The Role of Endoscopy in the Treatment of Obesity: Current and Future Concepts

by Justin T. Kupec, Stephan U. Goebel, Ehab Akkary

INTRODUCTION

Multidisciplinary patient care has become the expectation and the norm. With the advent of Natural Orifice Transluminal Endoscopic Surgery (NOTES), the envelope between surgery and advanced endoscopy continues to be pushed. As we move toward a new era in endoscopy, the previously laid foundation has proven to be a great starting point for the emerging field of endoscopic treatment of obesity. This article provides a review of the current and emerging state of endoscopic management of obesity as it pertains to bariatric surgery. We discuss the pre-operative evaluation, management of complications from bariatric surgery (including failed surgery) and procedures that may be performed in lieu of primary bariatric surgery. For the first time, patients now have an array of non-surgical options. As endoscopists, we are fortunate to be a part of this exciting and evolving field, and we should look forward to the advances that are to come.

BACKGROUND

In the 1960s and 1970s, as bariatric surgery was gaining momentum with the refinement of the now abandoned jejunoileal bypass (1,2), only a small segment of the adults in the United States were considered obese [with the definition of obesity as a body-mass index (BMI) \( \geq 30 \text{ kg/m}^2 \)]. Currently, according to the Center for Disease Control, two-thirds of the U.S. adult population is overweight, roughly one-third are considered obese and more than three million are morbidly obese (BMI \( \geq 35 \text{ kg/m}^2 \)). Perhaps even more worrisome is the rising trend of obesity in children. While healthcare cost is the major means of quantifying the impact of obesity (estimated at 100 billion dollars annually), other parameters such as the increased risk of comorbidities like gastroesophageal reflux (GERD), biliary disease, gastrointestinal cancer, non-alcoholic fatty liver disease (NAFLD) and non-alcoholic steatohepatitis (NASH) should be considered (3).

The number of bariatric surgeries performed over the past decades has increased exponentially, with an estimated 800% increase from 1998 to 2004 (4). Less than 1% of patients that meet the criteria for surgery for obesity actually undergo a procedure (5). More surgical options also exist for patients, and the trend toward minimally invasive or laparoscopic procedures has become routine. Although the technically simple vertical banded gastroplasty (VBG) has lost favor due to poor long-term weight loss, gastric bypass (open or laparoscopic), sleeve gastrectomy and adjustable gastric banding (AGB) have become common.

In spite of the large number of morbidly obese patients who may benefit from bariatric surgery, risk stratification for many of these patients may pose a prohibitive risk from their gaining access to surgical intervention for weight loss. To combat this, newer surgical modalities, greatly reducing the amount of...
operating room time and anesthesia exposure, have gained popularity. These procedures have greatly advanced the field of minimally invasive surgery and peroral therapy. This will allow endoscopists an opportunity to perform bariatric surgery and manage their own post-operative complications as well.

SURGICAL AND ENDOSCOPIC HISTORICAL PERSPECTIVE

For the majority (95%) of obese patients, the combination of diet and exercise alone fail to produce sustained weight loss. If weight loss is achieved, it is usually <10% of their body weight and the effects are short-lived. Many patients will seek further medical treatment that may include pharmacologic means such as sibutramine (Meridia®, Abbott, Chicago, Ill, USA) or orlistat (Xenical®, Roche Laboratories, Nutley, NJ, USA) which help to curb appetite or reduce fat absorption, respectively. Once these avenues are exhausted, options are limited with a surgical evaluation as a logical next step. However, few primary care providers refer their patients for bariatric surgery (6). Many of the surgeries available in the early days of bariatric surgery have not proven to be beneficial in the long run (i.e. no sustained weight loss) or the risks of the procedures out-weighed the benefits. This has established a barrier between primary care physicians and their patients receiving evaluations for surgical correction of their life-limiting disease. Most of these patients suffer from diabetes, hypertension, joint problems or a combination of these processes, most of which are managed by their primary care provider. Instead of avoiding bariatric surgery due to these comorbid conditions, patients should be referred for surgery as a means to treat them.

