

Gastroesophageal Reflux Disease in the Bariatric Surgery Patient

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Gastroesophageal Reflux Disease

Gastroesophageal reflux disease, GERD, is a chronic condition that is defined as “a condition that develops when the reflux of stomach contents causes troublesome symptoms and/or complications.” It is the most common gastrointestinal diagnosis recorded during visits to outpatient clinics in the United States and affects approximately 19 million Americans (1). Symptoms include heartburn, regurgitation, dysphagia, and chest pain and can range from mild to severe. Those patients with severe symptoms usually seek medical attention.

GERD-related complications include erosive esophagitis, aspiration, Barrett’s esophagus, and esophageal adenocarcinoma. In the United States, these conditions have been increasing, as the incidence of esophageal adenocarcinoma has increased fourfold over the past several years (2, 3). The exact reason for the increase in GERD and these conditions is not fully understood, but changes in diet, smoking, alcohol use, and prescription medications have been implicated. Interestingly, with a recently observed increase in obesity, there is a parallel increase in the development of esophageal adenocarcinoma, and a relationship has been hypothesized (4).

GERD is a multifactorial disease in which both functional and anatomical factors play a role. The main mechanism implicated is attributed to transient lower esophageal sphincter relaxation (TLESR) (5). The lower esophageal sphincter (LES) provides the barrier between the esophagus and the stomach, and it prevents gastric contents from entering the esophagus. Three characteristics of the LES are attributed to keep its function: pressure, overall length, and position. The LES is associated with a high-pressure zone to prevent the regurgitation of gastric contents, except in two cases: after swallowing to allow the passage of food and when the fundus is distended with gas, to allow the elimination of gas. The pathology of GERD is associated with abnormal relaxation of the LES, thus allowing contents to enter the esophagus. The resistance of the LES is a combination of both its pressure and the length over which the pressure is exerted, and in GERD both of these mechanisms of protection will be impaired.

The position is also important, since this determines what length is exposed to the positive intra-abdominal pressure. If the intra-abdominal length of the esophagus is decreased, as in cases such as the presence of a hiatal hernia, then there will be less pressure exerted on the LES, which can lead to reflux.

Association Between GERD and Obesity

Obesity is a serious health problem in the United States. Two-thirds of adults are overweight (BMI > 25 kg/m²) or obese (BMI > 30 kg/m²) (6). While obesity has been implicated as a cause for a lot of serious diseases, it is strongly associated with the development of GERD. Studies looking at the prevalence of GERD in the obese population have found a combined incidence of between 39 % in a large study at the Houston VA Medical Center and 53 or 61 % in two smaller studies (7–9).

Other studies have looked into the odds ratio (OR) for the development of GERD in the obese population, which has a range between 2.6 and 6.3 (10–12). Nocon et al. studied 7,124 subjects in Germany and confirmed the relationship between reflux symptoms and being overweight or obese (odds ratio 1.8, 95 % confidence interval; odds ratio 2.6, 95 % confidence interval, respectively) (10). The Bristol helicobacter project similarly showed that patients with BMI > 30 kg/m² have an adjusted odds ratio of 1.8 of experiencing weekly symptoms of reflux. The group studied 10,537 subjects, age 20–59 in Southwest England (11).

A variety of pathophysiological mechanisms have been proposed to explain the association between GERD and obesity. These can be divided into abnormalities associated with the esophagus, gastroesophageal (GE) junction, or stomach, and they include esophageal and gastric motility disorders (13–16), increased abdominal pressure, diminished LES pressure (13, 17), increased frequency of TLESRs (18), and the presence of hiatal hernia (9, 17).

Transient Relaxations of the Lower Esophageal Sphincter in Obesity

As in nonobese individuals, the most important reflux mechanism in obese individuals appears to be the presence of TLESRs (2, 19). Gastric distension is the main stimulus for causing TLESRs, by causing stimulation of both stretch and tension mechanoreceptors in the proximal stomach. In a study done by Wu et al., the researchers compared three groups of study subjects—normal-weight, overweight, and obese individuals—by comparing BMI measurements, upper endoscopy, manometry, and pH recordings for both the fasting and postprandial periods. At the 2-h mark after a meal, both overweight and obese subjects had a higher rate of TLESR episodes ($P < 0.001$). In this study, a direct correlation between increasing BMI and the number of TLESR episodes was identified. It was hypothesized the postprandial TLESR episodes are due to the higher postprandial intragastric pressure (19).

