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Endoscopy in the Bariatric Surgical Patient

Christopher S. Huang, MD[a,b,*],
Francis A. Farraye, MD, MSc[a,b]

[a]*Boston University School of Medicine, 715 Albany Street, Boston, MA 02118, USA*
[b]*Section of Gastroenterology, Boston Medical Center, 85 East Concord Street, 7th Floor, Boston, MA 02118, USA*

In 1996, a National Institutes of Health Consensus Panel recognized bariatric surgery as the only effective long-term treatment for morbid obesity [1]. As the problem of obesity in the United States has grown, the number of patients undergoing bariatric surgery has risen dramatically. The American Society for Bariatric Surgery estimated that 140,000 bariatric operations would be performed in 2004, compared with approximately 23,000 in 1997. Although most patients achieve successful outcomes following surgery in terms of excess weight loss and improvement of comorbid conditions, many patients develop untoward postoperative gastrointestinal (GI) symptoms. These symptoms are often difficult to interpret clinically and frequently require investigation with upper GI barium studies and upper endoscopy. As the performance of bariatric surgery rises, an increase in the number of patients referred for evaluation and endoscopy is expected. Therefore, gastroenterologists must become familiar with the surgically altered anatomy and the possible endoscopic findings in these patients to perform upper endoscopy in a safe and facile manner.

Understanding the anatomy in the bariatric surgical patient

The major types of bariatric procedures that gastrointestinal endoscopists may encounter are discussed here. A basic understanding of the anatomical

* Corresponding author.
E-mail address: christopher.huang@bmc.org (C.S. Huang).

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changes that occur after bariatric surgery is critical before endoscopy is performed.

Gastric bypass

The Roux-en-Y gastric bypass (RYGBP) is the most commonly performed bariatric procedure in the United States (Fig. 1) [2]. Although there are several modifications of the RYGBP, in the standard procedure a small gastric pouch (typically less than 30 mL) is created along the lesser curvature and transected from the remainder of the stomach. The pouch is anastomosed to a Roux limb in an end-to-side fashion, creating a gastrojejunostomy with a stomal diameter of approximately 10 to 12 mm. The length of the Roux limb is typically 60 to 75 cm, but varies depending on the degree of malabsorption that is desired, and can be as long as 150 cm in the long-limb RYGBP. The original gastric bypass was fashioned with a loop gastrojejunostomy (Fig. 2) [3], which subsequently was abandoned because of problems with alkaline reflux into the pouch.

Vertical banded gastroplasty

Vertical banded gastroplasty (VBG) is a purely restrictive operation that still is performed today, although it is inferior to RYGBP in terms of long-term excess weight loss [4,5]. The key components of this operation include a vertically oriented gastric channel (pouch) that has a volume of 15 mL or less and an outlet (stoma) from the channel into the remainder of the stomach (Fig. 3). The stoma is reinforced by a polypropylene mesh collar or a Silastic ring to prevent stomal dilation. The remainder of the stomach and small intestine are unaltered in VBG.

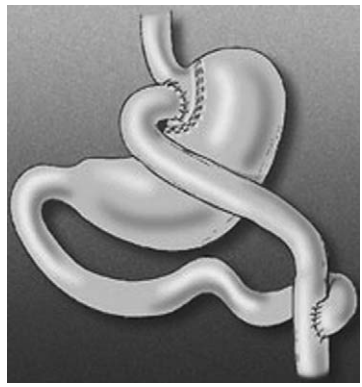

Fig. 1. Roux-en-Y gastric bypass. (*From* the American Society for Bariatric Surgery, Gainesville, Florida.)

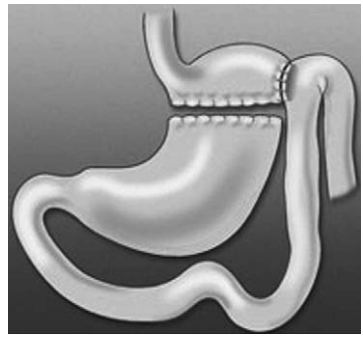

Fig. 2. Illustration of the original gastric bypass operation with loop gastrojejunostomy. (*From* the American Society for Bariatric Surgery, Gainesville, Florida.)

