Notable Grand Rounds

of the

Michael & Marian Ilitch
Department of Surgery

Wayne State University
School of Medicine

Detroit, Michigan, USA

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Daniel Matienzo, MD

BARIATRIC SURGERY AND ITS FUTURE

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March 4, 2026

About Notable Grand Rounds

These assembled papers are edited transcripts of didactic lectures given by mainly senior residents, but also some distinguished attending and guests, at the Grand Rounds of the Michael and Marian Ilitch Department of Surgery at the Wayne State University School of Medicine.

Every week, approximately 50 faculty attending surgeons and surgical residents meet to conduct postmortems on cases that did not go well. That "Mortality and Morbidity" conference is followed immediately by Grand Rounds.

This collection is not intended as a scholarly journal, but in a significant way it is a peer reviewed publication by virtue of the fact that every presentation is examined in great detail by those 50 or so surgeons.

It serves to honor the presenters for their effort, to potentially serve as first draft for an article for submission to a medical journal, to let residents and potential residents see the high standard achieved by their peers and expected of them, and by no means least, to contribute to better patient care.

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Bariatric Surgery and Its Future

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WSU/DMC Grand Rounds

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Editor's Note: This is an edited summary of a Grand Rounds talk given by Dr. Matienzo on March 4, 2026 at the Ilitch Department of Surgery, Wayne State University School of Medicine.

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Introduction

Severe obesity, historically referred to as morbid obesity, represents one of the most pressing public health challenges of modern medicine. The condition is commonly defined by several criteria: body weight exceeding ideal body weight by 100 pounds, body weight that is twice the ideal body weight, or a body mass index (BMI) of 40 kg/m² or greater. Ideal body weight calculations traditionally estimate 106 pounds plus 6 pounds for every inch above five feet in men, and 100 pounds plus 5 pounds for every inch above five feet in women. BMI, calculated as weight divided by height squared and multiplied by 703 in U.S. units, remains the standard clinical metric for classification of obesity severity.

Severe obesity is characterized not only by excess adiposity but also by persistent hunger that is not satiated by amounts of food that would satisfy individuals without obesity. This physiologic dysregulation underscores the biological complexity of obesity and the limitations of lifestyle interventions alone in many patients.

In evaluating outcomes after bariatric surgery, two primary measures of weight reduction are commonly used. Percent excess weight loss (%EWL) is defined as the proportion of excess body weight lost relative to ideal body weight, calculated as:

$$\%EWL = \frac{(\text{Preoperative Weight} - \text{Current Weight})}{(\text{Preoperative Weight} - \text{Ideal Body Weight})} \times 100$$

Alternatively, percent total weight loss (%TWL) is calculated as the percentage reduction in total body weight:

$$\%TWL = \frac{(\text{Preoperative Weight} - \text{Current Weight})}{\text{Preoperative Weight}} \times 100$$

Recent literature increasingly favors the use of total weight loss as a metric of surgical success, as it is less influenced by baseline BMI and may more accurately identify treatment responders.

BMI categories provide the standard framework for defining obesity severity. Individuals with BMI values between 18.5 and 24.9 kg/m² are considered to have normal weight, while those with BMI between 25 and 29.9 kg/m² are classified as overweight. Obesity itself is subdivided into Class I (BMI 30–34.9), Class II (BMI 35–39.9), and Class III (BMI ≥40), the latter corresponding to severe obesity. (Table 1)

Epidemiologically, obesity has reached alarming prevalence in the United States. Nearly 40% of the adult population meets criteria for obesity, and approximately 9.7% of adults fall into the category of severe obesity. The condition is associated with significant morbidity and mortality and represents the second leading cause of preventable death after cigarette smoking.

The impact of severe obesity on life expectancy is substantial. For example, a 40-year-old man with severe obesity may experience a reduction in life expectancy of approximately nine years compared with a normal-weight individual. These data highlight the profound systemic consequences of obesity and emphasize the importance of effective treatment strategies.

Pathophysiology of Obesity

The pathophysiology of obesity reflects a complex interaction between genetic susceptibility, environmental influences, and neuroendocrine regulation of appetite and energy expenditure. Several genes have been implicated in the development of obesity, including the fat mass and obesity-associated (FTO) gene, which influences feeding behavior and energy balance. Another important genetic contributor is the melanocortin-4 receptor (MC4R) gene, the most common gene mutation associated with obesity. Mutations in MC4R can lead to increased fat mass, hyperphagia, and insulin resistance.

Category	BMI Range
Normal	18.9 to 24.9
Overweight	25 to 29.9
Class I, Obesity	30 to 34.9
Class II, Serious Obesity	35 to 39.9
Class III, Severe Obesity	40 and greater

Table 1. Body Mass Index categories and clinical definitions of obesity. *Source:* https://asmbs.org/condition_procedures/obesity/. Accessed March 10, 2026.

Hormonal regulation also plays a critical role. Among the most important appetite-regulating hormones is ghrelin, produced primarily by P/D1 cells located in the gastric fundus. Ghrelin is commonly referred to as the “hunger hormone.” Elevated ghrelin levels stimulate the release of neuropeptide Y and growth hormone, resulting in increased appetite and food intake. Surgical procedures that remove or bypass the gastric fundus therefore reduce circulating ghrelin levels and contribute to appetite suppression following bariatric surgery.

Beyond metabolic dysregulation, obesity is associated with a wide range of systemic diseases and malignancies. Epidemiologic studies have demonstrated increased risks of breast, gastric, esophageal, thyroid, colon, kidney, prostate, pancreatic, and gynecologic cancers in individuals with obesity. Chronic inflammation resulting from excess adipose tissue contributes to carcinogenesis in multiple organ systems.

Adipose tissue also acts as an endocrine organ. Increased peripheral adiposity enhances the aromatization of testosterone to estrogen, leading to elevated estrogen levels and increased risk of endometrial, ovarian, and postmenopausal breast cancers. Additionally, obesity-related gastroesophageal reflux disease

(GERD) may promote esophageal adenocarcinoma through chronic mucosal injury.

These complex pathophysiologic mechanisms illustrate why obesity is not simply a consequence of lifestyle factors but rather a chronic disease requiring multifaceted management strategies.

Medical Versus Surgical Therapy

One of the most influential investigations comparing surgical and nonsurgical treatment of obesity is the Swedish Obese Subjects (SOS) study, conducted between 2004 and 2012. This landmark prospective cohort study matched approximately 2,000 patients undergoing bariatric surgery with over 2,000 control patients treated with medical therapy alone and followed them for 10–20 years.

At 15-year follow-up, patients who underwent bariatric surgery demonstrated an average weight reduction of approximately 18%, compared with only 1% weight loss in the medically treated control group. More importantly, surgical treatment was associated with a 29% reduction in overall mortality, as well as significant reductions in myocardial infarction and cardiovascular events. Among diabetic patients, bariatric surgery produced an approximately 80% reduction in annual mortality compared with controls.