Esophageal Body Motor Disorders in the Obese

An association between esophageal body motor abnormalities and the bariatric patient has been established. In a study done in 2004, which included 345 patients who were selected to undergo bariatric surgery, esophageal manometry revealed that 25.6 % of the patients had abnormal esophageal findings. These included, in decreasing frequency, hypotensive LES pressure (< 10 mmHg) (69 %), nutcracker esophagus (19 %), and nonspecific motility disorders (16 %) (13). Koppman et al. also demonstrated motility disorders in 40 % of 116 obese bariatric. Nonspecific motility disorders were the most common presentation, comprising 57 %, followed by nutcracker esophagus, 26 %, and hypotensive LES (7 %) (14).

Hiatal Hernia in Obesity

Hiatal hernia is associated with an increased incidence of GERD due to diminished intra-abdominal esophageal length, diminished angulation at the angle of His, and decreased pressure at the LES. Hiatal hernias are frequently found in obese patients. Several studies have looked into hiatal hernia in obesity and its relation to GERD. The presence of a hiatal hernia was thought to be the strongest predictor of esophagitis in the general population (20). Suter et al. studied 345 morbidly obese patients. One hundred eighty-one (52.6 %) had a diagnosis of hiatal hernia. In the patients with hiatal hernia, compared to the group without hiatal hernia, 47.5 % had esophagitis (vs. 15.8 %) and 7.4 % had low distal esophageal pH (vs. 5.1 %) (13). Similar results were also reported by Iovino et al. and Pandolfino et al. (9, 21).

Lower Esophageal Sphincter Abnormalities

Normal LES pressure is considered between 10 and 35 mmHg. Hypotensive LES (< 10 mmHg) is a risk factor for the development of GERD. Several studies have looked into the connection between LES pressure and obesity and have shown an inverse relationship: as the BMI increases, the LES pressure decreases. Two studies done by Iovino et al. and Kouklakis et al. have supported this inverse relationship. Iovino et al. studied 43 obese patients, who were monitored by questionnaires, stationary manometry, and a 24-h ambulatory pH-metry, and compared these patients to control subjects. The group concluded that LES pressures were significantly lower in obese patients (17). Kouklakis et al. studied 64 subjects, who were divided into three groups based on BMI. The group concluded that there is a strong inverse relationship between BMI and LES pressures (22).

In contrast, Fisher et al. showed no correlation between weight and LES pressures. The group showed a correlation between weight and BMI with gastroesophageal reflux; however, no relationship was found between BMI and LES pressures ($P = 0.068$). LES pressures were higher in patients with normal esophageal acid exposure than in those with abnormal findings ($P < 0.05$) (8).

Presentation of GERD

In a study including a large cohort of 10,545 women, there was a significant dose-dependent relationship between increasing BMI and GERD symptoms. Jacobson et al. concluded that BMI is associated with symptoms of GERD in both normal-weight and overweight women, as even moderate weight gain may exacerbate these symptoms (23). GERD symptoms are present in about 55 % of morbidly obese patients, as those include heartburn (87 %), wheezing (40 %), water brash (18 %), laryngitis (17 %), and aspiration (14 %) (24).

Treatment

Medical Treatment in Obese Patients

As with the general population, initial treatment should include diet and lifestyle modifications and medical treatment. Patients should be advised to elevate the head of the bed; eat small, frequent meals; lose weight; and avoid certain foods, such as coffee, alcohol, spicy foods, and others, that may aggravate their symptoms. The core of the medical therapy is acid suppression. Initially patients should attempt antacids, but if symptoms persist, patients should try H₂-inhibitors or proton pump inhibitors (PPIs). If patients do not respond to medication, further evaluation is required.