Gastric banding

Gastric banding is another purely restrictive procedure in which a constricting prosthetic band is placed around the proximal stomach, creating a small proximal pouch and a large remnant in an hourglass configuration (Fig. 4) [6]. An adjustable band lined by an inflatable balloon connected to a subcutaneous saline port subsequently was developed, allowing for changes in the degree of restriction [7]. This procedure now is performed laparoscopically, the so-called laparoscopic adjustable silicone gastric banding (LASGB) operation [8].

Biliopancreatic diversion and duodenal switch

Biliopancreatic diversion (BPD) is primarily a malabsorptive procedure with two key components: a distal gastrectomy, which results in mild reduction of oral intake, and construction of a long limb Roux-en-Y

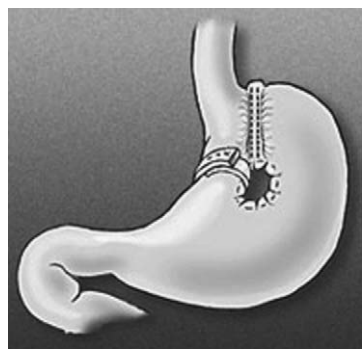

Fig. 3. Illustration of the vertical banded gastroplasty. (*From* the American Society for Bariatric Surgery, Gainesville, Florida.)

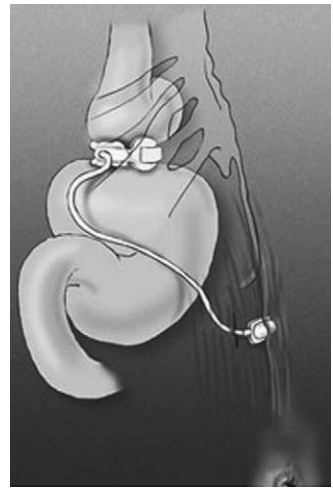

Fig. 4. Illustration of the laparoscopic adjustable silicone gastric banding procedure. (*From* the American Society for Bariatric Surgery, Gainesville, Florida.)

anastomosis with a short (50 cm) common alimentary channel (Fig. 5) [9,10]. A modification of the BPD is the duodenal switch procedure, which uses a sleeve gastrectomy rather than distal gastrectomy, and anastomosis of the jejunal limb end-to-end with the proximal duodenum (Fig. 6) [11,12]. These procedures comprise less than 15% of all bariatric operations performed in North America.

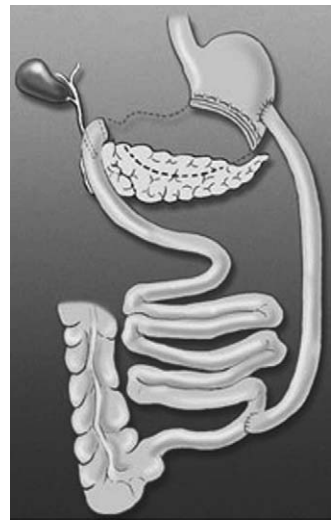

Fig. 5. Illustration of the biliopancreatic diversion. (*From* the American Society for Bariatric Surgery, Gainesville, Florida.)

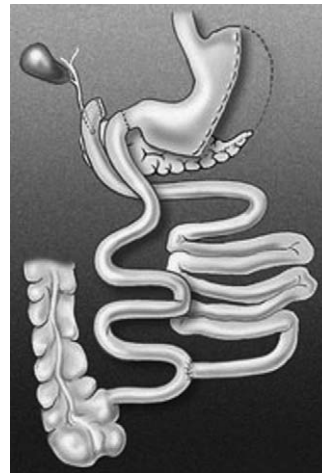

Fig. 6. Illustration of the biliopancreatic diversion with duodenal switch. (*From* the American Society for Bariatric Surgery, Gainesville, Florida.)

Indications for endoscopy

In general terms, the most common indications for endoscopy in bariatric surgical patients are the evaluation of symptoms (such as nausea, vomiting, abdominal pain, dysphagia, and weight regain or the failure to lose weight) and the treatment of complications. In the authors' experience, the most common symptoms reported by patients referred for endoscopy are epigastric abdominal pain (53%), nausea/vomiting (35%), and dysphagia (16%) [13]. The etiology of these symptoms is often multi-factorial. Dumping syndrome, inappropriate eating habits, and poor food selection frequently contribute, but upper endoscopy should be performed to exclude structural abnormalities in the surgically altered GI tract.