PRIOR BARIATRIC SURGICAL PROCEDURES

While a number of bariatric surgeries have been tried without success in the past, they have laid the groundwork for current practices. Some of the older procedures, such as jaw wiring, were abandoned as they provided minimal short-term weight loss and weight regain once reversed. Gastric partitioning, which utilized a smaller pouch separated by staple lines to decrease oral intake, was fraught with high failure and complication rates. Jejunointestinal bypass surgery, which produced weight loss by malabsorption, remained popular for many years despite the large numbers of risks. Vertical band gastroplasty (VBG) was popular in the 1980s, however, long term weight loss was not sustained and intolerance to the band was common (4,5).

OLDER APPROACHES TO THE ENDOSCOPIC TREATMENT OF OBESITY

Until recently, options for treating obesity endoscopically were limited to space-occupying devices deployed via upper endoscopy. Their deployment within the gastric lumen increases satiety and reduces oral intake thus leading to weight loss while in place. Gastric balloons have been in use since the 1980s. They are inserted into the esophagus after upper endoscopy is performed, filled to the predetermined size (with air or fluid) in the stomach and subsequently released. Unfortunately, however, due to the size of the balloon (filling capacity) and the actual make up of the balloon itself, earlier generations did not prove to be safe or effective enough for continued use (3,7). Today, these procedures and devices have been refined and modified, based on significant positive and negative trials, and their successors are safer and more effective.

CURRENT SURGICAL AND ENDOSCOPIC CONCEPTS

Collaboration between gastroenterologists and surgeons is important in the care of the bariatric patient. There are several stages of involvement of the gastroenterologist, each with its own unique challenges. Baseline knowledge of the types and techniques of currently performed surgeries for obesity is critical. A review of common bariatric surgeries allows the gastroenterologist the ability to understand the anatomy and changes that may be seen in post-operative endoscopy. This may allow the endoscopist to become familiar with systematic problems encountered and effective endoscopic resolutions based on the surgery performed (e.g. covered stent placement at a staple line in a Roux-en-Y gastric bypass (RYGB) patient). Additionally, it is important that the bariatric surgeon have full training in endoscopy as well.

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CURRENT BARIATRIC SURGICAL PROCEDURES

Early gastric bypass has undergone many changes and technical refinements since the first surgeries. Since the mid-1990s, the RYGB procedure, the most recent and refined bypass surgery, is the most widely performed bariatric surgery (Figure 1). In essence, a 20–30 mL gastric pouch (effectively bypassing the stomach), constructed by dividing the stomach with staples, feeds an alimentary limb that re-connects in the jejunum with the biliopancreatic limb via a side-to-side anastomosis. This procedure can be done with an open or a much more favorable laparoscopic approach. If necessary, an adjustable band may be placed around the gastric remnant for further weight loss. In RYGB, the main methods of weight loss are a combination of reduced oral intake and mild malabsorption (4). As with other bariatric surgeries, the involvement of leptin, ghrelin, glucagon-like peptide (GLP) and glucose-dependent insulinotropic polypeptide (GIP), is important. Leptin (long-term) and ghrelin (short-term) are key in maintaining energy balance, as GIP and GLP are incretins that regulate insulin secretion. Life-long vitamin supplementation is necessary.

Laparoscopic adjustable gastric banding (LAGB) consists of forming a 30 mL pouch in the proximal stomach (just distal to the gastroesophageal junction) by an adjustable band (Figure 1). The effect is to produce a small reservoir for food thus greatly reducing the amount of oral intake due to early satiety. LABG has been proven more effective than VBG due to the ability to adjust the band as needed (4).

