METHODIST
DEBAKEY
CARDIOVASCULAR JOURNAL

# Surgical Strategies for the Management of Obesity

REVIEW

**CONNIE AU, MD**
**ROBERT BRUMER, MD, PHD**
**JULIA SCHROER, MD**
**NABIL TARIQ, MD**

*Author affiliations can be found in the back matter of this article

HOUSTON Methodist
DEBAKEY HEART & VASCULAR CENTER

## ABSTRACT

Obesity is one of the most difficult medical conditions to treat in the United States (US) and requires multidisciplinary treatment. Bariatric surgery is one of the most effective treatment options for morbid obesity. In this review, we describe the most up-to-date information regarding the impact of obesity on cardiovascular disease and other comorbidities as well as the various surgical approaches for treatment.

**CORRESPONDING AUTHOR:**
**Nabil Tariq, MD**
Department of Surgery,
Houston Methodist Hospital,
Houston, Texas, US
ntariq@houstonmethodist.org

**KEYWORDS:**
bariatric surgery; sleeve gastrectomy; Roux-en-Y gastric bypass; obesity; cardiovascular disease

**TO CITE THIS ARTICLE:**
Au C, Brumer R, Schroer J, Tariq N. Surgical Strategies for the Management of Obesity. Methodist DeBakey Cardiovasc J. 2025;21(2):84-93. doi: 10.14797/mdcvj.1513

## INTRODUCTION

Obesity is associated with numerous medical conditions including diabetes, heart disease, hyperlipidemia, sleep apnea, and hypertension.[1] Cardiovascular diseases associated with obesity include atrial fibrillation, heart failure, coronary artery disease, and stroke.[1] Treatment for obesity is multidisciplinary and involves lifestyle modifications, increased physical activity, dietary changes, and pharmacological treatment.[1] For patients with morbid obesity, bariatric surgery is an accepted and effective treatment that has been shown to reduce the incidence of heart failure, myocardial infarction, and stroke in these patients.[1,2]

According to the American Society for Metabolic and Bariatric Surgery (ASMBS) database, approximately 279,000 bariatric procedures were performed in 2022.[3] Indications for bariatric surgery as stated by the ASMBS were updated that same year.[4] Individuals with a body mass index (BMI) ≥ 35 kg/m$^2$, regardless of presence or absence of medical comorbidities, or with a BMI of 30 to 34.9 kg/m$^2$ and metabolic disease should be considered for bariatric surgery.[4] The BMI threshold for the Asian population is adjusted so that a BMI ≥ 25 kg/m$^2$ is defined as clinical obesity.[4] ASMBS guidelines recommend that patients of Asian descent with a BMI ≥ 27.5 kg/m$^2$ should be offered bariatric surgery.[4]

Absolute contraindications for bariatric surgery include the inability to undergo general anesthesia, severe psychiatric illness, and uncontrolled coagulopathy.[5] All patients who wish to undergo bariatric surgery should undergo a psychosocial and behavioral assessment and meet with a dietitian or nutritionist prior to surgery.[6]

Physicians must take into consideration the invasiveness of the procedure, risk of complications, medical comorbidities, and weight loss desired when deciding which procedure is the safest surgical option.[6] The Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program (MBSAQIP) bariatric surgical risk calculator is a useful tool surgeons often use to estimate the risk of an unfavorable outcome (ie, complication or death).[7] Use of the calculator has been shown to be independently associated with reduced risk of serious complications but not with reduced risk of mortality.[7]

Several procedures currently are being performed in the US, with sleeve gastrectomy and gastric bypass being the most predominant. Other procedures such as the duodenal switch, the single anastomosis duodeno-ileostomy with sleeve gastrectomy, the one anastomosis gastric bypass (OAGB), and endoscopic sleeve gastroplasty are performed at much lower rates, but some are increasing rapidly. Laparoscopic gastric banding is no longer performed except by those surgeons on a self-pay basis, as most insurance companies in the US no longer cover it due to its limited efficacy, especially with new medications that offer alternative options.

