The impact of bariatric surgery on esophageal function

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Obesity is a worldwide epidemic. There is increasing evidence that obesity is associated with benign gastroesophageal disease, including gastroesophageal reflux disease (GERD) and esophageal dysmotility. Bariatric surgery—including sleeve gastrectomy, gastric bypass, and adjustable gastric band placement—can effectively result in weight loss and control of obesity-related conditions, including GERD. However, there is increasing evidence that bariatric surgery itself can have a deleterious effect on esophageal function. In this review, we address the effect of obesity and bariatric surgery on esophageal dysfunction.

Keywords: bariatric surgery; esophagus; manometry; GERD

Introduction

Obesity is a worldwide epidemic: the prevalence of obesity has doubled since 1980, and an estimated 13% of the world’s population satisfied the criteria for obesity in 2014.¹ The relationships between obesity and medical conditions such as cardiovascular disease, sleep apnea, and diabetes are well established.² There is increasing evidence that obesity is associated with benign gastroesophageal disease, including gastroesophageal reflux disease (GERD) and esophageal dysmotility. Bariatric surgery—including sleeve gastrectomy, gastric bypass, and adjustable gastric band placement—is an effective treatment for obesity and obesity-related medical comorbidities. However, with the increased frequency of bariatric surgery, there is mounting evidence that these operations may affect gastroesophageal function. In this review, we address the effect of obesity and bariatric surgery on esophageal dysfunction.

Obesity and esophageal function

There appears to be a relationship between obesity, lower esophageal sphincter (LES) pressure, and distal esophageal acid exposure. In an observational study of 1659 patients, Ayazi et al. demonstrated an inverse correlation between body mass index (BMI) and LES pressure and a direct correlation between BMI and acid exposure.³ In particular, 13% of underweight patients showed a defective LES, whereas 50% of overweight and 55% of obese subjects had defective LES.

Obesity also appears to affect esophageal function. In one study using conventional manometry to assess esophageal function in obese patients, up to 60% of obese subjects demonstrated esophageal dysmotility, including defective LES, nonspecific motility disorder, nutcracker esophagus, distal spasm, and even achalasia.⁴ Interestingly, the majority of patients with abnormalities of esophageal motility were asymptomatic. These data were confirmed in other series, with similar incidence of dysmotility and rate of symptoms.⁵ Oelschlager et al. evaluated esophageal function by means of combined multichannel intraluminal impedance and manometry.⁶ Compared to nonobese patients with GERD, this study demonstrated that obese patients with GERD had a greater incidence of esophageal dysmotility, including impaired complete bolus transit. Interestingly, the distal esophageal amplitude in obese GERD patients was greater than that in nonobese...
GERD controls, potentially a result of increased distal esophageal acid exposure in these patients. The advent of high-resolution manometry (HRM) has provided new insights into esophageal function. Pandolfino et al. highlighted the effects of obesity on esophagogastric junction (EGJ) function. In particular, they found a direct linear relationship between BMI and intragastric pressure, gastroesophageal pressure gradient, and incidence of a dual high-pressure zone, suggesting the presence of a hiatal hernia. The increased incidence of a dual high-pressure zone may also explain the increased number of transient LES relaxations and reflux events determined with postprandial impedance-pH monitoring in obese patients.

Tolone et al. recently investigated a consecutive cohort of patients with obesity stratified for the presence of GERD symptoms and signs using impedance HRM and impedance-pH monitoring. The authors identified LES dysfunction in most cases; hiatal hernia was often detected, as well as the presence of ineffective motility. Compared to lean controls, increased intragastric pressure, gastroesophageal pressure gradient, and segmentary intrabolus pressure were commonly detected. In a subsequent study, Tolone et al. reviewed data on 138 obese subjects with or without symptoms. Compared to nonobese patients, obese patients demonstrated more frequent hiatal hernia, lower LES resting pressure, and lower distal contractile integral values. Furthermore, they had increased incidence of ineffective esophageal motility (weak and failed) and a low rate of hypercontractile esophagus and premature contractions. These findings demonstrate that obesity affects several aspects of gastroesophageal function, including esophageal body motility and LES resting pressures. HRM is a safe and effective method for assessing esophageal function and may play a role in the preoperative assessment of patients undergoing bariatric surgery. Further studies are needed to specifically elucidate the clinical impact of these findings on obese patients and whether HRM can help guide the specific type of bariatric surgery in these patients.

**Esophageal function after bariatric surgery**

**Gastric bypass**

Roux-en-Y gastric bypass (RYGB) is performed by creating a small gastric pouch and a Roux-en-Y gastrojejunostomy of variable length. In this way, RYGB is both a restrictive and a malabsorptive operation—the small gastric pouch prevents overeating, and the long Roux limb decreases calorie absorption. It is associated with durable weight loss and control of medical comorbidities. For this reason, RYGB is one of the most commonly performed bariatric operations.