Biliopancreatic diversion (BPD) was introduced nearly 40 years ago. The surgery consists of removing more than two-thirds of the stomach with the reattachment of an alimentary limb within the ileum. While weight loss was sufficient (up to 70% excess weight shed with decent sustainability), ulcers and steatorrhea were encountered due to a shorter transit time of undigested food and bile to the colon. Duodenal switch (BPD/DS) was added to reduce the risk of ulcers and dumping syndrome and it is the most current version of the surgery (Figure 1). The procedure consists of producing a sleeve gastrectomy with the lesser curvature of the stomach keeping the duodenum intact to connect with the jejunum; the biliopancreatic limb is an ileoduodenostomy. Weight loss is from a combination of gastric restriction, hormonal effects and malabsorption (4).

Sleeve gastrectomy (Figure 1) has proven to be beneficial as a primary bariatric surgery by decreasing gastric volume and decreasing ghrelin, thus exhibiting some hormonal control as well. Sleeve gastrectomy, now a primary surgical procedure, was performed initially as a preliminary surgery prior to RYGB or duodenal switch. The majority of the stomach is removed with the formation a “tube” that connects the esophagus to the duodenum. With its overall lower risk of complications, it is a favorable surgery in the most obese patients. From the gastroenterologist’s perspective, sleeve gastrectomy allows for easier post-operative endoscopy, but if the sleeve is large, stent placement may be difficult (4,8–10).

PRE-OPERATIVE ENDOSCOPIC EVALUATION

Typically driven by patient symptomatology, the pre-surgery evaluation for the bariatric patient may include upper endoscopic evaluation. As with any patient presenting with refractory reflux symptoms, endoscopy is usually warranted. The finding of gastric or duodenal ulcers or other pathology will allow the appropriate amount of time for the patient to heal before undergoing their bariatric procedure. In asymptomatic patients who do not warrant pre-operative endoscopy, Helicobacter pylori screening should be performed and treated if positive. It is also important to evaluate for anatomical differences that may prohibit certain surgical procedures. For example, the presence of a hiatal hernia may prove to be a surgical challenge. While there is no mandate that all patients having bariatric surgery undergo endoscopy, most surgeons advocate pre-operative EGD because it will provide them with important information (11). At our institution, we routinely perform pre- and intra-operative EGD. While malignancy is not often found in routine pre-surgery endoscopy on asymptomatic patients, other pathology may be present. If pathology is found, similar to the symptomatic patient, the timing of surgery may be altered (11).

ANATOMICAL CONSIDERATIONS IN THE POST-OPERATIVE BARIATRIC PATIENT

The difference in anatomy in the post-operative patient is significant and, therefore, direct communication
with the surgeon or review of the operative report is warranted. If this is not possible, care should also be taken to obtain a quality history from the patient to determine the type of surgery performed as it may dictate changes in the endoscopic procedure.

For example, while the esophagus is routinely normal, variation in the size/length of the jejunal limbs can be seen. Portions of the upper gastrointestinal tract, previously accessible (e.g. stomach that may become an excluded remnant after a RYGB) may no longer be reached by standard endoscopic means. Attention should also be paid to the gastric pouch to assess for dilation or leaks especially in patients in whom staple lines are visible. The presence (or absence in the case of RYGB) of the ampulla will determine the feasibility for future endoscopic retrograde cholangiopancreatography (ERCP) (11).

**POST-OPERATIVE ENDOSCOPIC MANAGEMENT OF ROUTINE GI COMPLAINTS**

Endoscopy in the post-operative setting has proven beneficial over the years. For the most part, such requests are to help manage unforeseen complications such as marginal ulcers, stenosis, obstruction and other pathology. Patient symptomatology, for example with the rare
complaint of post-operative gastroesophageal reflux (GERD), typically drives the decision to perform post-procedure endoscopy. Nausea, vomiting and reflux are common in the post-operative setting and can usually be managed with lifestyle modifications or medical therapy. Certain clinical entities, such as food bolus impactions, however, are not routine and may be the source of the patient’s symptoms. Therefore, the decision to perform an upper endoscopy typically hinges on persistence of symptoms despite appropriate therapy.