## SLEEVE GASTRECTOMY

Sleeve gastrectomy, also known as vertical sleeve gastrectomy or gastric sleeve, is one of the most common bariatric procedures. In 2022, approximately 160,609 sleeve gastrectomy procedures were performed in the US, accounting for approximately 57.4% of all metabolic and bariatric surgeries.[3] Sleeve gastrectomy typically results in 25% to 35% of total body weight loss in long-term studies.[8,9] It has shown fewer postoperative complications and similar effectiveness in excess weight loss as the Roux-en-Y gastric bypass (RYGB) in studies evaluating outcomes after 36 months.[10] However, longer-term studies have shown rates of weight loss failure (defined as excess weight loss percentage < 50%) of 30.4% at 5-year follow-up and 51.4% at 7-year follow-up.[8] Relative contraindications for sleeve gastrectomy, specifically, include Barrett esophagus and gastroesophageal reflux disease (GERD), suggesting that these patients may be better served with an RYGB to improve reflux symptoms.[5]

The sleeve gastrectomy can be done laparoscopically or robotically. Current data on robotic sleeve gastrectomy (RSG) shows increased operative time, higher leak rates, and higher surgical site infections compared to laparoscopic sleeve gastrectomy (LSG).[11] Several studies also have shown an increased hospital cost with RSG compared to LSG, with one institution reporting a 4% increase in total hospital charges.[11-13] Due to the higher risk of morbidity and higher costs associated with RSG, the LSG remains the gold standard.[11] However, when looking at a more recent subset of data from robotic bariatric surgery, the outcomes from RSG approach that of LSG but are not superior.[11,12] It is possible that with more experience and expertise in this new increasingly popular robotic platform, RSG may become more advantageous after overcoming its current learning curve.

According to data from the Bariatric Outcomes Longitudinal Database (BOLD), the average operative time for LSG is approximately 78 minutes, with a standard deviation of 37.4 minutes.[14] Using an energy device, the gastroepiploic and short gastric vessels are divided along the greater curvature up to the left diaphragmatic crus. A 32F to 40F Bougie measuring device is pressed against the lesser curvature to create a tubularized stomach and help determine where the stomach will be divided. Using a stapler, the stomach is divided superiorly up to the fundus, lateral to the esophagus. The remaining stomach is approximately one-third or less of its original

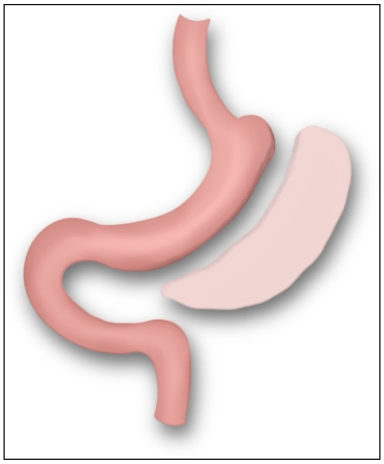

**Figure 1** Sleeve gastrectomy: anatomic resection of the greater curvature of the stomach in a sleeve gastrectomy results in approximately one-third or less of the original stomach. Images created by Rodrigo Jacobucci, MD

volume (Figure 1). The stomach is a distensible organ and can dilate over some time but will not "stretch out" to its original size, which is falsely believed by some patients who regain weight.

The endoscopic sleeve gastroplasty (ESG) is a less invasive and more cost-effective alternative to the LSG. First described in 2013, the ESG is performed using a flexible endoscope to imbricate the stomach from the incisura to the cardia with full thickness sutures. The ESG preserves gastric tissue and is reversible. In the MERIT (Endoscopic sleeve gastroplasty for treatment of class 1 and 2 obesity) trial, patients who underwent the ESG had an average excess weight loss (the excess weight over the ideal weight for BMI > 25 kg/m$^2$) of 49.2%, whereas patients who were randomized to undergo lifestyle modifications had only seen a 3.2% excess weight loss.[15] Of those patients who underwent ESG, 80% also saw an improvement in one or more metabolic comorbidities in that same trial.[15] The ESG has a similar safety profile as the LSG.[16] However, several studies have reported greater total body weight loss in patients who underwent LSG compared to ESG.[16,17] Although insurance coverage for ESG can be difficult to obtain, most insurance companies will cover LSG if the patient has bariatric benefits. Medicare covers bariatric surgery due to its overall health benefits, although it is quite restrictive when covering weight loss medications for patients without diabetes.