Upper GI hemorrhage is a relatively uncommon indication for endoscopy after bariatric surgery [14–16]. Early postoperative GI hemorrhage usually arises from the staple lines of the gastrojejunostomy, gastric remnant, and jejunojejunostomy [16]. Late GI hemorrhage is commonly from a marginal ulcer at the gastrojejunostomy, but it is important to consider the excluded gastric segment and duodenum as potential sites of bleeding [15].

Failure to lose weight or the presence of weight regain after gastric bypass or gastroplasty may indicate the development of a staple line dehiscence, although these symptoms may not predict this complication [17]. An excessively large stoma at the gastrojejunal anastomosis can also present as weight gain [13], presumably because of less restriction of food intake. Weight gain after VBG or LASGB also commonly occurs with band erosion (intragastric band migration), which is diagnosed best by endoscopy.

Heartburn has been reported to be a common complication of gastric banding [18–20], but the actual effect of this procedure on gastroesophageal reflux (GER) is controversial, as some studies report a decrease or no effect of banding on GER [21,22]. One key factor that may determine how GER is affected by gastric banding is the presence and size of the gastric pouch proximal to the band. Reflux and esophagitis appear to be worsened when a large gastric pouch is present (as can occur with band slippage), but improved when the band is placed at or just below the gastroesophageal junction, thereby augmenting the effect of the lower esophageal sphincter [23]. One word of caution: heartburn in a patient after gastric banding may be caused by an excessively tight band, and endoscopy in this setting may lead to perforation [23]. A contrast radiological study should be performed first to assess the degree of constriction and the position of the band. Endoscopy should be performed if heartburn persists after band deflation.

Endoscopic principles

Before performing upper endoscopy in the bariatric surgical patient, the endoscopist should adhere to the following basic principles, as outlined by Stellato et al [24]:

- Discuss the specific bariatric operation with the patient's surgeon to understand the altered anatomy, as modifications to the standard operations are commonplace.
- Review the operative report, pertinent perioperative records, and all available postoperative abdominal imaging studies.
- Select the most appropriate type of endoscope and accessories based on the indication for the procedure and information gathered from investigations. Obtain any specially designed accessories that may be necessary beforehand.

For most RYGBP patients, a standard diagnostic upper endoscope can be used to evaluate the esophagus, gastric pouch, gastrojejunal anastomosis, and proximal portion of the Roux limb. A pediatric colonoscope or enteroscope may be required to examine the jejunojejunal anastomosis, particularly in patients with a long-limb RYGBP.

Retrograde evaluation of the bypassed stomach and biliopancreatic limb is challenging, but this can be accomplished with the use of a pediatric colonoscope or enteroscope long enough to traverse the Roux limb [25,26]. A long-limb RYGBP or acute angulation at the jejunojejunostomy may preclude successful intubation of the bypassed segments, for which intraoperative enteroscopy or antegrade examination by means of percutaneous gastrostomy [27–29] may be required.

Abdominal imaging studies play an important role in the diagnosis of complications following bariatric surgery [30]. Barium studies are particularly useful in defining the postsurgical anatomy and identifying stomal

stenosis and staple line dehiscence; therefore the authors routinely obtain barium studies in most patients before performing endoscopy.

Endoscopic findings in normal postsurgical anatomy

Gastric bypass

The esophagus and gastroesophageal junction should appear normal following gastric bypass. Following RYGBP, the normal gastric pouch is small, so minimal air should be insufflated. Special attention should be paid to the gastrojejunostomy, which normally has a stoma measuring 10 to 12 mm in diameter (Fig. 7). Being an end-to-side anastomosis, there is typically a short, blind limb of jejunum just distal to the gastrojejunostomy in addition to the Roux limb. Endoscopists should be aware of variations such as the loop gastrojejunostomy, which was part of the original gastric bypass procedure. Another variation is in the length of the Roux limb, which typically measures approximately 60 to 75 cm but can be as long as 150 cm in the long-limb RYGBP. This limb should be examined (in patients with nausea and vomiting) to evaluate for evidence of obstruction, which can occur with adhesions or internal hernias.