ADDRESSING POST-OPERATIVE COMPLICATIONS VIA ENDOSCOPY

Healing in the immediate post-operative setting is vital to a patient’s operative success. Steps should be taken to reduce or eliminate anything that prolongs recovery, such as an additional surgical revision or post-operative infections. Every attempt should be made to allow patients to begin improving their nutritional status. Of patients that undergo bariatric surgery, 1%–27% experience post-operative complications with a dramatic decrease in the 30-day morbidity in recent years. These complications are usually either anastomotic strictures or leaks in the first days to months after surgery (12,13). Bleeding is also seen post-operatively as well. It is usually along staple lines and is sometimes precipitated by the use of anticoagulation. Often therapeutic endoscopic measures (e.g. balloon dilation, stent placement, endoclip placement) are necessitated in this time period (14). The challenge of endoscopically reaching the separated gastric remnant remains.

While the underlying pathology of anastomotic strictures is not fully understood [i.e. technique (large pouch), smoking, ischemia, retained sutures, etc.], they are common in patients presenting with dysphagia and vomiting within the first 90 days after Roux-en-Y surgery. Endoscopic balloon dilation with a large diameter (ranging to 18 mm) through-the-scope (TTS) balloon remains the initial treatment method for symptomatic strictures. A recent review by Ryskina, et al shows successful resolution of anastomotic strictures after one dilation in two-thirds of their patients with less than 10% of patients requiring three or more dilations. The use of a larger TTS balloon reduced the need of additional dilations (13). Ukleja, et al performed balloon dilation on 61 patients with GJ strictures and 72% needed more than one session. They did experience perforation, the most feared complication of any dilation procedure, in three patients. This stresses the importance of considering the clinical scenario and endoscopist’s comfort level in performing the procedure with every case (15). Stents can be used in stenoses refractory to balloon dilation (16).

Stomal stenosis is another condition that can be treated with balloon dilation or Savary-Gilliard bougies. While often taking more than one session for complete resolution of the stenosis, dilation has been proven reasonably safe and effective for this pathology (17,18). Catalano, et al and Go, et al showed that an average of just over two sessions of dilation in 26 and 38 post-RYGB patients, respectively, were needed to reduce the need for additional surgical management (17,19). They suggest dilations be performed serially at two to three week intervals until appropriate diameter is achieved. Few, if any, complications were observed during these studies, and balloon dilation is considered safe for stricture treatment post surgery. If using Savary-Gilliard bougies for stomal stenoses, typically less than two treatments are necessary to achieve success with low complication rates (20).

The use of self-expanding stents (SES) has become an evolving method of endoscopic therapy in bariatric patients over the last several years. Endoscopic placement of an enteric stent offers a much less invasive means of repairing a post-op complication. Commonly, stents are used for anastomotic leaks, fistulas and strictures. Consideration must be given for stent migration (30% of patients or more [13,21,22]) and perforation as the main complications; however, data on successful migrated stent retrieval exists and can be performed with various methods.

SES are usually covered (CSES) and can either be plastic or metal. The procedure performed, the pathology seen and the location of the lesion dictates the type and location of stent placement. For example, staple lines usually pose the highest risk for anastomotic leaks. Eubanks, et al showed success with acute post-op leaks (treated within one day of diagnosis), chronic fistulas (persisting more than one month) and stricture with placement of covered stents (16). Symptomatic (continued on page 28)
improvement in 90% of all comers was experienced and healing time was improved as well with early introduction of oral nutrition. Significant stent migration (58%), however, was also seen. The use of SES is not just limited to RYGB patients or GJ leaks. Successful outcomes in duodenal switch and gastric sleeve patients as well as in gastroesophageal (GE) leaks have been reported (23,24).