Gastric bypass has been shown to provide excellent control of typical symptoms of GERD. In a study performed on 55 patients with preoperative GERD symptoms, the authors found that, after RYGB, 96% of subjects had improvement or total resolution of symptoms, and no patients had aggravation of their disease. The protective effect of RYGB on GERD was also objectively demonstrated with conventional pH monitoring. In fact, following RYGB, all pH-based parameters, such as esophageal acid exposure, percent time at esophageal pH < 4, number of reflux episodes, number of reflux episodes lasting greater than 5 min, and DeMeester score, have been shown to improve significantly in short- and long-term studies. Additionally, esophagitis was resolved after RYGB in most case series. Finally, Frezza et al. demonstrated that, in addition to typical symptoms, atypical symptoms of GERD, such as wheezing, laryngitis, and aspiration, which are often refractory to conventional medical therapy, were also improved after RYGB.

The mechanisms by which RYGB mitigate distal esophageal acid exposure and GERD symptoms probably depend on the new anatomy after surgery. First, the volume of the new gastric pouch is small, averaging 30 cc, minimizing any reservoir capacity to promote regurgitation. Further, the cardia region of the stomach, where the pouch is created, has been shown to be relatively lacking in parietal cells. Smith et al. have shown a virtually absent basal and stimulated gastric acid secretion in the gastric pouch after bypass, lending credibility to this theory. Thus, a significant reduction of acid production in the gastric pouch is achieved, reducing the acid reflux in the esophagus. Additionally, bile reflux is avoided, due to the Roux-en-Y biliary diversion. A recent variation on the RYGB is the omega-loop gastric bypass, also known as the mini-gastric bypass or one-anastomosis gastric bypass. In this procedure, the surgeon creates a long, linear, lesser-curvature gastric tube with a terminolateral gastroenterostomy approximately 180–200 cm
distal to the ligament of Treitz. There have been concerns about the proximity of the biliary flow to the gastric tube in this procedure compared to RYGB and the potential for both biliary reflux and esophagitis. Recently, Tolone et al. studied 15 patients before and 1 year after the omega-loop gastric bypass with impedance HRM and 24-h pH–impedance monitoring. The authors found that this procedure did not cause de novo gastroesophageal reflux or esophagitis. Long-term data on the risk of GERD developing after this particular procedure are needed.

**Sleeve gastrectomy**

Sleeve gastrectomy is a restrictive weight-loss operation that is performed by removing the majority of the stomach along a line between the angle of His and a point along the greater curve of the stomach, approximately 3–6 cm from the pylorus. Despite little or no malabsorptive component to this operation, it has been associated with durable weight loss and control of medical comorbidities.

Esophageal function appears to be affected by sleeve gastrectomy, particularly the function of the LES. This was first suggested by Klaus and Weiss, who evaluated the effect of sleeve gastrectomy on GERD. In this observational study, patients with normal LES function and lack of GERD symptoms developed de novo GERD after sleeve gastrectomy, and patients with preoperative GERD and hypotensive LES developed worse GERD following sleeve gastrectomy. Braghetto et al. identified alterations in LES function following sleeve gastrectomy. They performed esophageal manometry preoperatively and 6 months postoperatively in 20 patients who underwent sleeve gastrectomy. Overall, compared to preoperative pressures, the LES resting pressure decreased significantly (3.7 mmHg, \( P < 0.01 \)), and the majority (17/20; 85%) of patients demonstrated hypotensive LES. Furthermore, they demonstrated a decrease in both overall LES length and intra-abdominal LES length in 14/20 patients; only six patients demonstrated normal total and intra-abdominal LES length postoperatively.

One explanation for these findings is specific to the operative technique of gastric sleeve. During creation of the sleeve, the gastric sling fibers are frequently transected near the angle of His, particularly if the transection line is very close to this anatomic landmark. These sling fibers contribute significantly to the function of the LES. Disruption of these fibers can compromise LES pressure and length. Interestingly, compromised LES function is not uniform in patients who undergo sleeve gastrectomy. Kleidi et al. identified a significant increase in postoperative total (1.09 cm, \( P < 0.001 \)) and intra-abdominal (0.84 cm, \( P < 0.003 \)) LES length. As such, they altered their technique of sleeve gastrectomy to mitigate the disruption of the gastric sling fibers. In fact, their technique involves transection of the stomach close to the GEJ and esophagus. While this eliminates the gastric sling fibers’ contribution to the LES, they believe that this tubularized stomach contributes to the increased length of the LES.

Theoretically, sleeve gastrectomy should compromise LES function owing to operative technique and disruption of normal gastroesophageal anatomy. However, on the basis of the current literature, the effect of sleeve gastrectomy on LES function appears to be variable. Importantly, in these studies, the absolute differences in LES length and pressure are relatively small, and it is still unclear whether these manometric changes truly translate into clinically appreciable alterations in esophageal function. Further investigations to specifically establish a relationship between clinical symptoms and manometric alterations following sleeve gastrectomy are needed.