Compared with other bariatric procedures, the sleeve gastrectomy is technically simpler, with a shorter operative time and fewer complications, which may be more beneficial in high-risk surgical patients.[6,10,18] The 30-day mortality after LSG is reportedly 0.02%.[11] One of the most feared complications after LSG is staple line leak, which occurs in 0.15% to 2.4% of cases; the majority of current data suggests this is at the lower end of that range.[12,19] Most staple line leaks occur in the proximal stomach and close to the gastroesophageal junction.[19] Staple line leaks may require further treatment by operative or percutaneous drainage and endoscopic stenting.[19] Infection is another potential complication after LSG, with a surgical site infection rate of 0.2%.[11] In a 10-year follow-up study, patients who underwent LSG had a 26% remission rate in type 2 diabetes mellitus (T2DM), 19% remission rate in hyperlipidemia, 8% in hypertension, and 16% in obstructive sleep apnea.[20] Given the low risk of morbidity and mortality after LSG, high-risk patients with numerous cardiovascular comorbidities who qualify for bariatric surgery should be considered for this surgical approach.

## ROUX-en-Y GASTRIC BYPASS

The RYGB, first described in the 1960's, was developed based on patterns of failed weight gain in patients who previously underwent partial gastrectomy.[21] Today, RYBG is the second most commonly performed bariatric surgery in the US, with 62,907 cases reported in 2022—approximately 22% of all bariatric procedures performed that year.[3] While the procedure is similar to sleeve gastrectomy in that it involves creation of a restrictive gastric pouch, it was originally thought to confer added weight loss via malabsorption. However, it is now thought to be due to a metabolic effect, from gut hormonal changes like elevated glucagon-like peptide (GLP) 1 levels. A Roux limb from jejunum, typically about 100 cm to 150 cm in length, is connected to a gastric pouch, thus allowing ingested food to bypass the majority of the stomach and duodenum/proximal jejunum. The earlier contact of food with the small bowel results in a quicker release of satiety hormones and incretin effect for glucose control.[22] The residual stomach remains in place and the proximal jejunum is connected to the side of the Roux limb (Figure 2). This additional connection facilitates delivery of digestive enzymes into a more distal common channel, through which the remainder of digestion occurs.

The RYGB has several advantages over sleeve gastrectomy. In patients with preexisting GERD, the RYGB is the preferred bariatric procedure since studies show that those receiving sleeve gastrectomy have significantly more interventions for worsening GERD symptoms and/or development of de novo GERD compared with patients receiving RYGB.[23] One systematic review notes that the odds for revisional surgery to treat GERD in sleeve gastrectomy patients are 11 times higher compared with RYBG patients.[23] Although both procedures may have similar effectiveness in short-term weight loss, a 5-year randomized clinical trial showed greater total estimated weight loss with RYGB (26%) than with sleeve gastrectomy (22.5%).[9] Furthermore,

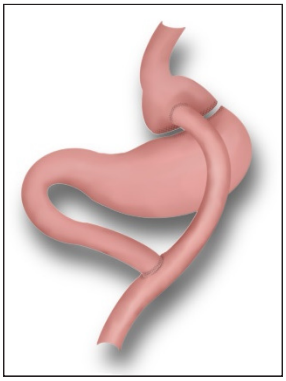

**Figure 2** Roux-en-Y gastric bypass involves anatomic resection of the stomach to create a gastric pouch that is anastomosed to a segment of jejunum, creating the roux limb. The distal duodenum connected to the gastric remnant is anastomosed to the distal jejunum, creating the biliopancreatic limb. Images created by Rodrigo Jacobucci, MD

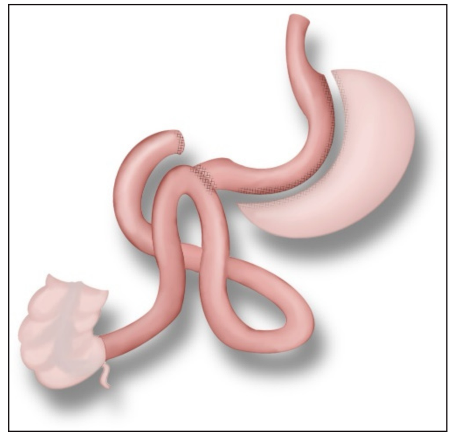

**Figure 3** Single anastomosis duodeno-ileal bypass with sleeve gastrectomy involves anatomic resection of the greater curvature of the stomach with the proximal duodenum, then anastomosed to a loop of ileum. Images created by Rodrigo Jacobucci, MD

patients undergoing RYGB had an additional 8.4% average excess body weight loss compared to patients undergoing sleeve gastrectomy.[9]