Similarly, covered stents are helpful in the setting of gastric fistulas. Enterocutaneous fistulas can occur as a complication of gastric bypass surgery and can cause significant morbidity and mortality. Several case reports and smaller studies have shown improved healing, reduced sepsis and better outcomes in patients that have had covered stents placed endoscopically (25–28). Covered stents offer patients a non-surgical option (and an option for poor surgical candidates) for fistula repair.

The complications that patients face further out from bariatric surgery can be different from the initial post-operative setting. Endoscopic management of these problems has also been attempted with the same goal: to reduce the number of surgical procedures required for patient healing. For example, chronic leaks and fistulas (present for greater than a month) have also been shown to be amenable to non-surgical treatment. Kriwanek, et al extrapolated the use of CSES to fistula repair in the chronic post operative setting (28). Placement of a CSES in a patient who was more than two months removed from their operation spared them from an additional surgery. In another series, two patients that underwent stenting for chronic fistulas both exhibited healing in an average of 30 days, with good long-term follow-up (29). Unfortunately, success is not uniform as some small case series have shown stent failure and subsequent need for surgical intervention (16,30).

Problems and complications arising from the older bariatric procedures still pose management challenges for the gastroenterologist today. For example, known complications of gastric banding are slippage and erosion of the band through the gastric lumen. Patients with this complication may present with abdominal pain, bleeding, nausea and vomiting and would warrant initial endoscopic evaluation. While the majority of these patients will require surgical repair, endoscopy is still the initial step in the treatment algorithm.

OPTIONS FOR ENDOSCOPIC REPAIR OF FAILED BARIATRIC SURGERY

Failed bariatric surgery can be defined as significant weight regain after initial loss. It is proposed that some of this regain is due to dilation of previously formed gastrojejunal (GJ) anastomoses. Thompson, et al have suggested that plication of these anastomoses may allow patients to re-establish their baseline weight loss (31). In a small subset of patients that had significant weight regain after RYGB, endoscopic management of dilated gastrojejunal (GJ) anastomoses with the Bard EndoCinch Suturing System® (C.R. Bard, Inc., Murray Hill, NJ) was performed with good results. In a retrospective case series, Catalano, et al also looked at 28 patients with weight regain after bypass surgery (thought to be from stomal dilation). Nearly two-thirds of the patients treated with an average of 2.3 sessions of sodium morrhuate achieved a significant loss in the weight that was regained (32).

Mullady, et al also propose an endoscopic procedure, Revision Obesity Surgery Endoscopic (ROSE), with the goal of reversing weight regain in patients without subjecting them to more surgery. The procedure, performed on 20 patients (95% of whom are female), involves tissue approximation and subsequent suturing thus reducing the GJ anastomosis and shortening the gastric pouch (33). While there is no long term assessment of patient follow-up yet, the study shows 85% feasibility with significant reduction of the GJ anastomosis and pouch length (34).

One of the major hurdles in achieving full endoscopic management of obesity is the ability of gastroenterologists to manage their own complications. As described above, CSES have an established role in post-operative management of bariatric surgery, but the use of endoclips may allow a glimpse of what may be to come. Tang, et al report a successful repair of a balloon dilation of a stomal stenosis that resulted in a mucosal tear. A patient, roughly two months post-op, experienced symptoms of dysphagia that warranted upper endoscopy. After balloon dilation, the mucosal tear that was observed was repaired with four endoclips (35). Merrifield, et al have also exhibited the utility of endoclips [TriClip® (Cook Endoscopy, Wilson-Cook, Winston-Salem, NC), Quick Clips® (Olympus America, Inc, Melville, NY) and Resolution
Clips® (Microvasive Endoscopy, Boston Scientific Corp, Natick, Mass) in bariatric surgery patients by endoscopically repairing significant, chronic fistulas in two patients in their case series (36).