Subsequent studies have reinforced these findings. Investigations by Adams, Guidry, and others demonstrated earlier mortality differences—within three to five years—following Roux-en-Y gastric bypass. Additional studies have also shown that bariatric surgery improves or resolves many obesity-associated comorbidities, including hypertension, type 2 diabetes mellitus, obstructive sleep apnea, hyperlipidemia, and quality of life.

However, surgery is not without risks. Long-term observational studies have identified increased rates of suicide and self-harm among patients undergoing bariatric surgery, particularly following Roux-en-Y gastric bypass. These findings underscore the importance of thorough preoperative psychiatric evaluation and ongoing postoperative psychological monitoring.

Preoperative Evaluation and Patient Selection (Table 2)

Appropriate patient selection and careful preoperative evaluation are essential to achieving safe and effective outcomes in bariatric surgery. Historically, eligibility for surgical treatment was based largely on body mass index. Earlier guidelines recommended surgery for patients with BMI ≥40 kg/m² or BMI ≥35 kg/m² in the presence of obesity-related comorbidities such as diabetes, hypertension, or obstructive sleep apnea. Contemporary guidelines have broadened these criteria. Current recommendations generally include patients with BMI ≥35 kg/m² regardless of comorbidities, as well as selected patients with BMI between 30 and 34.9 kg/m² who have obesity-related metabolic disease. In individuals of Asian descent, BMI thresholds may be lower due to higher metabolic risk at comparatively lower body mass indices.

In addition to BMI criteria, patients are typically expected to demonstrate prior attempts at nonsurgical therapy, including supervised dietary programs or structured lifestyle modification. Candidates must also be psychiatrically stable, medically fit for surgery, and capable of understanding the operative procedure and its long-term consequences. Motivation and adherence to postoperative follow-up are critical determinants of success.

Preoperative evaluation is multidisciplinary and often involves a coordinated team including bariatric surgeons, primary care physicians, nutritionists, psychologists or psychiatrists, anesthesiologists, and other medical specialists as indicated. Comprehensive patient education forms a central component of the evaluation process. Patients are typically provided written educational materials and may attend informational seminars describing surgical options, expected outcomes, and potential complications.

Initial clinic visits commonly include group educational sessions addressing nutritional requirements both before and after surgery. Individual consultations with the surgical team and dietitians allow for personalized assessment and counseling. Routine laboratory testing is obtained to evaluate metabolic status,

micronutrient levels, and potential medical contraindications to surgery.

Subsequent evaluations may include a formal psychological assessment to identify psychiatric conditions that could interfere with postoperative adherence. Insurance authorization is frequently required prior to scheduling surgery. Additional testing may include flexible upper endoscopy to evaluate for structural abnormalities such as hiatal hernia or mucosal disease. In many centers, antral biopsies are obtained during endoscopy to rule out Helicobacter pylori infection, which may increase the risk of postoperative marginal ulceration and should be treated before surgery.

Other preoperative investigations may include abdominal ultrasonography to evaluate the gallbladder, arterial blood gas testing when indicated, and consultations with medical specialists for optimization of comorbid conditions. Once evaluation is complete, patients typically undergo final counseling with the surgical team, educational sessions with nurse coordinators, and preoperative anesthesia assessment prior to scheduling surgery.

Controversies in Patient Selection

Although BMI has historically served as the primary criterion for determining eligibility for bariatric surgery, some investigators have questioned whether BMI alone adequately predicts which patients will derive the greatest benefit from surgical intervention. Data from the Swedish Obese Subjects study suggested that BMI was not a reliable predictor of reductions in cardiovascular, diabetic, or cancer-related mortality following bariatric surgery.

Alternative metabolic markers have therefore been proposed. In particular, fasting hyperinsulinemia—reflecting insulin resistance—has been suggested as a potential predictor of favorable surgical outcomes. Elevated fasting insulin levels are associated with metabolic dysfunction and may identify patients most likely to experience improvements in cardiovascular risk factors, diabetes, and overall mortality following bariatric surgery.

Some authors have therefore recommended incorporating preoperative measurements of insulin and glucose metabolism into the decision-making process. However, despite these considerations, BMI remains the primary clinical metric used to guide patient selection in most bariatric programs.

Before the Clinic Visit
Documented, medically supervised diet
Counseling and referral from the primary care physician
Reading a comprehensive written brochure and / or attendance at a seminar regarding operative procedure: Xpected results, and potential complication:
Initial Clinic Visit
Group presentation on information in the booklet
Group presentation on preoperative and postoperative nutritional issues by the nutritionist
Individual assessment by the surgeon's team
Individual counseling session with the surgeon
Individual counseling session with the nutritionist
Screening blood test
Subsequent Events/ Evaluations
Full psychological assessment and evaluation as indicated
Medical specialist evaluations as indicated
Insurance approval for coverage of the procedure
Screening flexible upper endoscopy as indicated
Screening ultrasound of the gallbladder (if present)
Arterial blood gas analysis as indicated
Subsequent Clinic Visits
Counseling session with the surgeon (including selection of the date for surgery)
Education session with the nurse educator
Preoperative evaluation by the anesthesiologist
Final paperwork by the preadmissions center

Table 2. Components of comprehensive preoperative evaluation for bariatric surgery candidates. *Source:* Adapted from Townsend et al. (2021).

Surgical Options in Bariatric Surgery

Several operative techniques have been developed to treat severe obesity. The most widely performed procedures include **laparoscopic sleeve gastrectomy** and **Roux-en-Y gastric bypass**, although other procedures such as **biliopancreatic diversion**, **duodenal switch**, and **single-anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S)** are also used in selected cases.

Each of these is discussed in separate sections below, beginning with laparoscopic adjustable gastric banding (LAGB), which was widely performed during the early 2000s. However, its

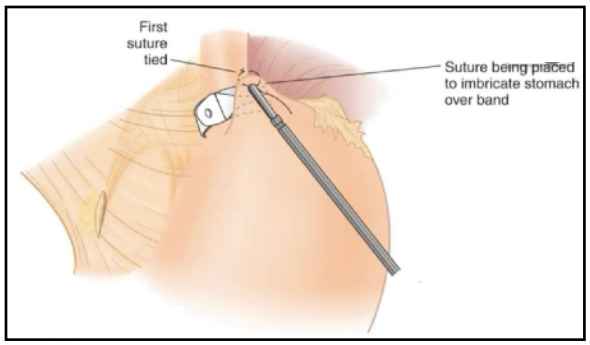

Fig. 1. Imbricating the anterior aspect of the stomach over the LAP-BAND. *Source:* Townsend et al. (2021).

popularity has declined significantly due to relatively poor long-term weight loss and higher reoperation rates. As a result, most contemporary bariatric practices have transitioned toward procedures such as sleeve gastrectomy and Roux-en-Y gastric bypass, which offer more durable metabolic outcomes.