**Adjustable gastric band placement**

Laparoscopic adjustable gastric banding (LAGB) is a restrictive weight-loss operation that involves the placement of a silicone ring around the proximal stomach. The band is connected to a subcutaneous port, which allows injection of saline to adjust the band tightness. In the early 1990s, the first reports of LAGB were published, suggesting that it was a safe and effective weight-loss operation. Among both patients and surgeons, the popularity of this technique grew, owing to short operative times, low perioperative morbidity and mortality, absence of the need to reroute the gastrointestinal tract, reversibility of the operation, and fewer nutritional deficiencies. Over the next 2 decades, LAGB became the most frequently performed operation for the management of morbid obesity and obesity-related complications. However, as long-term outcomes of this technique were collected, the durability of weight loss and the resolution of comorbidities were called into question. Furthermore, long-term side effects and complications of the device were
reported, including slippage of the band and erosion of the band into the stomach and esophagus.

In the early experience of LAGB, one of the underappreciated side effects of the band was alteration in esophageal function. Esophageal function can be assessed through patient-reported symptoms, barium esophagram, upper gastrointestinal endoscopy, and esophageal manometry, and abnormalities in all of these patient-assessment tools can be found following LAGB. Bothersome patient symptoms following LAGB include GERD symptoms (e.g., heartburn and regurgitation), dysphagia, early satiety, and postprandial epigastric pain. Radiographic and endoscopic abnormalities include esophageal dilation and narrowing of the distal esophagus/GEJ. Esophageal manometry can demonstrate abnormalities in esophageal-body contractility (typically ineffective esophageal motility or aperistalsis) and incomplete relaxation of the LES.

The most severe form of esophageal dysfunction that results after LAGB is pseudoachalasia, a condition characterized by esophageal aperistalsis associated with impaired distal esophageal/LES relaxation. Reported to occur in under 2% of patients undergoing band placement, the true incidence of pseudoachalasia due to LAGB is likely underreported secondary to incomplete gastrointestinal assessment in patients who present with mild to moderate symptoms. Robert et al. reported their experience with postoperative esophageal dysfunction in 359 patients who underwent LAGB over an 8-year period. They identified 20 patients with food intolerance; 11 of those patients fit manometric criteria for achalasia and had a dilated esophagus on esophagram.

Evaluation of a patient with esophageal dysfunction following LAGB should begin with careful history and physical examination to rule out causes of symptoms unrelated to the gastric band. This should be followed by removal of all saline from the band to eliminate overfilling of the band as a contributing factor. Emptying the band is easily performed in the office, and frequently patients will receive some relief of their esophagogastric obstructive symptoms with this simple maneuver. Some of this relief may be due to improved esophageal function, and there is evidence that impaired distal esophageal contractile segments may improve with removal of band fluid. Next, an esophagram should be performed to assess for gastric band slippage, slow transit of contrast through the GEJ, and a dilated esophagus. Esophageal manometry should also be performed to assess for esophageal-body dysmotility and elevated distal esophageal/GEJ pressures.

When there are no significant abnormalities noted on imaging and HRM, deflating the band will frequently improve the patient’s symptoms. However, in patients with ongoing symptoms, strong consideration should be given to removal of the band. In patients with pseudoachalasia, this is almost always required. Removal of the band can be performed laparoscopically with minimal morbidity. Esophageal dysmotility will improve with removal of the band; however, it is important to remember that weight regain will almost uniformly occur after band removal. As a result, some have advocated for single-stage removal of the band and conversion to a RYGB. This approach appears to improve esophageal dysmotility and provide a concurrent procedure to manage obesity and related comorbidities.

Despite improvement in symptoms in the majority of patients who undergo band removal, there are patients who have persistent symptoms despite elimination of the band. These ongoing symptoms can be multifactorial, including persistent esophageal dysmotility; however, one cause is persistent esophageal obstruction due to a fibrous rind that develops at the site of the previously placed gastric band. Although this rind is frequently identified at the time of removal of the band, it does not always cause symptoms, and attempted surgical division at the time of band removal can result in injury to the GEJ or perforation of the stomach. Therefore, it is advisable to first remove the band, and, if persistent symptoms exist due to esophageal obstruction, reoperation for ring division is reasonable.

Recently, endoscopic management of persistent esophageal obstructive symptoms following removal of gastric band has been described. In this technique, a distal esophageal/proximal gastric stricture that developed from the band placement is transected using a similar technique to per-oral endoscopic myotomy. Although experience with this technique remains extremely limited, the results of a case study demonstrated objective improvement in the stricture diameter and LES pressure measurements using HRM.
Bariatric surgery and esophageal function  

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Summary

Obesity is a growing health problem worldwide, and mounting evidence suggests an association between obesity and esophageal dysfunction, including GERD. Bariatric surgery can effectively result in weight loss and control of obesity-related conditions, including GERD. However, there is increasing evidence that bariatric surgery itself can have a deleterious effect on esophageal function. Given the widespread use of these operations, it is important to identify the specific mechanisms behind esophageal dysfunction following bariatric surgery, including de novo GERD following sleeve gastrectomy.

References

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