Vertical banded gastroplasty

Endoscopy following VBG is relatively straightforward. The vertical lesser curvature channel permits easy endoscopic visualization. The stoma is located at the lower end of the channel, typically 7 to 8 cm distal to the gastroesophageal junction. The stoma should be approximately 10 to 12 mm wide, and endoscopically it may appear similar to the pylorus or the diaphragmatic narrowing of a hiatal hernia (Fig. 8A). After passing the endoscope beyond the stoma, complete examination of the unaltered

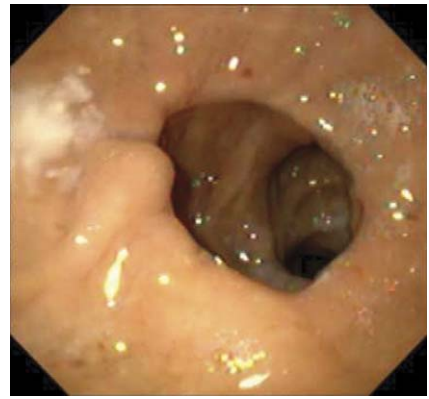

Fig. 7. Endoscopic appearance of a normal gastrojejunostomy after gastric bypass.

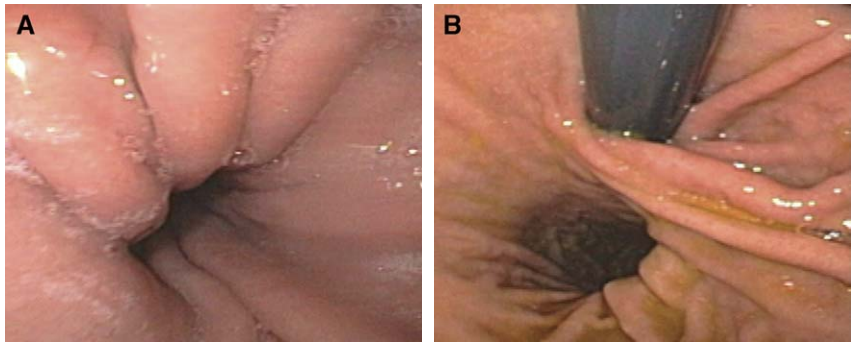

Fig. 8. (*A*) Endoscopic appearance of a normal stoma after vertical banded gastroplasty. (*B*) Retroflexed endoscopic view from the antrum after vertical banded gastroplasty.

antrum, pylorus, and duodenum can be performed. Retroflexion of the endoscope within the antrum reveals the gastric partition, greater curvature, and gastric fundus (Fig. 8B).

Common endoscopic abnormalities

Among symptomatic patients following RYGBP, the most common endoscopic abnormalities are marginal (anastomotic) ulcer, stomal stenosis, and staple line dehiscence [13].

Marginal ulcer

Marginal ulcers, which are defined as ulcers at the gastrojejunal anastomosis, occur in up to 16% of patients following RYGBP (Fig. 9) [31–34]. Their etiology remains unclear, but potential contributory factors include gastric acidity (especially in the presence of a staple line dehiscence and gastrogastric fistula), pouch orientation and size, nonsteroidal anti-inflammatory drug use, *Helicobacter pylori* infection, and local ischemia and tension at the anastomosis [33,35–38]. Marginal ulcers frequently are located on the jejunal side of the anastomosis, so special attention should be paid to this area during endoscopy. The detection of a marginal ulcer should prompt biopsies for *H. pylori* and a careful search for a gastrogastric fistula, both of which have been implicated in the formation of marginal ulceration [33,37].

Stomal stenosis

Stomal stenosis is another important complication of bariatric surgery, occurring in approximately 3% to 12% of patients following RYGBP, with reported rates as high as 27% following laparoscopic RYGBP [30,34,39–43].

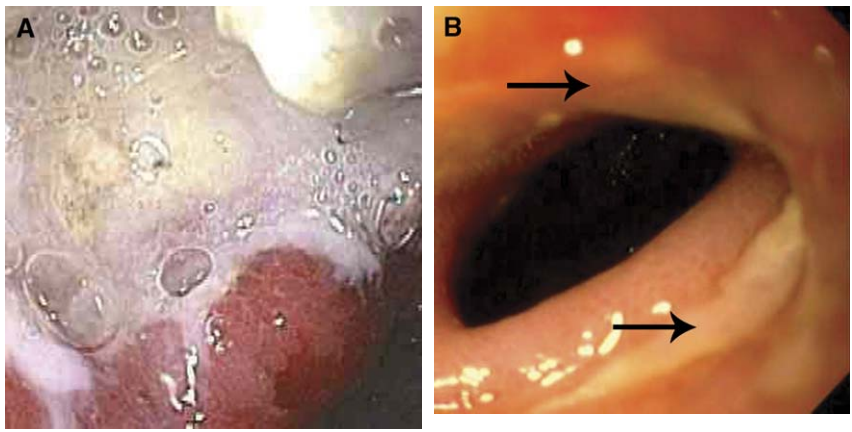

Fig. 9. (*A*) Endoscopic appearance of a large, clean-based marginal ulcer. (*B*) Endoscopic appearance of a marginal ulcer, encompassing 75% of the stomal circumference *(arrows)* and resulting in mild stomal stenosis.