Laparoscopic Adjustable Gastric Banding

Adjustable gastric banding involves placement of a silicone band around the proximal stomach to create a small gastric pouch and restrict oral intake. The procedure gained popularity in the early 2000s and reached its peak utilization around 2011, after which its use declined sharply. By 2017, gastric banding accounted for only approximately 2.8% of bariatric procedures performed in the United States.

The operation is technically straightforward and historically attracted interest because of its relatively low perioperative morbidity and mortality compared with more complex bariatric procedures. The surgical technique involves dissection of the angle of His followed by entry into the pars flaccida of the lesser omentum. A retrogastric tunnel is then created behind the stomach, through which the band is passed and secured using a locking mechanism. The anterior gastric wall is imbricated over the band to stabilize its position, and the band's access port is placed subcutaneously for postoperative adjustments. The band is typically positioned approximately 1 cm below the gastroesophageal junction.

Following placement, saline is not initially injected into the band. Gradual adjustments are made during follow-up visits by injecting small volumes of saline—typically 1 to 1.5 mL—into the subcutaneous port. These adjustments tighten the band and help achieve gradual weight loss, typically targeting approximately 1–2 kilograms per week.

Although gastric banding has a low incidence of nutritional deficiencies, several complications have limited its long-term success. Patients frequently experience dysphagia, regurgitation, heartburn, or aspiration. One potentially serious complication is band slippage, which may lead to gastric obstruction or strangulation and often necessitates urgent band removal. Radiographically, band position can be evaluated on plain radiographs. Normally the band appears between the two- and seven-o'clock positions; slippage may produce horizontal or vertical displacement.

Additional complications include esophageal dilation, band erosion into the stomach, and poor long-term weight loss. Some patients develop abnormal esophageal motility or pseudoachalasia after band removal. Due to these limitations, gastric banding has largely fallen out of favor, and many patients previously treated with gastric bands have undergone conversion to other bariatric procedures.

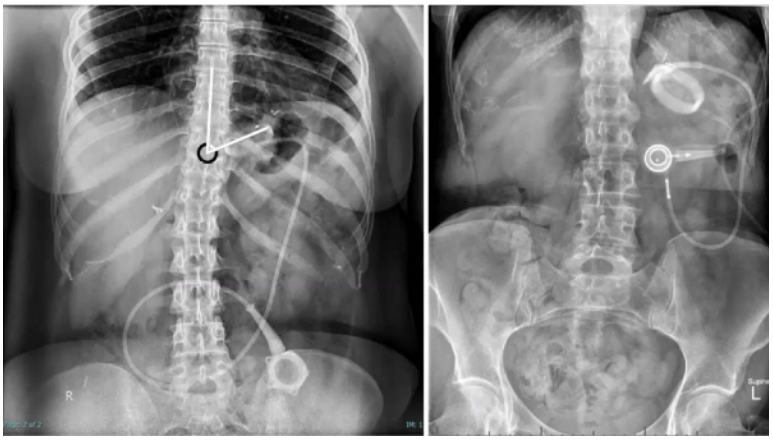

Fig. 2. Image on the left demonstrates a phi angle of greater than 45 degrees. Image on the right demonstrates the "O Sign" which both are radiographic signs of band slippage. *Source:* Sheikh Z, Weerakkody Y, Knipe H, et al. (2025, revised).

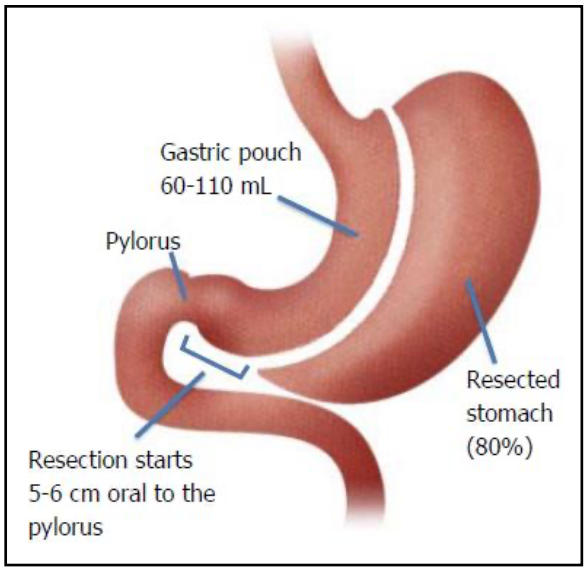

Fig. 3. Laparoscopic sleeve gastrectomy. *Source:* Benaiges D, Más-Lorenzo A, Goday A, et al. (2015).

Sleeve Gastrectomy

Laparoscopic sleeve gastrectomy has become the most frequently performed bariatric procedure in the United States. By 2017 it accounted for approximately 60% of bariatric operations nationally, reflecting its technical simplicity, favorable metabolic outcomes, and relatively low complication profile compared with more complex procedures.

The operation is primarily restrictive but also has important metabolic effects. Sleeve gastrectomy preserves the pylorus and maintains normal gastrointestinal continuity, thereby reducing the incidence of dumping syndrome compared with bypass procedures. In addition, removal of the gastric fundus significantly decreases circulating levels of ghrelin, the hormone responsible for stimulating appetite. This hormonal effect contributes to reduced hunger and improved long-term weight control following the operation.

Another advantage of sleeve gastrectomy is that it preserves the option for future conversion to other bariatric procedures if weight loss proves inadequate. Patients may subsequently undergo conversion to Roux-en-Y gastric bypass, biliopancreatic diversion, duodenal switch, or SADI-S if necessary.

Operative Technique

Sleeve gastrectomy begins with mobilization of the greater curvature of the stomach. The surgeon typically measures approximately 3–5 cm proximal to the pylorus, which marks the starting point for gastric division. The gastrocolic ligament is divided along the greater curvature, and the short gastric vessels are ligated as the dissection proceeds cephalad toward the angle of His. Full exposure of the left crus of the diaphragm is necessary to ensure complete mobilization of the fundus.

Once the stomach is fully mobilized, a bougie—commonly between 34 and 40 French in diameter—is introduced along the lesser curvature to calibrate the size of the gastric sleeve. Sequential firings of a linear stapler are then used to divide the stomach vertically along the bougie, thereby creating a narrow tubular gastric remnant. The resected portion of the stomach, including the fundus and most of the greater curvature, is removed.

The technical details of this first stapler firing are critical. If the stapler is placed too close to the incisura angularis, a functional narrowing may occur. This narrowing increases intraluminal pressure within the sleeve and predisposes the patient to staple-line leaks, one of the most feared complications of sleeve gastrectomy.