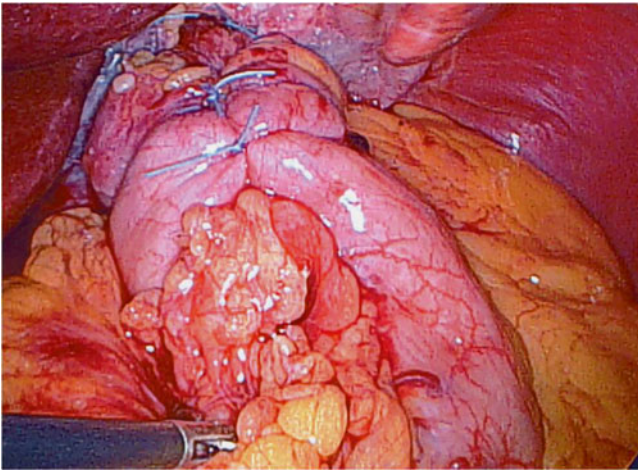


FIG. 1. Laparoscopic Nissen fundoplication.

A 24-h pH study should be obtained, as it is able to confirm the diagnosis of GERD. Endoscopic evaluation is needed to evaluate the esophageal mucosa, during which mucosal biopsies can be obtained to evaluate for any histologic changes. A video esophagogram can identify the presence of hiatal hernia. This is important as medical management is less successful with anatomic abnormality such as hiatal hernia, and hence, these patients ultimately require surgical treatment.

Surgical Treatment

In the general population, indications for surgery include anatomic abnormality, relatively severe GERD, patients who are dependent on PPIs without mucosal injury, presence of erosive esophagitis or Barrett's esophagus, failure of medical management, aspiration, or presence of stricture. The surgical strategies aim to restore the cardioesophageal competence. The standard treatment consists of hiatal reconstruction and fundoplication. Examples of fundoplication include: Toupet, Dor, or Belsey (partial) and Nissen (full wrap) (Fig. 1). Other surgical techniques attempt to reduce the contributors of GERD, such as pyloroplasty, which in principle is used to widen the pylorus and increase gastric emptying; vagotomy, which is used to reduce acid secretion; Hill repair (i.e., Hill posterior gastropexy); and finally vagotomy with antrectomy. In the general population, total fundoplication has a 93 % success rate at 3 years (25) and is considered standard therapy. However, in the obese and severely obese population, there is a controversy regarding the long-term efficacy and durability of these surgeries, with the main concern being herniation of the wrap (26).

In a study done by Perez et al., 224 patients who underwent either Nissen fundoplication or Belsey Mark IV (BM4) procedure were followed for 37 months. Subjects were divided into three groups: normal weight (BMI < 25), overweight (BMI 25–29.9), and obese (BMI > 30).

The overall recurrence of symptoms was identified as 31.3 % in obese patients (22.9 % Nissen, 53.8 % BM4), which was significantly higher than in the normal-weight individuals (4.5 %). The study concluded that obesity adversely affects the long-term success of these operations. Furthermore, there was no difference in rate of recurrence by procedure, i.e., Nissen procedure was no more durable than the BM4 procedure (27).

Similar results were reported by Morgenthal et al., who reported that morbid obesity (BMI > 35 kg/m²) is a risk factor for failure of laparoscopic Nissen fundoplication for the treatment of GERD. Failure in this study was defined as the need for reoperation, lack of satisfaction, or any severe symptoms at follow-up. The group studied 312 patients who underwent laparoscopic Nissen fundoplication between 1992 and 1995. Preoperative morbid obesity (BMI > 35 kg/m²) was associated with failure ($P=0.036$), whereas obesity (BMI 30–34.9 kg/m²) was not (28).

Smaller studies have shown contradicting results. D'Alessio et al. studied 257 patients who underwent laparoscopic Nissen fundoplication. Patients were stratified by preoperative BMI: normal (BMI < 25), overweight (BMI 25–30), and obese (BMI > 30). Following surgery, mean heartburn and dysphagia symptoms improved for patients in all BMI categories, and there were no statistical differences between different BMI groups (29). Another study, done by Anvari and Bamehriz, showed similar results. The study included 70 patients with proven diagnosis of GERD and mean BMI of 38.4 (range 35–51). Patients underwent laparoscopic Nissen fundoplication. Surgical outcomes were compared to a group containing 70 patients who had BMI < 30. The GERD symptom score improved, and percent acid reflux in 24-h testing decreased in both groups. The authors concluded that morbid obesity does not adversely affect the outcomes of laparoscopic Nissen fundoplication (30).