Fibrin glue (Baxter, Deerfield, IL), was utilized in the second patient of Merrifield’s series as well as a third patient in combination with multiple stents. While the use of fibrin glue is not new, its application to bariatric surgery is relatively recent. This agent, as well as other “acellular” agents, have proven beneficial when used in conjunction with stents and additional supportive care. Several case series illustrate the importance of using fibrin glue, endoclips or fistula plug as supplemental therapy for persistent leaks. There is also utility in sealing residual leaks (even after several sessions of stent placement) in patients that have had complications from numerous types of bariatric surgery (26,27,37).

FUTURE ENDOSCOPIC CONCEPTS

While non-surgical options for the treatment of obesity in the 1980s were limited, the growth of endoscopy has afforded us with a future of possibilities. Primary endoluminal treatment of obesity is still in its infancy, but huge strides have been made to get where it is today. The future of endoscopic management will likely combine elements of preliminary procedures (e.g. endoscopic placement of an intragastric balloon for weight loss in conjunction with subsequent RYGB) with primary endoscopic procedures (e.g. transoral gastroplasty). The goal will be to perform endoscopy for the treatment of obesity instead of bariatric surgery, regardless of invasiveness. The final step will be advancements in managing complications from endoscopic procedures.

Intragastric Balloon

A combination of past, present and future therapy, intragastric balloons serve as physical mechanisms to curb pre-meal hunger, assist with early satiety and provide short term weight loss (38). These devices are usually used in conjunction with rigorous diet/exercise and behavior modification. Two of the three available intragastric balloons, the BioEnterics Intragastric Balloon® (BIB) (BioEnterics Corporation, Carpinteria, CA) and Heliosphere Bag (Helioscopic Medical Implants, France), are placed and checked entirely endoscopically.

The BIB (Figure 2) is currently only available in an international market. The device, which is fluid filled, has been used in tens of thousands of patients (38,39). The other two intragastric balloons available are air filled [Heliosphere Bag® and Adjustable Totally Implantable Intragastric Prosthesis® (ATIIP) or Endogast® (Districlass Medical SA, France), Figures 3 and Figure 4, respectively] and have had varied amounts of success. These have been more prone to failure and, interestingly, may require both endoscopic and surgical means for insertion (similar to a percutaneous gastrostomy placement) (40,41).

Prospective studies and large reviews have proven the BIB to be more effective at weight loss than diet/exercise alone and sham procedures (38,42–44). Dastis, et al show success (defined as >10% weight reduction from baseline at six months) in 24% of their patients with minimal adverse events to 2.5 years (38). The 2.5 year follow up is longer than some previous trials, but further studies are needed. Adverse events are not frequent, but balloon removal for intolerance (pain and vomiting), spontaneous deflation, gastrointestinal pathology (ulcers and erosions) and small bowel obstruction have occurred (43,44). While the BIB has shown promise of weight loss as a primary method of weight loss, more benefit is derived with
using the BIB as a precursor for bariatric surgery as weight regain can occur once removed (45).

**EndoBarrier**

Adapted from the porcine and rat models, the most recent derivation of the endoluminal sleeve may soon be ready for widespread human use (46,47). Designed to function as an impermeable barrier that restricts caloric intake, the EndoBarrier System® (GI Dynamics, Lexington, MA, USA) is currently FDA approved for clinical trials. Deployed, and retrieved, endoscopically under fluoroscopy, the system is anchored proximally in the duodenum by a barbed, self-expanding...
The 60-cm sleeve extends as a sheath to the jejunum thus effectively creating an intestinal bypass (Figure 6). While still in the initial stages of development, there is promise of weight loss in combination with lifestyle modifications (5,48).