In the authors' experience, after RYGBP, nearly 20% of symptomatic patients had some degree of stomal stenosis. Significant stomal stenosis is identified endoscopically as a pinhole orifice, precluding passage of the endoscope beyond the gastrojejunal anastomosis (Fig. 10). Other potential findings include gastric pouch dilatation, undigested food in the pouch, or foreign material (eg, phytobezoar) obstructing the stoma.

Endoscopic dilation by a variety of methods is safe and effective for treating stomal stenosis, and this reduces the need for revisional surgery.

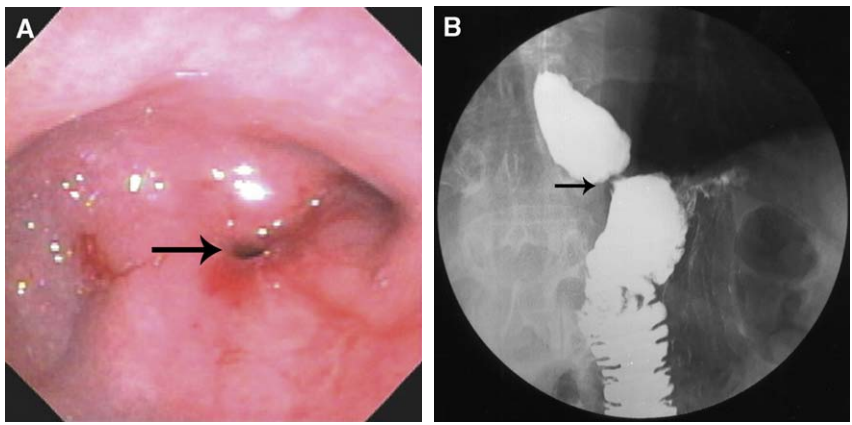

Fig. 10. (*A*) Endoscopic appearance of significant stomal stenosis after gastric bypass, resulting in a pinpoint stoma *(arrow)*. (*B*) Radiographic appearance of stomal stenosis after gastric bypass *(arrow)*.

Staple line dehiscence

Staple line dehiscence with gastrogastric fistula following RYGBP can be heralded by weight gain and may contribute to marginal ulcer formation. The incidence of staple line dehiscence following gastric bypass appears to be highly dependent on surgical technique, with rates over 20% when the pouch and bypassed stomach are stapled in continuity, compared with 1% when the segments are transected completely [32]. Dehiscences are frequently small and easily overlooked, and they may have an endoscopic appearance similar to that of a diverticulum (Fig. 11A). Barium studies are helpful in identifying small dehiscences (Fig. 11B). In contrast, large dehiscences are identified easily and may permit passage of the endoscope into the bypassed stomach and duodenum (Fig. 11C).