Findings from a 12-year observational prospective study anticipate that roughly 93% of patients who undergo RYGB will maintain at least 10% weight loss from baseline by year 12, 70% will maintain at least 20% of weight loss, and 40% will maintain at least 30% of weight loss.[24] In long-term studies, RYGB is also superior to the sleeve gastrectomy for treatment of metabolic diseases. Patients undergoing RYGB have superior hypertension remission compared to those receiving sleeve gastrectomy (24% vs 8%).[20] Also, some literature suggests that RYGB is superior to sleeve gastrectomy in hyperlipidemia remission.[10,25] However, several studies show no statistically significant difference in T2DM resolution between RYGB and sleeve gastrectomy, with one randomized clinical trial noting a remission rate of 33% and 26%, respectively.[10,20,25]

As with any surgery, RYGB is not without risk: It has a reported 8% 30-day minor and major combined complication rate, which is higher than that of sleeve gastrectomy and OAGB.[18,26] This more complex procedure is associated with complications including bowel obstruction, internal hernia, stricture, and micronutrient deficiencies.[18,27-29] Although these complications are rare, they may require additional interventions for treatment.

## SINGLE ANASTOMOSIS DUODENO-ILEOSTOMY WITH SLEEVE GASTRECTOMY AND ONE ANASTOMOSIS GASTRIC BYPASS

A relatively recent innovation in the field of bariatric surgery has led to the adaptation of two new surgical techniques endorsed by the ASMBS: single anastomosis duodeno-ileostomy with sleeve gastrectomy (SADI-S) and one anastomosis gastric bypass (OAGB) (Figure 3). Successful bariatric surgery offers effective long-term weight loss with low risk of complications. Of the commonly performed procedures, gastric sleeve offers a relatively low complication rate but has questionable long-term efficacy, whereas RYGB provides effective weight loss but may have long-term complications including internal hernia and chronic marginal ulcers. Both the SADI-S and duodenal switch procedures include sleeve gastrectomy and duodeno-ileostomy. However, in the duodenal switch, the biliopancreatic limb is anastomosed to the distal ileum, creating two reconnection sites, whereas SADI-S has only one reconnection site. Biliopancreatic diversion with duodenal switch is the most metabolically effective surgery but has risks of chronic malabsorption and malnutrition. Compared to these procedures, SADI-S and OAGB offer a middle ground of effective weight loss and relatively low complication rate.

With a SADI-S, the restrictive effect of a gastric sleeve is combined with an intestinal bypass that is more distal than a classic bypass but not as extreme as a duodenal switch (Figure 3). This longer intestinal bypass allows for more effective stimulation of glucagon-like peptide-1 (GLP-1) while avoiding the malnutrition associated with the duodenal switch. A typical SADI-S will have about 250 cm to 300 cm of common intestinal channel, where ingested food can mix with pancreatic and biliary secretions to allow for absorption; this is in contrast to the duodenal switch that usually has only 50 cm to 75 cm of a common channel. Another benefit is that preserving the pylorus with the gastric sleeve anatomy reduces the risk of dumping syndrome and postprandial hypoglycemia. Additionally, although there is a theoretical concern for bile reflux with the operative anatomy, a 2022 meta-analysis of 2,029 patients found a relatively low incidence of bile reflux, approximately 1.2%.[30]

A 2022 systematic review and meta-analysis of 3,319 patients compared SADI-S to other malabsorptive procedures, such as RYGB and duodenal switch, and found comparable weight loss with a shorter operative duration, shorter hospital stay, and a trend towards fewer complications.[31] Another meta-analysis from 2021 showed significantly greater weight loss with SADI-S versus RYGB.[32] Long-term efficacy of SADI-S has also been demonstrated, with a 2023 systematic review finding that 10-year excess weight loss exceeded 80%.[33] Some of this metabolic success can be explained by the strong GLP-1 response that has been observed after SADI-S.[34,35] Furthermore, animal studies have shown a comparable hormone response after SADI-S compared to RYGB.[36] Although the SADI-S currently only represents about 0.5% of bariatric procedures performed annually in the US, the advantages over existing procedures suggested by these studies may lead to its continued adaptation as a bariatric procedure of choice.[3]

The OAGB procedure has gained popularity outside the US, overtaking RYGB in some countries. Similar to SADI-S, OAGB offers a longer biliopancreatic limb that results in a shorter common intestinal channel compared to RYGB (Figure 4). A 2018 systematic review and meta-analysis comparing OAGB to RYGB in 7,452 patients found that OAGB had a shorter operative time with greater excess weight loss and remission of T2DM but with a similar risk profile.[37] Similarly, the YOMEGA (efficacy and safety of one anastomosis gastric bypass versus Roux-en-Y gastric bypass for obesity) prospective randomized controlled trial showed comparable weight loss and diabetes improvement between OAGB and RYGB, although OAGB had a higher rate of nutritional complications, likely related to the longer biliopancreatic limb.[38] Additionally, a 2024 publication from the MBSAQIP found a slightly better 30-day outcome compared to RYGB in US data.[39] Despite these promising results, OAGB has yet to gain a foothold in the US, with fewer than 1,000 cases performed annually in recent years.[3]

