up

Group	Age (yr)	Gender	Initial Weight (lb)/ BMI (kg/m ²)	Last Weight (lb)/ BMI (kg/m ²)	EWL (%)	(mos)
1 (<1 yr follow-up)	40	M	280/45	238/37	32.31	3
	40	M	470/57	344/46	30.1	6
	40	F	392/57	274/44	48.8	7
	55	M	405/52	245/32	69.5	8
	34	F	253/40	156/25	89.8	9
	57	M	392/54	245/34	65.3	9
	38	F	246/38	138/22	106.9	10
2 (>1, <2 yr follow-up)	28	F	283/54	161/30	76.2	14
	55	F	229/40	164/30	67.6	16
	32	F	379/57	192/29	81.6	17
	31	F	326/60	153/29	86.9	19
	23	F	256/56	143/32	73	20
3 (>2, <3 yr follow-up)	60	M	356/53	240/38	54.9	30
	48	M	498/64	372/48	39.6	44
	19	F	526/79	332/50	52	45

Abbreviations as in Table 2

In this subset, the mean percentage of excess weight loss was 53.9%. The percentage of excess weight loss during this period was recorded for all patients (Table 2). Three groups of patients were analyzed for the percentage of estimated weight loss according to the length of follow-up (Table 3). The mean follow-up period was 17.1 months (range 3–45). Patients complaining of symptoms such as epigastric pain, vomiting, and/or nausea were evaluated initially with EGD or a Gastrografin swallow test. All patients diagnosed with gastrogastric fistulas were treated with proton-pump inhibitors regardless of symptoms. Concomitant marginal ulcerations were seen in 8 (53.3%) of the 15 patients. Confirmed ulcers were treated with sucralfate, in addition to the proton-pump inhibitor regimen these patients were already receiving. Medical therapy, as demonstrated in follow-up EGD studies, was effective in the treatment of these marginal ulcers in 6 (75%) of the 8 patients. By 6 weeks postoperatively, all patients were completely asymptomatic, and repeated endoscopy confirmed the absence of ulcers.

Discussion

RYGB surgery, especially when performed laparoscopically, is an increasingly popular surgical procedure for the treatment of morbid obesity. During the past decade, the laparoscopic approach to RYGB has undergone several modifications in an effort to reproduce the results of the open approach and reduce the morbidity and mortality associated with this procedure. One of the most challenging, yet unusual, complications stemming from this surgical procedure is the development of gastrogastric fistula. The term “gastrogastric fistula” denotes an abnormal communication between the neogastric pouch and the excluded gas-

tric remnant after RYGB. Overall, gastrogastric fistulas have been rarely reported and are considered an uncommon complication after divided RYGB.

Since the first report regarding weight-loss surgery was introduced >30 years ago by Mason and Ito [1], the surgical complication of gastrogastric fistula has been documented after bariatric operations in only a small number of reports. Most of these reports have agreed that this complication tends to occur when the gastric pouch and excluded gastric remnant have been partitioned but not divided. In 1995, Cucchi et al. [8] reported that gastrogastric fistulas might occur after division of the stomach in weight reduction procedures. In their series of 100 consecutive patients, they identified a 6% incidence of this complication. They found that most of the fistulas resulted from failed stapled lines. In an earlier report, Favretti et al. [9] also attributed much of the etiology on the placement and mechanical failure of staples during the gastric partition step of the operation. Furthermore, in their series of 810 patients, Capella and Capella [5] reported a 49% incidence of gastrogastric fistulas in a subgroup of patients who, as part of their RYGB surgery, underwent gastric stapling in continuity without transection or any omental or jejunal interposition. This was in sharp contrast to the other subgroups in their series, in which an incidence of 2.6% and 0% was seen among those patients whose gastric segments were stapled and separated by transection or who underwent stapled division plus jejunal interposition, respectively.