Outcomes and Metabolic Effects

Sleeve gastrectomy has demonstrated substantial efficacy in producing weight loss and improving obesity-related comorbidities. In addition to reducing body weight, the procedure has been associated with remission or significant improvement in conditions such as Type 2 diabetes, hypertension, and dyslipidemia.

Because the procedure does not bypass large portions of the small intestine, it produces less malabsorption of vitamins and minerals than operations such as Roux-en-Y gastric bypass or biliopancreatic diversion.

However, despite its advantages, sleeve gastrectomy is not without limitations. One of the most important considerations when selecting patients for this operation is the presence of gastroesophageal reflux disease (GERD).

Complications

Several complications may occur following sleeve gastrectomy. Early complications include infection, venous thromboembolism, and staple-line leaks. The earliest clinical sign of a leak is often tachycardia, which should prompt immediate evaluation. Fortunately, as surgical experience has increased and the procedure has become concentrated in high-volume bariatric centers, the incidence of leaks has decreased substantially.

Another important limitation is the potential for worsening GERD. Sleeve gastrectomy creates a relatively high-pressure gastric system, which can exacerbate reflux symptoms. Patients with severe GERD may therefore be better candidates for Roux-en-Y gastric bypass, which lowers intragastric pressure and diverts acid away from the esophagus.

Weight regain is another recognized issue. In some cases, insufficient weight loss or subsequent weight regain may necessitate conversion to another bariatric procedure such as gastric bypass or duodenal switch. Earlier studies suggested that larger bougie sizes used during the procedure contributed to higher rates of weight regain, leading many surgeons to adopt smaller calibration bougies in modern practice.

Roux-en-Y Gastric Bypass

Roux-en-Y gastric bypass (RYGB) remains one of the most extensively studied and widely performed bariatric operations. The procedure was first described in 1969 by Mason and Ito, who created a gastric pouch and anastomosed it to a loop of jejunum. However, the initial loop reconstruction produced bile reflux into the gastric pouch. Subsequent development of the Roux-en-Y reconstruction eliminated this reflux by separating biliopancreatic secretions from the gastric pouch, while maintaining excellent weight-loss outcomes.

Today, RYGB is one of the most commonly performed bariatric procedures worldwide. Historically the operation was associated with significant morbidity and mortality, but outcomes have improved dramatically with the adoption of minimally invasive approaches and concentration of bariatric surgery within high-volume centers.

Operative Principles and Technique

The fundamental components of Roux-en-Y gastric bypass include creation of a small gastric pouch, division of the proximal small intestine, and construction of a gastrojejunostomy (GJ) and jejunojejunostomy (JJ). The procedure combines restrictive and malabsorptive mechanisms to achieve durable weight loss.

The operation typically begins with laparoscopic or robotic access and placement of trocars. The hiatus is first evaluated, and any hiatal hernia is repaired prior to proceeding. The small bowel is then measured approximately 40–50 cm distal to the ligament of Treitz, and a marking stitch is placed to identify the future Roux limb.

Attention is then turned to creation of the gastric pouch. Dissection begins approximately 5 cm distal to the gastroesophageal junction, where a retrogastric tunnel is developed. A horizontal staple firing is performed, followed by sequential vertical staple firings toward the angle of His, creating a small proximal gastric pouch. A smaller pouch is associated with improved long-term weight loss and reduced risk of marginal ulceration, as larger pouches contain more parietal cells and generate increased acid secretion.

The omentum attached to the transverse colon is often divided to reduce tension on the gastrojejunostomy. The previously marked Roux

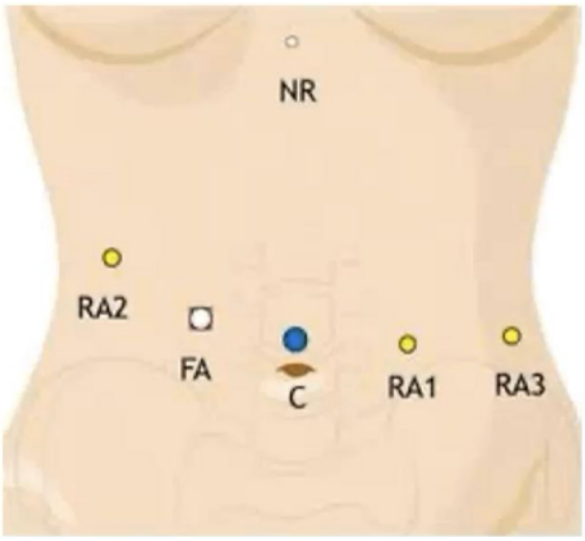

Fig. 4. Port placement and robotic configuration for minimally invasive Roux-en-Y gastric bypass
Source: Townsend et al. (2021).

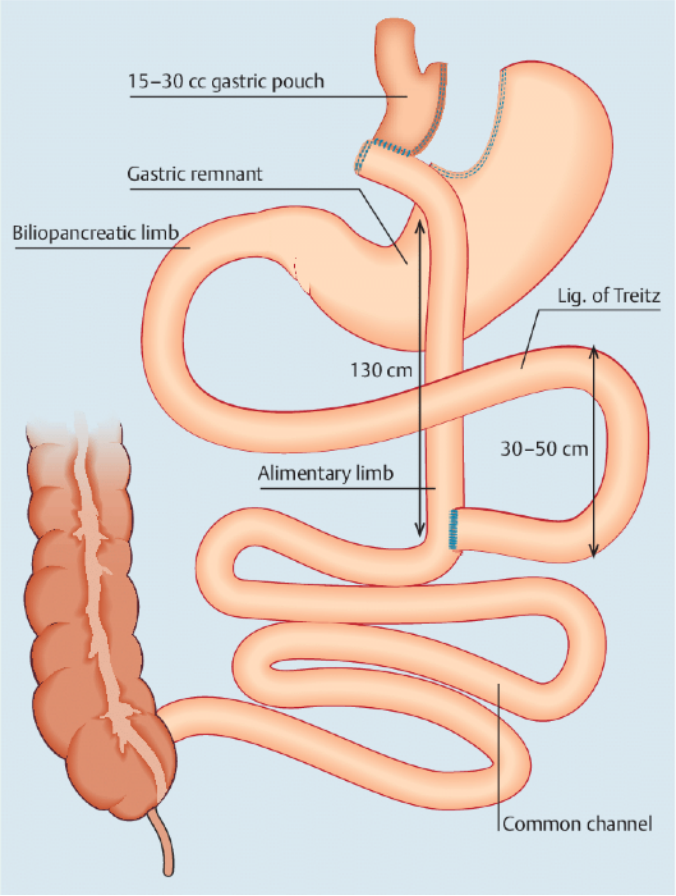

Fig. 5. Surgical anatomy of Roux-en-Y gastric bypass. *Source:* Townsend et al. (2021).

limb is then brought up to the gastric pouch using an antecolic approach, which minimizes mesenteric defects and reduces the risk of internal hernia formation.