Even though the standard for surgical treatment for GERD in the general population is fundoplication, there are conflicting data in terms of efficacy of the current treatment in the overweight and obese population. Thus, weight loss procedures have been evaluated as an alternative surgical intervention in the treatment of GERD.

Weight Loss Procedures and Effects on GERD

Bariatric surgeries, which are intended to reduce weight, can also play a role in the treatment of GERD, as they can result in weight loss, restore the cardioesophageal competence, and minimize the gastric reservoir and/or other mechanisms. These can be divided into gastric-specific procedures and gastric with additional malabsorption procedures. Gastric-specific procedures include vertical sleeve gastrectomy and the adjustable gastric band, mostly done laparoscopically. The gastric plus malabsorptive procedures include biliopancreatic diversion with or without duodenal switch and Roux-Y gastric bypass (RYGB).

Roux-en-Y Gastric Bypass and GERD

The underlying mechanism for RYGB has been used as a stand-alone reflux procedure: gastric volume reduction and rapid emptying into the small bowel. Several studies have shown that GERD either improves or completely disappears after RYGB. Frezza et al., in a study of 435 patients undergoing laparoscopic Roux-en-Y gastric bypass (LRYGB), in which 55 % had evidence of chronic GERD, showed that there was a significant decrease in GERD-related symptoms, including heartburn (from 87 to 22 %, $P < 0.001$), water brash (from 18 to 7 %, $P < 0.05$), wheezing (from 40 to 5 %, $P < 0.001$), laryngitis (from 17 to 7 %, $P < 0.05$), and aspiration (from 14 to 2 % $P < 0.01$). The researchers concluded that this procedure provides a very good control of GERD in morbidly obese patients during the 3-year study. The authors proposed that in addition to volume reduction and rapid egress, the mechanism of how LRYGB affects symptoms of GERD is through weight loss and elimination of acid production in the gastric pouch. The gastric pouch lacks parietal cells; thus, there is no acid production, and also, due to its small size, it minimizes any reservoir capacity to promote regurgitation (24).

Similar results have been reported in other studies. Smith et al. found a significant reduction in reflux symptoms after RYGB with or without distal gastrectomy and gastropexy. In their study of 188 patients who were followed up to 4 years, there was a significant decrease in symptoms, as only 14 patients reported the need for medication postoperatively (31).

Jones compared Nissen fundoplication to RYGB in reflux patients with BMI under 35. RYGB was done primarily as an antireflux procedure in 332 patients from 1987 to 1996. Postoperatively only one patient was symptomatic (32). Varela et al. compared laparoscopic fundoplication with laparoscopic gastric bypass in morbidly obese patients in terms of mean length of stay, observed mortality, risk-adjusted mortality, and hospital costs and concluded that LRYGB is as safe as laparoscopic fundoplication in the treatment of GERD in this group of patients (33) and it may provide additional health-related benefits.

Gastric Banding and GERD

Since its FDA approval in 2001, the gastric band has rapidly become a popular bariatric procedure for obese patients due to its simplicity, lack of reconstruction, and perceived safety profile. However, conflicting results have been published about the effect of gastric banding on GERD. A few studies have shown that the incidence of GERD is still increased after gastric banding; however, the majority of the literature suggests that in fact symptoms and pH improve after the procedure. In fact an overly tightened band can induce reflux.

One study, done by Gutschow et al., reported worsening of reflux symptoms. In the study, 31 patients were followed from

1997 to 2003, mean BMI of 46.5 kg/m². Upper endoscopy was performed in 18 patients after 30 months showing a high prevalence of esophagitis. Postoperative esophageal pH-manometry was performed in 16 patients and was pathologic in 43.8 % of the cases. The group concluded that the incidence of gastroesophageal reflux and esophagitis remains increased after laparoscopic gastric banding (34). These results were similar to those by Ovrebø et al., Westling et al., and Suter et al. Overall, the mechanism by which this procedure may lead to poorer outcomes in reducing the incidence of GERD is not well understood. However, it is thought that postoperative reflux may be attributed to an unrecognized hernia at the time of procedure or inappropriate (overly tight) adjustment regimens.