The creation of the gastric pouch is perhaps one of the most important steps in RYGB for the treatment of morbid obesity. For a number of years, the integrity and significant complications stemming from this crucial step of the operation have led to a number of experiments and studies in an effort to understand the normal behavior of the damaged

gastric tissue, the effects of staples on the gastric mucosa, and the pathophysiology behind the formation of gastrogastric fistulas [10–12]. The use of linear stapling devices was first introduced in the field of bariatric surgery by Alden and LaFave [13]. These linear stapling devices, which can be used to divide and completely transect the stomach during creation of the gastric pouch, and the use of vapor-heated fibrin sealant for anastomotic reinforcement were introduced in an effort to reduce the incidence of gastrogastric fistula formation [14–16]. Moreover, technical modifications and additions, such as jejunal and/or omental interposition or unidirectional suture reinforcement of staple lines, have also reduced, but not completely eliminated, this complication [17,18]. From the beginning of our reported series, as suggested by others in the literature, we elected to buttress the staple lines with bovine pericardium during construction of the medial portion of the neopouch in an effort to decrease extraluminal bleeding and staple-line failure, thereby diminishing the risk of leaks and subsequent gastrogastric fistula formation. Although we initially questioned the efficacy and cost-effectiveness of bovine pericardial strips, we decided to make them a consistent step in our procedure on the basis of the reported evidence. In our own experience, we observed minimal bleeding during this step of the operation [19,20].

In our analysis of 1292 consecutive patients who underwent divided RYGB at our institution, we identified 15 patients (1.2%) with gastrogastric fistulas. Although this incidence appears greater than that reported in other series with >500 patients, the true incidence of gastrogastric fistulas in most studies, including our own, is not entirely accurate. This inaccuracy in the reported incidence may be a result of the dissimilar detection rates among published studies, the disparity in follow-up schemes implemented by different surgeons and institutions, the uncommon practice of performing routine radiographic follow-up studies on otherwise asymptomatic patients, and the number of patients who have been lost to follow-up who may in turn develop this complication. However, we obtain an intraoperative EGD and a Gastrografin study for every patient on postoperative day 1, regardless of symptoms. This is done to document the size and to corroborate the integrity of the anastomoses and other stapled areas in the newly created gastric pouch. To increase our gastrogastric fistula detection rate, we also obtain radiographic studies or endoscopy at any point after surgical intervention for patients with the slightest symptoms suggestive of this complication, including persistent dyspeptic symptoms, marginal ulcerations, and weight loss failure. Moreover, we have implemented a close follow-up scheme for all our RYGB patients, which has reached approximately 77% of the entire postoperative population at 2 years postoperatively. Our follow-up schedule requires office visits at 2 weeks and 2, 6, and 12 months after the weight reduction procedure, as well as yearly office visits thereafter. In addition, patients are encouraged to

Table 4
Etiologic factors of gastrogastric fistulas

Iatrogenic
Failure of complete gastric transection
Inadequate visualization during apical transection of stomach
Presence of perigastric fat included in transected tissue
Anastomotic leaks
Failure of staples to penetrate and anchor to gastric tissue properly despite gastric wall division
Incomplete gastric transection
Technical nature of operation
Failure of staple lines to divide stomach permanently
Gastric wall tissue migration
Ability of gastric wall to heal and reattach to excluded stomach
Marginal ulceration and perforation
Presence of gastric-acid secreting cells in pouch—secondary ulceration/perforation
Tissue injury
Anastomotic ischemia
Excessive tension during suturing of anastomosis
Foreign body erosion by rings

attend regular visits to psychological and nutritional counselors, who are trained to report to the treating physician any physical anomaly presented by the patient. As such, we believe that this series is representative of our clinically relevant experience.

Marginal ulcers are one of the most commonly reported complications of this operation. In our series, the overall incidence of marginal ulceration was approximately 4.2%; however, when taking into account those patients who developed concomitant gastrogastric fistula, the incidence increased dramatically to 53.3%. Most of these patients presented with symptoms suggestive of marginal ulceration, all of which were confirmed by EGD. This sharp increase in the incidence of this complication coincides with the well-documented association between gastrogastric fistulas and marginal ulceration in the bariatric population [5,6]. Marginal ulcers have been reported to be present in as many as 27% of all patients who have undergone RYGB [21].