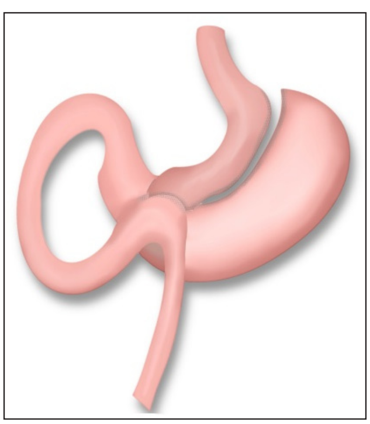

**Figure 4** One anastomosis gastric bypass involves anatomic resection of the stomach with the stomach pouch anastomosed to a loop of jejunum. Image created by Rodrigo Jacobucci, MD

Some US surgeons have turned to performing RYGB with a longer biliopancreatic limb in an effort to gain some of the metabolic effects of OAGB and potentially improve the incretin effect. However, retrospective data have not found a major difference in GLP-1 levels and metabolic profiles between longer and shorter limb lengths.[40,41] One of the major reasons for this slow adaptation may be that most major insurers do not cover OAGB as an accepted surgical procedure. Perhaps as promising data continue to be gathered and coverage becomes more available, OAGB may gain more popularity in the US. Both the SADI-S and OAGB procedures seem to have fewer problems with chronic anastomotic ulcer and internal hernia, the two most common long-term complications of gastric bypass.

## SUMMARY

There are a variety of options for bariatric surgery, each with unique benefits and drawbacks. It is important to emphasize that bariatric surgery improves numerous health outcomes beyond weight loss and metabolic benefits. A 2018 retrospective cohort study comparing 5,301 diabetic patients who underwent bariatric surgery to 14,934 control patients—matched by multiple factors including site, age, sex, BMI, and hemoglobin A1c—found that those receiving bariatric surgery had a reduced risk of macrovascular events (HR 0.60; 95% CI, 0.42-0.86) and coronary artery disease (HR 0.64; 95% CI, 0.42-.99).[42] These findings are similarly reflected in a 2019 retrospective cohort study comparing 2,287 patients undergoing bariatric surgery to a 1:5 matched control group of 11,435 patients. This study found that bariatric surgery provided an absolute risk reduction of 16.9% (95% CI, 13.1%-20.4%) for the composite end point of major adverse cardiac events, with an additional reduction in all-cause mortality (HR 0.59: 95% CI, 0.48-0.72).[43]

In addition to its cardiovascular benefits, bariatric surgery results in a significant reduction in risk for multiple forms of cancer. A 2023 meta-analysis that cumulatively compared 511,585 bariatric surgery patients to 1,889,746 control patients found a significant overall reduction in risk of cancer (RR 0.62; 95% CI, 0.46-0.84) as well as cancer-related mortality (RR 0.51; 95% CI, 0.42-0.62),[44] with this risk reduction extending to multiple specific forms of cancer, including hepatocellular carcinoma, pancreatic

| OUTCOMES | SURGICAL PROCEDURES | | | |
|---|---|---|---|---|
| | LSG [8,10,18,20,25,26,50-55] | RYGB [10,18,20,25,26,38,53-59] | SADI-S [33,57,59] | OAGB [16,37-39,52,55-57] |
| % Morbidity, 30-day | 1-5% | 4-8% | 6.4-12% | 7.5-8% |
| % Mortality, 30-day | 0.1-0.2% | 0.1-0.5% | 0.67% | 0.1% |
| % EBWL, 1-year | 50-70% | 60-80% | 50-85% | 50-80% |
| % EBWL, 5-years | 50-60% | 50-70% | 75-80% | 70-85% |
| % HTN Remission, 5-years | 40-60% | 50-60% | 40-70% | 60-80% |
| % Diabetes Remission, 5-years | 30-40% | 50-80% | 60-80% | 90% |