Other studies have shown that laparoscopic adjustable gastric banding improves pH and symptoms. De Jong et al. studied 26 patients who underwent gastric banding. The patients were assessed by 24-h pH monitoring, endoscopy, and barium swallow, preoperatively, at 6 weeks, and at 6 months. The group concluded that this procedure generally decreases GERD symptoms, as they claimed that the antireflux effect of a proximally placed gastric band is due to creating a longer intra-abdominal pressure zone or by pulling the stomach more in the abdomen in the presence of a hiatal hernia. They also hypothesized that the pouch formation is a crucial determining factor in the occurrence of symptoms after the procedure, as newer techniques advocate for a “virtually-no-pouch” procedure with placement of the band at or near the gastroesophageal junction. This high placement can still lead to pouch formation and possible dilatation of the esophagus, which can lead to concomitant esophageal motility disorders. They showed that the presence of a pouch leads to esophagitis (35).

Tolonen et al. also studied the relationship between gastric banding and GERD. The study included 31 patients who underwent gastric banding. The patients were monitored using 24-h pH tests, symptom assessment, and upper GI endoscopy. The number of reflux episodes significantly decreased postoperatively (44.6 ± 23.7 SD to 22.9 ± 17.1 SD, $P = 0.0006$) after 19 months, symptoms decreased from 48.3 to 16.1 % ($P = 0.01$), and the diagnosis of GERD on 24-h pH recordings decreased from 77.4 to 37.4 % ($P = 0.01$). No pouch enlargement was noted on upper GI endoscopy. The researchers concluded that a gastric band that is correctly placed is associated with the effective treatment of GERD symptoms. They also hypothesized that these results were due to incomplete relaxation of the LES. No correlation between gastric band and esophageal motility was discovered. The group also felt that the antireflux effect may be mechanical, as the band may provide a narrowing at the region of the gastroesophageal junction similar to the historical Angelchik prosthesis (36).

Due to the conflicting results of studies looking into laparoscopic adjustable gastric banding and GERD, many surgeons

would not recommend this procedure for the treatment of GERD in bariatric patients.

Sleeve Gastrectomy and GERD

Laparoscopic sleeve gastrectomy has become a new option for the surgical treatment of morbid obesity. It is a gastric-specific operation, but unlike the gastric band, it does not require adjustments nor does it carry the complications of having a foreign object in the body. When compared to laparoscopic Roux-en-Y, it does not have any of the complications such as malnutrition, dumping syndrome, or marginal ulcers. It has been argued that laparoscopic sleeve gastrectomy is a superior procedure in terms of weight loss compared to the gastric band and it has similar low complications and mortality rates compared to the RYGB (37). Although sleeve gastrectomy is emerging as a favorable procedure, there have been conflicting results, as some have hypothesized that this procedure can promote the development of or exacerbate GERD symptoms.

A study by Himpens et al. showed that the de novo appearance of GERD occurred in 21.8 % of patients a year after sleeve gastrectomy. However, the group also noted that after 3 years, GERD symptoms were present in only 3.1 % of the study population. They hypothesized that these results were most likely due to restoration of the angle of His. Also, symptoms in 75 % of patients who were affected before surgery disappeared by 3 years after surgery (38). Another group with similar results contributed the de novo symptoms to too-radical resection of the gastric antrum (39).

A study done by Soricelli et al. showed that sleeve gastrectomy and crural repair in the obese patients are safe techniques. The group studied 378 patients; 60 patients (15.8 %) had symptomatic GERD, and hiatal hernia alone was diagnosed in 42 patients (11.1 %). 73.3 % of these patients had complete remission of GERD symptoms following sleeve gastrectomy, whereas the rest of the patients had decreased use of antireflux medications. In addition, GERD symptoms developed in 22.9 % of patients undergoing sleeve gastrectomy, but none if hiatal hernia repair was performed (40).