The etiologic reasons for the development of gastrogastric fistulas may be classified into six categories (Table 4):

1. Iatrogenic: One of the most frequent causes is an error in judgment and inadvertent failure to divide the stomach completely, especially in the apical portion near the gastroesophageal junction, where it is sometimes difficult to clearly visualize the angle of His. This type of fistula occurred in our series in patients with problematic body habitus, in which the gastroesophageal junction was difficult to visualize. This may have been the case for 1 patient in our series whose fistula was diagnosed on postoperative day 1 during routine Gastrografin swallow testing.
2. Leaks: An anastomotic leak contained within the serosal attachments of the gastric remnant, stemming mainly from disrupted staple lines or inappropriately

performed hand-sewn anastomosis may be another cause. In most cases, this can be avoided by performing anastomotic leak tests with air insufflation and methylene blue or routine intraoperative EGD to determine the integrity of the staple lines and gastrojejunal anastomotic sutures.

3. Nature of operation: An infrequent, yet possible, cause is the failure of the staple lines to divide the stomach permanently despite proper firing of the device. The trend toward creating a transected gastric pouch has drastically diminished the incidence of this type of fistula.
4. Gastric tissue migration: Because it occurs in other areas of the gastrointestinal tract, the gastric wall mucosal tissue has the capacity to migrate and reattach to the remnant stomach in the absence of an inflammatory process. This may take place despite the interposition of omentum or jejunum between the newly created gastric pouch and its lateral excluded remnant.
5. Marginal ulceration and perforation: As speculated by Capella and Capella [5], the development of marginal ulcers and gastrogastric fistulas in patients who have undergone LRYGB are closely interconnected. Tissue injury and ischemia, as well as migration of staples, may create a path for bidirectional cellular passage and migration, eventually leading to an abnormal communication between the neopouch and excluded gastric remnant.
6. Foreign body erosion: This type of gastrogastric fistula can be seen in patients who have, in addition to RYGB, a preanastomotic ring to prevent dilation of the gastrojejunal anastomosis. Isolated reports of bovine pericardium causing erosions have suggested they might also be a cause of gastrogastric fistula formation. In our series, we found only 1 case of Peri-Strips eroding into the pouch, which occurred in a patient with recurrent marginal ulceration. In addition, we did not identify the presence of Peri-Strips during the performed EGDs, nor were they present in the final pathology report of excised fistulous tracts.

The reliability of the gastrojejunostomy, and the potential for postoperative complications following its construction, depends initially on the technical ability and experience of the surgeon and the integrity of the staples or sutures used to construct it. It has been well-documented that anastomotic leaks, regardless of their etiology, are one of the most important predisposing factors for the development of viscerovisceral fistulas in the gastrointestinal tract [22,23]. According to published reports, the incidence of this complication after any general gastrointestinal surgery ranges from 4% to 20% [24]. In particular, the reported incidence of leaks after LRYGB surgery ranges from 0% and 4.3% [25]. In our series, we detected an overall 1.7% incidence of

leaks at the level of the gastrojejunal anastomosis. In this small group of patients, the incidence of gastrogastric fistulas was 27%, reiterating the well-reported association between leaks and gastrogastric fistula formation. Several intraoperative steps may be taken to prevent the development of gastrogastric fistulas after anastomotic leaks. These include applying carefully controlled pressure on the gastric tissues during creation of the gastrojejunal anastomosis using either the hand-sewn or stapled technique, unidirectional oversewing of the anastomotic staple lines, and use of reliable instruments. Furthermore, the forceful injection of methylene blue and air through a 32F calibrating tube by the anesthesiologist after clamping of the Roux limb distal to the gastrojejunostomy, as well as performing intraoperative EGD, are common and effective methods to test the integrity of the newly created gastrojejunal anastomosis. Several series have advocated the use of vapor-heated fibrin sealant to reduce the incidence of leaks and gastrogastric fistulas [15,26]. In our experience with almost 1300 cases, we believe that reinforcing the gastric staple lines with bovine pericardial strips may aid in the reduction of this complication. However, this is simply an educated assumption based on our surgical experience and the relatively low number of gastrogastric fistulas detected in our large series. In our analysis, all patients who presented with anastomotic leaks and subsequently developed gastrogastric fistulas were successfully treated conservatively with percutaneous drainage, parenteral nutrition, and bowel rest. To our knowledge, no reports have mentioned the spontaneous closure of gastrogastric fistulas in the absence of anastomotic ulcers or leaks. In addition, we did not find any correlation between an elevated body mass index and leak formation and the eventual development of gastrogastric fistulas.