A posterior gastrotomy is created, and the Roux limb is aligned with the pouch. After confirming bowel orientation, an enterotomy is made approximately 50 cm distal to the ligament of Treitz, and a gastrojejunostomy is constructed. A bougie is advanced across the anastomosis to calibrate the lumen before closure is completed.

The small bowel is then divided to establish the Roux limb. A leak test is performed using air insufflation and/or methylene blue to confirm anastomotic integrity. The jejunojejunostomy is subsequently created approximately 130 cm distal to the gastrojejunostomy, forming the alimentary and biliopancreatic limbs.

Finally, all mesenteric defects—including the Petersen defect and the mesenteric defect at the jejunojejunostomy—are closed to prevent internal hernias. Fibrin sealant may be applied to reduce the risk of anastomotic leakage.

Advantages of Roux-en-Y Gastric Bypass

Roux-en-Y gastric bypass offers several advantages compared with other bariatric procedures. Mortality rates for minimally invasive RYGB have been reported between 0.1% and 0.3%, reflecting the safety of modern surgical techniques.

The procedure also produces immediate improvement or resolution of gastroesophageal reflux disease. Creation of a small gastric pouch reduces acid production, while the Roux limb diverts gastric contents away from the esophagus, thereby relieving reflux symptoms.

Metabolically, Roux-en-Y gastric bypass has demonstrated superior outcomes compared with sleeve gastrectomy for remission of certain comorbidities, particularly type 2 diabetes mellitus and hypertension. These benefits are believed to result from both weight loss and hormonal changes affecting insulin sensitivity and gut signaling pathways.

Complications

Although outcomes are generally favorable, Roux-en-Y gastric bypass carries potential complications that must be recognized and managed appropriately.

Anastomotic leaks occur in approximately 0.5–1.5% of cases and most commonly arise at the gastrojejunostomy. Studies have shown that leak rates do not differ significantly between various anastomotic techniques, including circular stapled and linear stapled methods.

Venous thromboembolism is another important complication associated with bariatric surgery. Appropriate prophylaxis and early mobilization are therefore essential components of perioperative management.

Nutritional deficiencies may also develop after RYGB due to altered gastrointestinal anatomy. One particularly important deficiency is thiamine (vitamin B1) deficiency, which can lead to Wernicke encephalopathy characterized by confusion, ataxia, and nystagmus. Prompt recognition and immediate treatment with parenteral thiamine are critical to prevent irreversible neurologic injury.

Late complications may include bowel obstruction, anastomotic stenosis, and marginal ulcers. Anastomotic stenosis typically presents four to six weeks after surgery and is more commonly associated with circular stapled anastomoses. Treatment generally involves endoscopic balloon dilation.

Marginal ulcers occur in approximately 2–10% of patients. Risk factors include larger gastric pouch size, persistent acid secretion, smoking, and Helicobacter pylori infection. Because increased pouch size results in greater numbers of parietal cells, each additional centimeter of vertical staple height has been associated with a 14% increase in marginal ulcer risk.

Iron and vitamin B12 deficiencies may also develop because gastric bypass alters the normal absorption pathways for these nutrients. For iron supplementation, the gluconate form is often preferred because it is better absorbed in the relatively nonacidic environment of the bypassed gastrointestinal tract.

Comparative Outcomes of Sleeve Gastrectomy and Roux-en-Y Gastric Bypass

Both laparoscopic sleeve gastrectomy (LSG) and laparoscopic Roux-en-Y gastric bypass (LRYGB) have become standard bariatric procedures with well-established efficacy. Several randomized trials have compared the long-term outcomes of these two techniques, including the SLEEVEPASS and SM-BOSS studies, which provide five-year follow-up data on weight loss and metabolic outcomes. (Table 3)

These studies demonstrate that both operations produce substantial weight loss and improvement in obesity-related comorbidities. Roux-en-Y gastric bypass generally achieves slightly greater excess weight loss compared with sleeve gastrectomy, although the difference may not reach statistical significance in some cohorts. Both procedures show comparable reductions in BMI at five years.

Remission of type 2 diabetes has been observed with both procedures, with rates ranging from approximately 12% to over 60% depending on study population and disease duration. Hypertension remission may be somewhat greater following Roux-en-Y gastric bypass in certain studies, reflecting the stronger metabolic effects of the bypass procedure.

Quality-of-life scores improve significantly following both operations. However, an important distinction between the procedures involves gastroesophageal reflux disease. Roux-

Measure	LSG	LRYGB	Comments
Percent excess weight loss	49%	57%	LRYGB had more weight loss but not statistically significant
BMI at 5 years (kg/m²)	31.6–36.5	32.5–35.4	No significant difference between procedures
Remission of type 2 diabetes	12%–61.5%	25%–67.9%	No significant differences
Remission of hypertension	29%–62.5%	51%–70.3%	LRYGB in the SLEEVEPASS trial had increased remission rate
LDL cholesterol (mg/dL)	104.3–116.1	96.5–101.1	LDL level significantly lower after LRYGB
Quality of life (QOL)	Improved	Improved	Both procedures improved QOL
Remission of GERD	25%	60.4%	LRYGB associated with greater remission of GERD. In the SLEEVEPASS trial, 7/10 reoperations were done for severe reflux
Late complications	14.9%–19%	17.3%–26%	No difference between techniques

Table 3. Comparison of laparoscopic sleeve gastrectomy versus laparoscopic Roux-en-Y gastric bypass: 5-year outcomes in the SLEEVEPASS and SM-BOSS randomized trials. *Source:* Townsend et al. (2021).

en-Y gastric bypass is associated with significantly higher rates of GERD remission, whereas sleeve gastrectomy may worsen reflux in susceptible individuals. In the SLEEVEPASS trial, several reoperations following sleeve gastrectomy were performed to treat severe reflux symptoms.

Late complication rates appear broadly comparable between the two procedures, although the nature of complications differs because of their distinct anatomical reconstructions.

Biliopancreatic Diversion

Biliopancreatic diversion (BPD) represents one of the earliest malabsorptive bariatric operations and remains among the most powerful procedures for producing weight loss. The operation combines restrictive and malabsorptive mechanisms and produces dramatic metabolic changes.

The procedure begins with a distal gastrectomy. The ileum is then divided approximately 200 cm proximal to the terminal ileum, and the proximal ileal segment is anastomosed to the stomach. A second anastomosis is subsequently created approximately 50 cm proximal to the terminal ileum, connecting the biliopancreatic limb to the alimentary limb.

This configuration results in an alimentary limb of approximately 250 cm and a relatively short common channel of approximately 50 cm, where food mixes with biliopancreatic secretions. Because most nutrient absorption occurs within the common channel, this short segment produces profound malabsorption and significant weight loss.