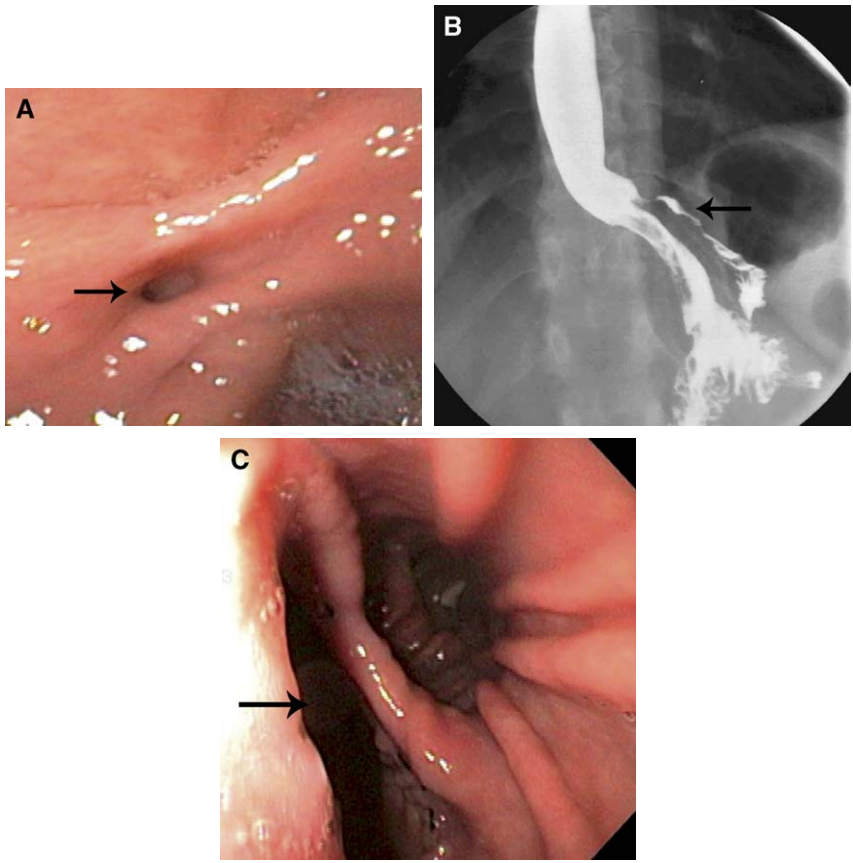

Fig. 11. (*A*) Endoscopic appearance of a small staple line dehiscence after gastric bypass *(arrow)*. (*B*) Radiographic appearance of staple line dehiscence with gastrogastric fistula *(arrow)*. (*C*) Endoscopic appearance of a large staple line dehiscence *(arrow)*, allowing easy access to the bypassed stomach.

Band erosion

Band erosion is a relatively uncommon complication of VBG and LASGB, occurring in approximately 1% to 2% of VBG patients and 1% to 11% of LASGB patients [44–46]. In VBG patients, band erosion may cause pain, but more often presents with weight gain and reduced restriction to food intake. Because of the tubing used for band insufflation, band erosion is a potentially serious complication after LASGB (Fig. 12), and this can result in pain, vomiting, bleeding, intra-abdominal abscess, or fistula formation [47]. As in VBG patients, sudden weight gain can occur with band erosion after LASGB; in many cases, the first sign of erosion is infection at the access port site by means of the connecting tube [45]. Therefore, erosion should be excluded at the first sign of port infection. Endoscopic removal of an eroded band can be performed [48], but surgical removal generally is recommended, as patients ultimately will require a repeat bariatric operation.

Therapeutic endoscopy in the bariatric surgical patient

Endoscopic dilation of stomal stenosis

Endoscopic dilation of stomal stenosis after bariatric surgery is safe, effective, and durable. It can be performed successfully by several methods, including balloon dilation, passage of dilators over a guide wire (Eder-Puestow, Savary-Guilliard), and endoscopic electrosurgical incision [34,39–42,49–55]. The optimal technique for dilation of stomal stenoses remains to be determined, but the authors prefer to use through-the-scope (TTS)

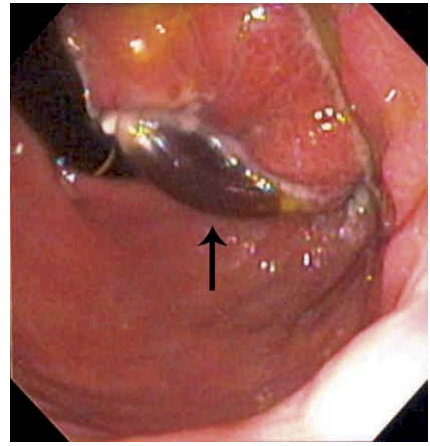

Fig. 12. Endoscopic appearance of band erosion after gastric banding. (*Courtesy of* Christine Ren, MD, New York).

balloon catheters whenever possible. The goal stomal diameter after dilation is 10 to 12 mm, up to a maximum of approximately 15 mm (45F) [47]. In a recent series using TTS balloons, nearly 60% of patients had complete symptomatic resolution after a single dilation session with a 15 mm balloon, suggesting that this size should be used initially [39]. Significant stenoses should be dilated gradually over several sessions using progressively larger balloons to reduce the risk of perforation. The incidence of perforation was 3% in a recent study in which the mean initial and final balloon size was 13 mm and 16 mm, respectively [55]. Overaggressive dilation should be avoided, not only to reduce the perforation risk, but also because of the concern that dumping symptoms and weight regain may occur as a result. Although there are reports of successful dilation to 18 to 20 mm without resulting in reoperation for weight regain [39,50], the authors recommend performing serial dilations up to a maximum of 15 mm using TTS balloons. Endoscopists should exercise caution when passing TTS balloon catheters through a tightly strictured stoma, recognizing that there is a short blind loop of jejunum beyond the gastrojejunostomy. A guide wire should be used when the TTS balloon catheter cannot be advanced with ease.