Some authors have demonstrated that transecting the stomach, instead of stapling it in continuity, may decrease the incidence of gastrogastric fistulas normally seen in procedures such as the silastic ring gastric bypass and vertical band gastroplasty [27]. Furthermore, Gould et al. [28] attributed their small incidence of gastrogastric fistulas to the incomplete division of the apical portion of the stomach during construction of the pouch and acknowledged the difficulty in the visualization of the angle of His during this step of the operation.

Our management of gastrogastric fistulas, based on our own experience, begins with a medical approach and careful patient observation (Fig. 1). All patients who have undergone LRYGB surgery for the treatment of morbid obesity and later develop nonspecific, yet suggestive, symptoms of gastrogastric fistulas, such as nausea, vomiting, marginal ulcers, bleeding, failure of weight loss, weight regain, and/or abdominal pain, are routinely evaluated with an upper gastrointestinal study such as Gastrografin swallow testing or EGD and/or abdominal CT [29,30]. Findings from an upper gastrointestinal study or CT may include extraluminal contrast material or gas, or both. Once a gastrogastric

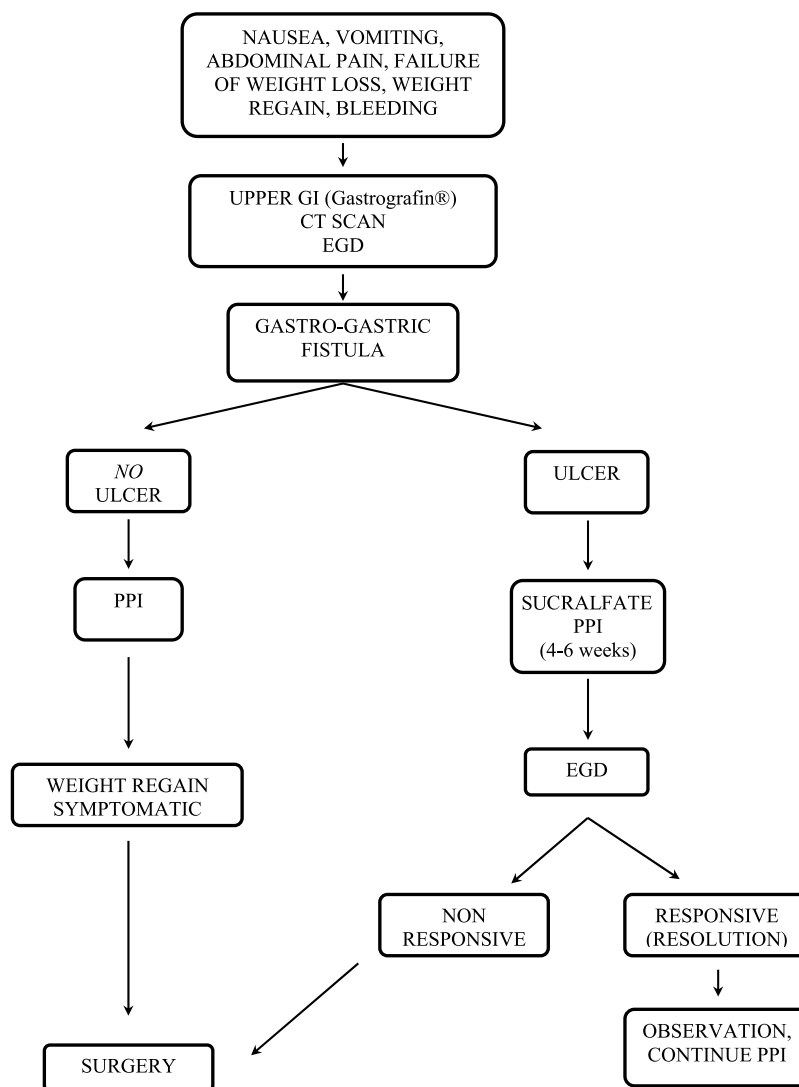


Fig. 1. Management algorithm for treatment of gastrogastric fistulas. GI = gastrointestinal; PPI = proton pump inhibitor.