While BPD produces excellent weight loss outcomes, the operation is technically complex and associated with substantial nutritional consequences. As a result, it has been largely replaced by modified procedures such as the duodenal switch and SADI-S.

Duodenal Switch

The duodenal switch (DS) was developed as a modification of biliopancreatic diversion in order to reduce the incidence of marginal ulcers and improve metabolic outcomes. The procedure combines a sleeve gastrectomy with a duodenoileal bypass.

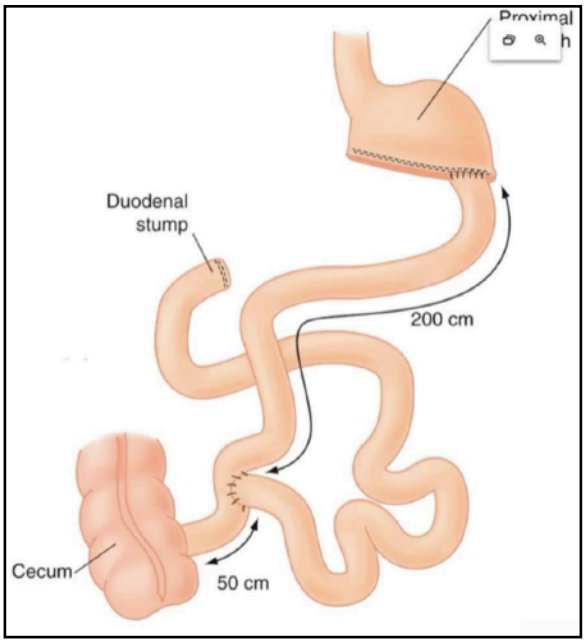

Fig. 6. Surgical anatomy of biliopancreatic diversion showing alimentary limb and short common channel. *Source:* Townsend et al. (2021).

The operation begins with sleeve gastrectomy. The duodenum is then divided approximately 2 cm distal to the pylorus, preserving pyloric function and reducing the risk of marginal ulceration. The ileum is measured approximately 250 cm from the terminal ileum, divided, and the proximal segment is anastomosed to the duodenum.

A second anastomosis is created approximately 100 cm proximal to the terminal ileum, forming a longer common channel compared with biliopancreatic diversion. This configuration reduces the severity of protein malabsorption while still maintaining substantial weight-loss effects.

Duodenal switch produces among the greatest degrees of weight loss of any bariatric procedure, typically achieving 65–70% excess weight loss, along with high rates of remission of metabolic comorbidities.

However, this powerful metabolic effect comes at the cost of significant nutritional risks. Complications associated with BPD and DS include deficiencies of fat-soluble vitamins (A, D, E, and K), zinc deficiency, frequent bowel movements, excessive flatulence, and steatorrhea. Approximately 12% of patients may

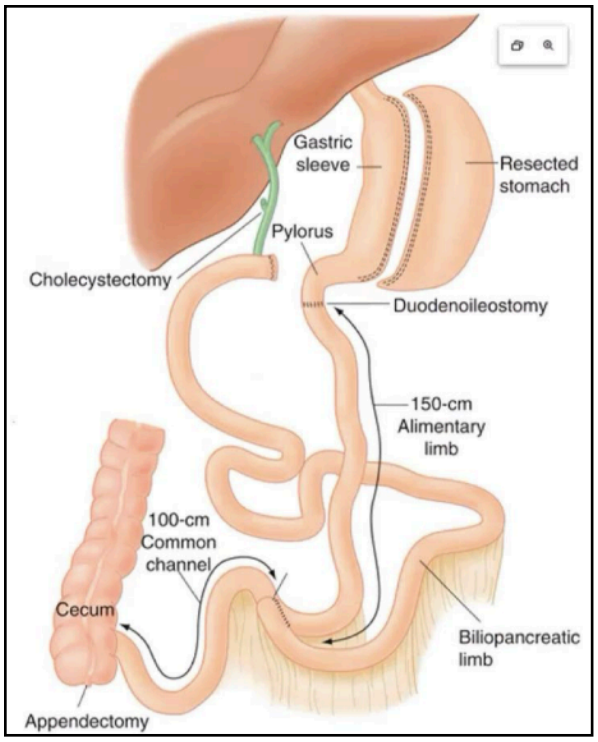

Fig. 7. Duodenal switch reconstruction with sleeve gastrectomy and duodenoileostomy. *Source:* Townsend et al. (2021).

develop protein malabsorption severe enough to require reoperation to lengthen the common channel.

Because of these risks, patients undergoing duodenal switch require lifelong nutritional monitoring and supplementation, including calcium and fat-soluble vitamins.

Single-Anastomosis Duodeno-Ileal Bypass with Sleeve Gastrectomy (SADI-S)

Single-anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S) is a more recent evolution of malabsorptive bariatric surgery designed to simplify the duodenal switch while preserving its powerful metabolic effects. The operation combines sleeve gastrectomy with a single duodeno-ileal anastomosis, thereby eliminating one of the intestinal reconstructions required in the traditional duodenal switch.

The procedure begins with sleeve gastrectomy, including removal of the gastric fundus. The duodenum is then divided distal to the pylorus. Preservation of the pylorus maintains physiologic gastric emptying and helps prevent dumping syndrome.

The ileum is measured approximately 250–300 cm proximal to the terminal ileum, and a loop of ileum is brought up to the duodenum. An end-to-side duodeno-ileostomy is then created. Unlike the classic duodenal switch, this procedure requires only a single anastomosis and therefore creates fewer mesenteric defects.

	O'brien [33]	Lazzati [26]	Bolckmans [41]
LAGB			
EWL (%)	45.9	44	NR
Mortality (%)	0.0 Single center (8378 patients)	0.0 (6506 patients)	NR
LSG			
EWL (%)	53–62	56	NR
Mortality (%)	NR	0.08 (17,960 patients)	NR
RYGB			
EWL (%)	56.7	67%	NR
Mortality (%)		0.11% (10,526 patients)	NR
BPD/DS			
EWL	74.1	NR	65–70
Mortality (%)	NR	NR	1.9% Three deaths <6 months after surgery (153 patients)

Table 4 Comparative excess weight loss and mortality for major bariatric procedures. *Source:* Townsend et al. (2021).

Advantages

SADI-S has gained increasing interest because it retains many of the metabolic advantages of the duodenal switch while simplifying the operative reconstruction. Reported outcomes demonstrate excess weight loss of approximately 75–80%, which is comparable to or greater than that seen with traditional duodenal switch procedures.

Because the pylorus is preserved, patients experience less dumping syndrome compared with gastric bypass. Additionally, the longer common channel decreases the incidence of severe protein malnutrition seen in classic biliopancreatic diversion procedures.

Another advantage is the reduced risk of internal hernias and bowel obstruction due to the presence of fewer mesenteric defects.