Bariatric Surgery Versus Fundoplication in the Treatment of GERD

As previously mentioned there are conflicting data about the surgical approach for the treatment of GERD in cases of obese patients. Interestingly, there are very few studies that have compared traditional GERD surgeries in this population to bariatric surgery techniques. As laparoscopic gastric bypass is successful in treating both obesity and related disease plus GERD, some surgeons are advocating this surgical procedure as the procedure of choice for morbidly obese patients who also have GERD (41, 42).

Patterson et al. presented one of the few studies that directly compared standard treatment versus bariatric surgery. The group studied 12 patients, 6 undergoing LRYGB (mean BMI 55) and 6 laparoscopic Nissen fundoplication (mean BMI 29.8). The patients underwent preoperative and postoperative esophageal physiologic testing. Both groups experienced a significant improvement in heartburn symptoms postoperatively, as the mean preoperative symptom score improved from 3.5 to 0.5 in the laparoscopic Nissen group ($P=0.01$) and from 2.2 to 0.2 in the gastric bypass group ($P=0.003$). The group concluded that the two procedures are both effective in treating heartburn symptoms and objective acid reflux in the morbidly obese population (43).

Similar results were reported by Varela et al. The group looked into all patients who underwent either laparoscopic fundoplication or laparoscopic gastric bypass from October 2004 to December 2007 ($n=27,264$). The authors compared safety between the two procedures in terms of length of stay, in-hospital overall complications, mortality, risk-adjusted mortality ratio, and hospital costs. They concluded that the two procedures were comparably safe in terms of treatment of GERD and recommended that in patients with morbid obesity, laparoscopic gastric bypass should be the preferred procedure of choice due to the favorable effect on other comorbid conditions (44).

Other groups looked into the outcomes of conversion of a failed fundoplication procedure to a gastric bypass. Ibele et al. looked into the impact of takedown of previous fundoplication and conversion to laparoscopic gastric bypass. In their study population, 36 % of patients had recurrent GERD at the time of revision, due to anatomic failure of the original fundoplication, and another 36 %, although with intact fundoplication, had recurrent GERD symptoms. After surgery, all of the patients in this group reported complete resolution of symptoms following surgery (45). Similar results were also reported in a study of 7 patients who originally had a laparoscopic Nissen fundoplication that was converted to a LRYGB, as the study showed significant reduction in symptoms postoperatively (16.7 % vs. 4.4 %) (46).

Kellogg et al. looked into the anatomic findings and outcomes in patients with failed Nissen fundoplication and subsequent conversion to RYGB. The group retrospectively reviewed a database of 1,435 patients who underwent RYGB between 2001 and 2006 and identified 11 patients who had previously undergone fundoplication. The mean BMI prior to gastric bypass procedure was 44 kg/m². Nine of these patients had GERD preoperatively. All patients had 100 % improvement in symptoms, with complete resolution in 78 %. Wrap disruption was present in 45 % of the patients, whereas herniation of an intact wrap occurred in 1 patient (47). Based on these results, many surgeons advocate primary bariatric surgery to avoid the risk of revision to RYGB in the event of wrap failure.

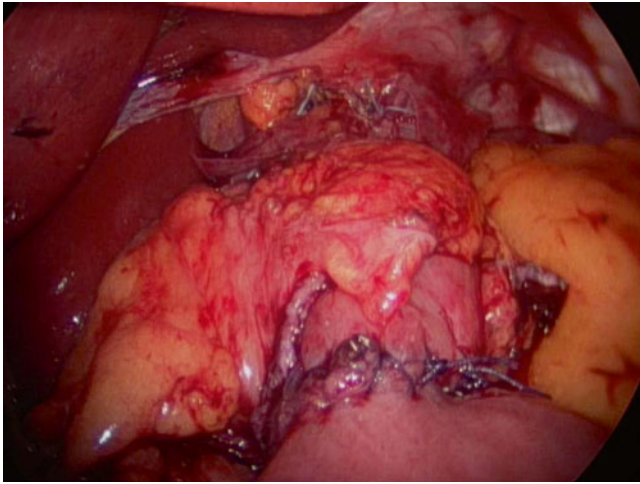


Fig. 2. Paraesophageal hernia repair and Roux-en-Y gastric bypass.