fistula has been diagnosed, and because of the reported close association between the two, the presence or absence of anastomotic ulcers should be determined. If an anastomotic ulcer is present, we administer sucralfate and proton-pump inhibitor therapy. Patients are reevaluated approximately 4–6 weeks later for resolution of physical symptoms, with confirmation by EGD. Sucralfate is given to provide a protective layer to the pouch and small bowel mucosa, thereby shielding them from gastric acid traversing from the gastric remnant. The proton pump inhibitors are given concomitantly to decrease significantly the acid production by the G cells of the antrum present in the excluded gastric remnant, in the event that a gastrogastric fistula is present. If symptoms persist and marginal ulceration is evident, and because of the well-documented association between marginal ulcerations and the development of gastrogastric fistula, we recommend that patients undergo a revisional surgical procedure to correct the fistulas and ulcers. If medical

therapy is effective, but patients remain symptomatic with nausea, vomiting, and uncontrollable abdominal pain and also present with inadequate weight loss or weight regain, surgical revision is also indicated. In contrast, if symptomatic patients who are diagnosed with a gastrogastric fistula do not present with concomitant anastomotic ulcers, only the proton pump inhibitor regimen is administered, and patients are reevaluated 4–6 weeks later. This pharmacologic step is taken in an effort to prevent the development of marginal ulcers secondary to the free passage of gastric acid secretions from the remnant stomach to the newly created pouch through a gastrogastric fistula.

Implementation of routine postoperative diagnostic tests such as the Gastrografin upper gastrointestinal series detects radiologic abnormalities such as gastrogastric fistulas in approximately 10% of patients, allows for early intervention, and may result in a shorter hospital stay [31]. In our series, the vast majority of the patients who developed

gastrogastric fistulas were diagnosed with either a Gastrografen study or an EGD, dramatically reducing the need for the more costly CT as a diagnostic method.

Conclusion

The development of gastrogastric fistulas represents a rare complication of divided RYGB surgery. Our relatively low incidence of gastrogastric fistulas among 1292 consecutive patients who underwent RYGB at our institution may have been due in part to our routine use of bovine pericardium to buttress the staple lines, the use of a hand-sewn technique to construct the gastrojejunostomy, and to the close follow-up scheme advocated by our program. Although gastrogastric fistulas are not considered a life-threatening complication in patients who have undergone RYGB surgery, the surgical and medical personnel involved in the care of these patients must have a high index of suspicion when nonspecific symptoms such as nausea, vomiting, and upper abdominal pain begin to emerge. Immediate diagnostic and therapeutic action must then be taken to shorten the patient's morbidity and avoid mortality. Taking precautionary steps during and after the gastric bypass procedure can minimize this infrequent, yet worrisome, complication.