### Endoluminal Vertical Gastroplasty or Transoral Gastroplasty

Perhaps the most promising of all endoscopic therapies for obesity is endoluminal vertical gastroplasty (EVG) or transoral gastroplasty (TOGA). A not-too-distant relative of the now abandoned vertical banded gastroplasty, this procedure is still in the very early stages of development. Initially evaluated in a porcine model, several derivations and changes have been made to the first procedures (49,50). TOGA is similar to the endoscopic suturing that has been used in the past to provide anti-reflux relief in patients with GERD (51). The concept is such that a flexible endoscope is passed in the normal fashion and another device, such as a “sewing machine” or linear suturing system, is used in tandem. Done under general anesthesia and with a surgeon present, the 45-minute procedure establishes a continuous suture line on alternating sides of the stomach in a zipper pattern (52). The goal of TOGA is to create a smaller gastric pouch that functions by limiting oral intake.

Long term success, as measured by sustained weight loss at 12 or 18 months, has been shown in studies on adults and children by Fogel, et al (52,53). The preliminary reports of their trials in Venezuela showed that their procedure, utilizing EndoCinch®, can be effective and safe. No serious adverse events were noted, and significant weight loss was seen.

Until recently, TOGA was not performed in the United States. Most of the larger studies involve patients in Belgium and China (49,54,55). The results of these studies were encouraging and showed good feasibility which paved the way for further trials. The first case of TOGA in the United States was performed in early 2009 by Dr. Gregory Cote. The case was featured in the DA VE Project Endoscopy Atlas (www.daveproject.org). Similar in theory to the TOGA procedures by Fogel, a series of two staplers was used to successfully create a restrictive pouch in this case. While long-term follow-up is not available yet, the patient had lost nearly 30 pounds and was doing well clinically at three months (56).

### CONCLUSION

The epidemic of obesity is here to stay and the field of bariatric surgery has proven to be effective in combatting this problem. Advances in surgical techniques and instrumentation have moved minimally invasive and endoscopic procedures to the forefront of technology. These procedures, in the motivated patient, have offered successful non-operative alternatives. Table 1

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**Table 1**

Summary of the endoscopic options for early and late surgical complications of bariatric surgery.

<table>
<thead>
<tr>
<th>Surgical Complication</th>
<th>Primary Endoscopic Intervention</th>
<th>Secondary Endoscopic Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early</td>
<td>Bleeding, Leak, Fistula, Stomal or Anastomotic Stricture</td>
<td>Endoclip, Covered stent, Balloon or bougie dilation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fibrin glue, Fibrin glue, Fibrin plug, Stent</td>
</tr>
<tr>
<td>Late</td>
<td>Fistula, Leak, Stomal or Anastomotic Stricture</td>
<td>Covered stent, Balloon or bougie dilation</td>
</tr>
<tr>
<td></td>
<td>Stomal Dilatation (weight regain)</td>
<td>Fibrin glue, Fibrin plug, Stent</td>
</tr>
<tr>
<td></td>
<td>Gastric Band Slippage/Erosion</td>
<td>Fibrin glue, Fibrin plug, Stent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ROSE procedure</td>
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nittingol stent (Figure 5). The 60-cm sleeve extends as a sheath to the jejunum thus effectively creating an intestinal bypass (Figure 6). While still in the initial stages of development, there is promise of weight loss in combination with lifestyle modifications (5,48).
offers a summary of endoscopic options available to manage post-operative complications arising from bariatric surgery. As gastroenterologists, we now have the unique opportunity of being able to not only watch this field mature but to apply our endoscopic skills to improve outcomes in the morbidly obese patient.

Practical Points

- The evolution and expansion of the role of endoscopy in the management of obesity is rapidly progressing
- Dilation of anastomotic or stomal stenoses, a relatively common complication of gastric bypass surgery, can safely be performed with TTS balloons or bougies
- Covered self expanding stents, fibrin glue and plugs offer the endoscopist alternatives for management of acute and chronic fistulas and leaks
- Several means of endoscopically plicating an enlarged anastomosis (common cause of weight regain) exist
- Future means of primary endoscopic treatment of obesity may include intragastric balloons, the Endo-Barrier and TOGA

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