Treatment of GERD in Patients Post-Bariatric Procedures

In the postoperative bariatric patient, the development of GERD is treated in a similar way as in the general population. Initially, medical treatment should be undertaken, including a trial of PPIs and/or Carafate. If medical treatment fails, further studies can be undertaken to evaluate for hiatal hernia (Fig. 2), esophagitis, or Barrett's esophagus, such as upper gastrointestinal endoscopy. If endoscopy is considered, the person performing the procedure should be aware of the exact procedure performed and should understand the anatomy (extent of resection and length of created limbs). Information about preoperative findings would also be helpful (48). Other studies may be done, such as upper GI series, manometry, and pH studies.

In this patient population, GERD can represent several complications depending on the bariatric procedure initially performed. Vertical banded gastroplasty is now a historical procedure in which a ring or a mesh is placed about 4–6 cm down from the GE junction, and staple line is done in order to construct a small pouch. It is known that this procedure can result in severe GERD. It is hypothesized that the introduction of a band can lead to symptoms of GERD by either introduction of a stricture in the upper GI tract or by pouch distension, which may in turn distend the LES and cause symptoms of GERD. Medical management would comprise the initial steps in trying to control symptoms of GERD. In terms of GERD refractory to these interventions, conversion to gastric bypass had been used in several studies (49, 50).

In the case of laparoscopic adjustable gastric banding (LAGB), symptoms of GERD are thought to be decreased by weight loss in addition to the introduction of the band as a mechanical barrier to reflux. However, postoperative complications of this procedure can manifest as GERD, such as a high or over-tight band, leading to pseudoachalasia, band slippage, or herniation. Depending on the mechanism, the management of GERD after LAGB can include medical

management, including high-dose PPIs, band adjustment, or repair of slippage or hiatal hernia by laparoscopic technique. If symptoms do not resolve, conversion of laparoscopic gastric banding to RYGB has been used as well and deemed a safe procedure with good results.

The development of GERD can be due to stenosis of the gastrojejunal anastomosis in the case of Roux-en-Y bypass. Further, previous undiagnosed motility disorders may worsen after bariatric procedures (51). It is imperative to evaluate for motility disorder in the post-bariatric patient who complains of reflux, particularly after RYGB. There are not many studies done in terms of treatment of GERD after a successful RYGB. One report described the conversion to BM4 fundoplication as a successful treatment of GERD after gastric bypass (52).

In summary, there is a spectrum of considerations for the management of gastroesophageal reflux in the bariatric surgical patient. A full evaluation for anatomic abnormalities is helpful for planning subsequent therapies, either before or after a bariatric procedure. When selecting a weight loss operation, RYGB is generally preferred for the patient with significant reflux disease.

Review Questions and Answers

1. What is the main mechanism of gastroesophageal reflux disease?

- (a) The presence of hiatal hernia
- (b) Increased frequency of TLESRs
- (c) Esophageal motility disorder
- (d) All of the above

Answer: b

2. Which of the following are pathophysiological mechanisms associated with GERD in obesity?

- (a) The presence of hiatal hernia
- (b) Increased frequency of TLESRs
- (c) Esophageal motility disorder
- (d) All of the above

Answer: d

3. An obese patient presents with symptoms of GERD. What would you recommend as the initial treatment?

- (a) 24-h pH study
- (b) Trial of antacids, followed by H₂-inhibitors or proton pump inhibitors
- (c) Laparoscopic Nissen fundoplication
- (d) Roux-en-Y Gastric Bypass

Answer: b

4. Which of the following weight loss procedures has the most positive impact on GERD in obese patients?

- (a) Vertical band gastroplasty
- (b) Laparoscopic gastric band
- (c) Roux-en-Y gastric bypass
- (d) Sleeve gastrectomy
- (e) All of them have the same effect on GERD

Answer: c

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