References

- [1] Mason EE, Ito C. Gastric bypass in obesity. *Surg Clin North Am* 1967;47:1345–51.
- [2] Simpfendorfer CH, Szomstein S, Rosenthal R. Laparoscopic gastric bypass for refractory morbid obesity. *Surg Clin North Am* 2005;85: 119–27.
- [3] Harrison RA, Clark CG. Vertical banded gastroplasty: operation for morbid obesity. *Ann R Coll Surg Engl* 1984;66:346–7.
- [4] Mason EE. Vertical banded gastroplasty for obesity. *Arch Surg* 1982; 117:701–6.
- [5] Capella JF, Capella RF. Gastro-gastric fistulas and marginal ulcers in gastric bypass procedures for weight reduction. *Obes Surg* 1999;9: 22–7.
- [6] MacLean LD, Rhode BM, Nohr C, et al. Stomal ulcer after gastric bypass. *J Am Coll Surg* 1997;185:1–7.
- [7] Sugerman HJ, Kellum JM Jr, DeMaria EJ, et al. Conversion of failed or complicated vertical banded gastroplasty to gastric bypass in morbid obesity. *Am J Surg* 1996;171:263–9.
- [8] Cucchi SG, Pories WJ, MacDonald KG, et al. Gastrogastric fistulas: a complication of divided gastric bypass surgery. *Ann Surg* 1995; 221:387–91.
- [9] Favretti F, Segato G, DeMarchi F, et al. Malfunctioning of linear staplers as a cause of gastro-gastric fistula in vertical gastroplasty. *G Chir* 1990;11:157–8.
- [10] Bluett MK, Healy DA, Kalemeris GC, et al. Experimental evaluation of staple lines in gastric surgery. *Arch Surg* 1987;122:772–6.
- [11] Printen KJ, Platz C, Tobin H, et al. Increasing the efficacy of gastric operations for the control of morbid obesity. *Am Surg* 1982;48:309–15.
- [12] Harris PL, Freedman BE, Bland KI, et al. Collagen content, histology, and tensile strength: determinants of wound repair in various stapling devices in a canine gastric partition model. *J Surg Res* 1987;42: 411–7.
- [13] Alden JF. Gastric and jejunoileal bypass. A comparison in the treatment of morbid obesity. *Arch Surg* 1977;112:799–806.
- [14] Moore EE. Failure of gastric partitioning for morbid obesity. *Surg Gynecol Obstet* 1981;152:86.
- [15] Sapala JA, Wood HH, Schuhknecht MP. Anastomotic leak prophylaxis using a vapor-heated fibrin sealant: report on 738 gastric bypass patients. *Obes Surg* 2004;14:35–42.
- [16] Lee MG, Provost DA, Jones DB. Use of fibrin sealant in laparoscopic gastric bypass for the morbidly obese. *Obes Surg* 2004;14:1321–6.
- [17] Zorrilla PG, Salinas RJ, Salinas-Martinez AM. Vertical banded gastroplasty-gastric bypass with and without the interposition of jejunum: preliminary report. *Obes Surg* 1999;9:29–32.
- [18] Shikora SA. The use of staple-line reinforcement during laparoscopic gastric bypass. *Obes Surg* 2004;14:1313–20.
- [19] Angrisani L, Lorenzo M, Borrelli V, et al. The use of bovine pericardial strips on linear stapler to reduce extraluminal bleeding during laparoscopic gastric bypass: prospective randomized clinical trial. *Obes Surg* 2004;14:1198–202.
- [20] Shikora SA, Kim JJ, Tarnoff ME. Reinforcing gastric staple-lines with bovine pericardial strips may decrease the likelihood of gastric leak after laparoscopic Roux-en-Y gastric bypass. *Obes Surg* 2003; 13:37–44.
- [21] Huang CS, Forse RA, Jacobson BC, et al. Endoscopic findings and their clinical correlations in patients with symptoms after gastric bypass surgery. *Gastrointest Endosc* 2003;58:859–66.
- [22] Baker RS, Foote J, Kemmeter P, et al. The science of stapling and leaks. *Obes Surg* 2004;14:1290–8.
- [23] Chousleb E, Szomstein S, Podkameni D, et al. Routine abdominal drains after laparoscopic Roux-en-Y gastric bypass: a retrospective review of 593 patients. *Obes Surg* 2004;14:1203–7.
- [24] Truong S, Bohm G, Klinge U, et al. Results after endoscopic treatment of postoperative upper gastrointestinal fistulas and leaks using combined Vicryl plug and fibrin glue. *Surg Endosc* 2004;18:1105–8.
- [25] Hamilton EC, Sims TL, Hamilton TT, et al. Clinical predictors of leak after laparoscopic Roux-en-Y gastric bypass for morbid obesity. *Surg Endosc* 2003;17:679–84.
- [26] Liu CD, Glantz GJ, Livingston EH. Fibrin glue as a sealant for high-risk anastomosis in surgery for morbid obesity. *Obes Surg* 2003; 13:45–8.
- [27] Fobi MA, Lee H, Igwe D Jr, et al. Prospective comparative evaluation of stapled versus transected silastic ring gastric bypass: 6-year follow-up. *Obes Surg* 2001;11:18–24.
- [28] Gould JC, Garren MJ, Starling JR. Lessons learned from the first 100 cases in a new minimally invasive bariatric surgery program. *Obes Surg* 2004;14:618–25.
- [29] Kolakowski S Jr, Kirkland ML, Schuricht AL. Routine postoperative barium swallow evaluation after Roux-en-Y gastric bypass: is it really necessary? *Surg Endosc* 2004;18:S185.
- [30] Serafini F, Anderson W, Ghassemi P, et al. The utility of contrast studies and drains in the management of patients after Roux-en-Y gastric bypass. *Obes Surg* 2002;12:34–8.
- [31] Sims TL, Mullican MA, Hamilton EC, et al. Routine upper gastrointestinal Gastrografen swallow after laparoscopic Roux-en-Y gastric bypass. *Obes Surg* 2003;13:66–72.