Endoscopic therapy for acute gastrointestinal bleeding

The management of acute GI bleeding in the early postoperative period is often challenging because of the inaccessibility of the excluded stomach and the jejunojejunostomy and the risks associated with early postoperative endoscopy. Some have advised against using therapeutic endoscopy in this setting, given the risk of perforation at the surgical anastomoses [16]. There are isolated reports of safe and effective therapeutic endoscopy for managing early GI bleeding after RYGBP [56,57]. Early reoperation with intraoperative endoscopy (or laparoscopy-assisted enteroscopy), however, is considered the preferred management approach in patients who fail conservative therapy [16,58].

Late GI bleeding commonly is caused by a marginal ulcer, which can be managed endoscopically using standard hemostatic interventions such as injection, thermal, and mechanical therapy.

Endoscopic management of staple line dehiscence, gastric fistulas, and dilated stomas

Staple line dehiscence complicating RYGBP and VBG generally requires surgical revision, and experience with endoscopic closure is limited. Local injection of sodium morrhuate surrounding the area of dehiscence was not effective in a small series of VBG patients [59]. A more promising, but technically difficult technique employs a combination of endoscopic suturing, hemoclip application, and argon plasma coagulation. In a preliminary study, Thompson et al achieved complete staple line closure in six

of eight RYGBP patients using this method, resulting in symptom improvement and cessation of weight gain [60]. Additional experience and clinical trials with long-term follow up are necessary before endoscopic closure of staple line dehiscence can be recommended routinely.

Successful closure of gastrocutaneous fistulas after bariatric surgery (VBG and BPD) using endoscopic fibrin sealant injection has been reported [61]. It is not known whether this technique can treat staple line dehiscence with gastrogastric fistula successfully. In the authors' experience with several patients, the use of fibrin sealant in combination with argon plasma coagulation and hemoclips did not result in long-term gastrogastric fistula closure.

An excessively dilated stoma resulting in weight gain after gastric bypass can be managed endoscopically with sodium morrhuate injection in four quadrants surrounding the stoma. In a small series published in abstract form, this technique resulted in a decrease in stomal size (to 12 mm or less) and resumption of weight loss in five of eight (63%) gastric bypass patients [59].

Endoscopic retrograde cholangiopancreatography

Performing endoscopic retrograde cholangiopancreatography (ERCP) in RYGBP patients is an arduous task, but it can be accomplished by several methods [62]. Using an enteroscope or pediatric colonoscope, Elton et al reported an 84% success rate in patients who had undergone a long-limb surgical bypass, including three RYGBP patients [63]. The investigators noted several disadvantages with this technique, however, including the lack of ERCP accessories compatible with the enteroscope, the lack of an elevator, and the limitations of forward-viewing endoscopes in performing biliopancreatic therapy. Wright et al described successful ERCP in 6 of 11 (55%) RYGBP patients by implementing maneuvers such as advancing the duodenoscope over a stiff guide wire previously placed into the bypassed stomach with a forward-viewing endoscope, or pulling up the duodenoscope by means of a wire-guided biliary balloon anchored at the pylorus [64]. The main reason for failure was inability to advance the duodenoscope through the biliopancreatic limb to the region of the papilla.

An alternative technique involves establishing percutaneous access to the bypassed stomach by means of a surgical gastrostomy, through which the duodenoscope is passed [64–66]. The advantages of this method include rapid, reliable access to the duodenum and visualization of the papilla in the usual anatomic orientation for ERCP.

Summary

Endoscopy in the bariatric surgical patient presents a new challenge for gastroenterologists, one that will be encountered with increasing frequency as the performance of bariatric surgery increases. To ensure a safe, successful,

and useful endoscopy, it is important to be familiar with the expected postsurgical anatomy and endoscopic appearance after the various bariatric operations and common complications that can arise.

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