Disadvantages and Complications

Despite its advantages, SADI-S is associated with several important limitations. Early postoperative complications appear somewhat more frequent than with Roux-en-Y gastric bypass. Reported leak rates for SADI-S are approximately 2.2% compared with approximately 0.5% for gastric bypass, and reoperation rates may also be higher.

Patients may still experience malabsorptive complications, including deficiencies in fat-soluble vitamins, although these deficiencies are typically less severe than those seen with biliopancreatic diversion. Diarrhea and steatorrhea remain common postoperative symptoms.

Additionally, because the procedure incorporates a sleeve gastrectomy component, patients may develop or experience worsening gastroesophageal reflux disease, again reflecting the higher intragastric pressure associated with sleeve anatomy.

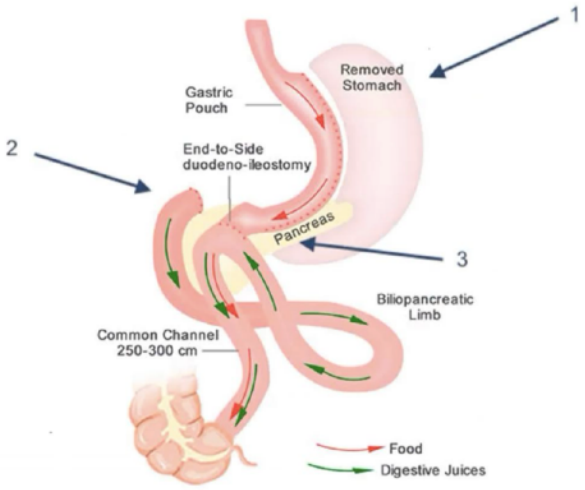

Fig. 8. SADI-S reconstruction showing sleeve gastrectomy and single duodeno-ileostomy. *Source:* Townsend et al. (2021).

Outcomes of Major Bariatric Procedures

Comparative analyses of bariatric procedures consistently demonstrate significant differences in expected weight loss among the various techniques.

In general:

- Laparoscopic adjustable gastric banding produces the least weight loss.
- Sleeve gastrectomy produces moderate weight loss with relatively low nutritional risk.

	2011	2012	2013	2014	2015	2016	2017
Total	158,000	173,000	179,000	193,000	196,000	216,000	228,000
Sleeve	17.80%	33.00%	42.10%	51.70%	53.61%	58.11%	59.39%
RYGB	36.70%	37.50%	34.20%	26.80%	23.02%	18.69%	17.80%
Band	35.40%	20.20%	14.00%	9.50%	5.68%	3.39%	2.77%
BPD-DS	0.90%	1.00%	1.00%	0.40%	0.60%	0.57%	0.70%
Revision	6.00%	6.00%	6.00%	11.50%	13.55%	13.95%	14.14%
Other	3.20%	2.30%	2.70%	0.10%	3.19%	2.63%	2.46%
Balloons	—	—	—	—	0.36%	2.66%	2.75%

Table 5. Trends in bariatric procedures performed in the United States from 2011–2017. *Source:* Townsend et al. (2021).

- Roux-en-Y gastric bypass provides substantial weight loss with strong metabolic effects.
- Biliopancreatic diversion and duodenal switch produce the greatest weight loss but carry the highest risk of nutritional complications.

These findings have shaped current practice patterns, with sleeve gastrectomy and gastric bypass now representing the majority of procedures performed in modern bariatric surgery.

Table 5 demonstrates the rapid rise of sleeve gastrectomy as the dominant bariatric procedure over the past decade, accompanied by a corresponding decline in adjustable gastric banding.

Postoperative Management

Postoperative management following bariatric surgery is guided by recommendations from the American Society for Metabolic and Bariatric Surgery (ASMBS). These guidelines emphasize prevention of thromboembolic events, nutritional optimization, and careful medication management.

Venous thromboembolism (VTE) prophylaxis is tailored according to patient risk. Individuals with low-to-moderate VTE risk may receive mechanical prophylaxis combined with early ambulation. Higher-risk patients should receive both mechanical and pharmacologic thromboprophylaxis. Risk stratification tools, such as the MBSC “Weigh the Odds” calculator, can help determine the need for extended anticoagulation after discharge.

Diet advancement typically begins with early initiation of clear liquids, followed by gradual progression to a full liquid diet as tolerated. Patients are generally advised to consume approximately 60 grams of protein per day and 60 ounces of fluid daily during the early postoperative period.

Proton pump inhibitors are commonly prescribed for approximately 90 days after surgery, particularly in patients undergoing gastric bypass, to reduce the risk of marginal ulcers.

Management of antihypertensive medications requires individualized evaluation. Many patients experience rapid improvement in blood pressure following surgery and may be able to discontinue medications. However, ACE inhibitors and beta-blockers should generally be restarted when appropriate, and patients should monitor blood pressure at home.

Gallstone formation represents another potential postoperative complication due to rapid weight loss. Prophylactic treatment with ursodiol (250–300 mg twice daily) for approximately six months is recommended for patients at elevated risk.

Multimodal pain management strategies are preferred in order to minimize opioid use after surgery.

Bariatric Surgery in the Era of GLP-1 Receptor Agonists

Recent advances in pharmacologic treatment of obesity have introduced new considerations for the future of bariatric surgery. Glucagon-like peptide-1 (GLP-1) receptor agonists act through multiple mechanisms to reduce body weight. These agents suppress appetite through central pathways, slow gastric emptying, enhance glucose-dependent insulin secretion, suppress glucagon release, and improve metabolic health.

A major turning point occurred in 2021, when the U.S. Food and Drug Administration approved semaglutide for the treatment of obesity. Clinical trials known as the STEP trials demonstrated unprecedented weight loss of approximately 15–17% of body weight, far exceeding the results of previous pharmacologic therapies.

Subsequently, tirzepatide, a dual GLP-1 and glucose-dependent insulinotropic polypeptide (GIP) receptor agonist, was approved in 2023. These medications have rapidly gained popularity due to their strong efficacy and relatively convenient weekly dosing schedules.

The SELECT trial in 2023 further expanded the role of GLP-1 receptor agonists by demonstrating significant cardiovascular benefits associated with semaglutide therapy.

Impact of Pharmacotherapy on Bariatric Surgery Trends

The growing popularity of GLP-1 receptor agonists has already begun to influence bariatric surgery utilization. Between 2021 and 2022,

prescriptions for GLP-1 receptor agonists doubled, while the number of bariatric operations performed decreased by approximately 25%.

Despite this shift, surgical treatment remains substantially more effective for weight loss and metabolic improvement. On average, bariatric surgery produces 22–25 kilograms more weight loss than pharmacologic therapy alone. Additionally, surgical treatment has demonstrated a clear mortality benefit, particularly in patients with diabetes when surgery is performed within ten years of diagnosis. In this population, bariatric surgery has been associated with a 62% reduction in mortality risk.

Pharmacologic therapy also presents several limitations. GLP-1 receptor agonists are expensive, frequently cause gastrointestinal side effects, and require long-term administration. Discontinuation of therapy often leads to weight regain.

Recent national procedure statistics illustrate these evolving trends.

The Future of Bariatric Surgery

Although pharmacologic treatments have expanded the therapeutic landscape for obesity, bariatric surgery remains the most effective intervention for sustained weight loss and remission of metabolic disease. Surgical therapy continues to demonstrate superior long-term outcomes, improved quality of life, and significant reductions in obesity-related mortality.

Rather than replacing surgery, GLP-1 receptor agonists are increasingly viewed as complementary therapies. These medications may serve several roles within a comprehensive obesity treatment strategy.

First, GLP-1 receptor agonists may be used preoperatively in patients with extremely high BMI or elevated surgical risk to reduce operative morbidity and mortality through modest weight reduction prior to surgery.

Second, pharmacologic therapy may be useful postoperatively in patients who fail to achieve adequate weight loss or who experience weight regain after bariatric surgery. In such cases, GLP-1 receptor agonists may reduce the need for revisional procedures.

Finally, future treatment strategies may involve tiered management systems. Patients with class I obesity may initially receive medical therapy, whereas those with class II or III obesity—or those who fail pharmacologic treatment—may proceed to surgical intervention.

Conclusion

Severe obesity remains a major public health challenge with significant consequences for morbidity, mortality, and healthcare systems. Bariatric surgery has evolved dramatically over the past several decades, progressing from early restrictive procedures to sophisticated

	2023	2022	2021	2020	2019	2018	2017
Sleeve	157,254	160,609	152,866	122,056	152,413	154,976	135,401
RYGB	63,132	62,097	56,527	41,280	45,744	42,945	40,574
Band	773	2,500	1,121	2,393	2,375	2,660	6,318
BPD-DS	3,775	6,096	5,525	3,555	2,272	2,123	1,588
Revision	32,267	30,894	31,021	22,022	42,881	38,971	32,238
SADI	2,387	1,567	1,025	488	—	—	—
OAGB	555	1,057	1,149	1,338	—	—	—
Other	3,898	6,189	7,339	1,221	6,060	5,847	5,606
ESG	4,587	4,600	2,220	1,500	—	—	—
Balloons	1,461	4,358	4,100	2,800	4,655	5,042	6,280
Total	270,089	279,967	262,893	198,651	256,000	252,564	228,005

Table 6. Annual bariatric surgery procedure volumes in the United States, 2017–2023. *Source:* Formerly accessed at the CDC via a link at https://asmbs.org/condition_procedures/obesity/#5-obesity-prevalence-and-rate-of-occurrence. CDC reported as of March 10, 2026 that the page had "moved," but the new link it gave also reported "Page Not Found."

metabolic operations capable of producing profound and durable improvements in weight and metabolic health.

Procedures such as sleeve gastrectomy and Roux-en-Y gastric bypass now dominate contemporary practice due to their balance of effectiveness and safety. More complex operations such as duodenal switch and SADI-S provide even greater weight loss but require careful patient selection because of their nutritional consequences.

Although new pharmacologic therapies such as GLP-1 receptor agonists have transformed obesity management, surgical treatment continues to provide the most reliable long-term outcomes. The future of obesity treatment will likely involve a collaborative approach in which medical therapy and metabolic surgery function as complementary tools rather than competing alternatives.

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References

1. Benaiges D, Más-Lorenzo A, Goday A, et al. Laparoscopic sleeve gastrectomy: More than a restrictive bariatric surgery procedure? *World J Gastroenterol*. Nov 7, 2015; 21(41): 11804-11814 Accessed online March 10, 2026 at https://www.wjgnet.com/1007-9327/full/v21/i41/11804.htm

2. Snauwaert CL, Dillemans P, Himpens B, et al. Laparoscopy-assisted transgastric endoscopic retrograde cholangiopancreatography in bariatric Roux-en-Y gastric bypass patients. *Endoscopy International Open*. 3. 10.1055/s-0034-1392108. Accessed March 10, 2026 at https://www.researchgate.net/publication/281197667_Laparoscopy-assisted_transgastric_endoscopic_retrograde_cholangiopancreatography_in_bariatric_Roux-en-Y_gastric_bypass_patients

3. Hedberg S, Thorell A, Österberg J, et al. Comparison of Sleeve Gastrectomy vs Roux-en-Y Gastric Bypass: A Randomized Clinical Trial. JAMA Netw Open. 2024;7(1):e2353141. doi:10.1001/jamanetworkopen.2023.53141 Acessed March 10. 2026 at https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2814336

4. Sheikh Z, Weerakkody Y, Knipe H, et al. Gastric band slippage. Reference article, Radiopaedia.org, https://doi.org/10.53347/rID-45659, https://doi.org/10.53347/rID-45659, Accessed March 10, 2026 at https://radiopaedia.org/articles/45659

5. Townsend CM, Beauchamp RD, Evers BM, Mattox KL. *Sabiston Textbook of Surgery: The Biological Basis of Modern Surgical Practice*. 21st ed. Philadelphia: Elsevier; 2021.

6. Elmaleh-Sachs A, Schwartz JL, Bramante CT, Nicklas JM, Gudzune KA, Jay M. Obesity management in adults: a review. JAMA. 2023;330(20):2000-2015.

7. Edwards MA, et al. American Society for Metabolic and Bariatric Surgery postoperative care pathway guidelines for Roux-en-Y gastric bypass. Surg Obes Relat Dis. 2025;21(5):523-536.

8. Sanchez-Cordero S, Lopez-Gonzalez R, Hermoza R, Pujol-Gebelli J. Five-year outcomes of single-anastomosis duodeno-ileal bypass with sleeve gastrectomy: a systematic review. Obes Surg. 2025;35(9):3784-3790.

9. Lin K, Mehrotra A, Tsai TC. Metabolic bariatric surgery in the era of GLP-1 receptor agonists for obesity management. JAMA Netw Open. 2024;7(10):e2441380.

10. Sarma S, Palcu P. Weight loss between glucagon-like peptide-1 receptor agonists and bariatric surgery in adults with obesity: a systematic review and meta-analysis. Obesity (Silver Spring). 2022;30(11):2111-2121.

11. Barrett TS, Hafermann JO, Richards S, LeJeune K, Eid GM. Obesity treatment with bariatric surgery versus GLP-1 receptor agonists. JAMA Surg. 2025;160(11):1232-1239.

12. Abdallah H, Klink WH, Derienne J, Voican C, Perlemuter G, Courie R, Dagher I, Tranchart H. Management of insufficient weight loss or weight regain after bariatric surgery. Obes Surg. 2025.