**Table 1** Bariatric surgery outcomes. EBWL: excess body weight loss (defined as initial weight - postoperative weight/initial weight - ideal weight); HTN: hypertension (remission defined as blood pressure < 135/85 mm Hg without medication; hemoglobin A1C: glycated hemoglobin (remission of diabetes defined as hemoglobin A1C < 6.5% without medication)

cancer, colorectal cancer, and breast and endometrial cancers. Another meta-analysis from 2020 comparing 269,818 bariatric surgery patients to 1,270,086 control patients demonstrated a reduction in all-cause mortality among bariatric surgery patients (OR 0.62; 95% CI, 0.55-0.69) as well as a reduced incidence of T2DM (OR 0.39; 95% CI, 0.18-0.83), hypertension (OR 0.36; 95% CI, 0.32-0.40), and ischemic heart disease (OR 0.46; 95% CI, 0.29-0.73).[45] These findings all represent substantial and clinically significant improvements in multiple health outcomes as a result of bariatric surgery. Given these data, it is not surprising that the number of bariatric procedures performed per year continues to steadily increase.[3]

Bariatric surgery has come a long way from the original open surgery with large incisions, to minimally invasive surgery with laparoscopy, robotics, and now advanced endoscopic procedures. The majority of bariatric surgery procedures in the US are done at accredited centers or "centers of excellence." Major postoperative outcomes are tracked on all patients. In recent years, several publications have shown very favorable outcomes with low complication rates (Table 1). Numerous publications also show significantly improved outcomes in cardiovascular disease, diabetes, cancer, and even mortality with bariatric surgery.[1,2,10,46,47] Several randomized trials support surgical intervention as well.[9,15,48] Improved outcomes are also seen with weight loss from obesity medications.[49]

## CONCLUSION

With more effective medical therapies, we hope to see continually improved outcomes with weight loss in various health conditions. For now, however, bariatric surgery is an effective and efficient way to lose a substantial amount of weight and see significant improvement in comorbidities and even mortality. Due to this efficacy and cost effectiveness, many insurance companies, including Medicare, currently cover bariatric surgery but have more restrictions on the use of medications for obesity, especially for nondiabetic patients.

## KEY POINTS

- Bariatric surgery has been shown to reduce the incidence of heart failure, myocardial infarction, and stroke in patients with obesity.
- Sleeve gastrectomy, the most common bariatric procedure performed in the US, has a low morbidity and mortality rate.
- Single anastomosis duodeno-ileostomy with sleeve gastrectomy and one anastomosis gastric bypass are newer procedures not often performed in the US, but they appear to result in greater excess weight loss compared to Roux-en-Y gastric bypass.

## ACKNOWLEDGEMENTS

We would like to thank Rodrigo Jacobucci, MD, for providing illustrations of the bariatric procedures seen in this paper.

## COMPETING INTERESTS

The authors have no competing interests to declare.

## AUTHOR AFFILIATIONS

**Connie Au, MD** orcid.org/0009-0005-2547-9374
Department of Surgery, Houston Methodist Hospital, Houston, Texas, US

**Robert Brumer, MD, PhD** orcid.org/0009-0000-1950-7512
Department of Surgery, Houston Methodist Hospital, Houston, Texas, US

**Julia Schroer, MD** orcid.org/0000-0002-0948-1897
Department of Surgery, Houston Methodist Hospital, Houston, Texas, US

**Nabil Tariq, MD** orcid.org/0000-0002-6315-6788
Department of Surgery, Houston Methodist Hospital, Houston, Texas, US

## REFERENCES

1. **Van Veldhuisen SL, Gorter TM, Van Woerden G,** et al. Bariatric surgery and cardiovascular disease: a systematic review and meta-analysis. Eur Heart J. 2022 May 21;43(20):1955-1969. doi: 10.1093/eurheartj/ehac071
2. **Mentias A, Aminian A, Youssef D,** et al. Long-Term Cardiovascular Outcomes After Bariatric Surgery in the Medicare Population. J Am Coll Cardiol. 2022 Apr 19;79(15):1429-1437. doi: 10.1016/j.jacc.2022.01.047
3. **Clapp B, Ponce J, Corbett J,** et al. American Society for Metabolic and Bariatric Surgery 2022 estimate of metabolic and bariatric procedures performed in the United States. Surg Obes Relat Dis. 2024 May;20(5):425-431. doi: 10.1016/j.soard.2024.01.012
4. **Eisenberg D, Shikora SA, Aarts E,** et al. 2022 American Society of Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO) Indications for Metabolic and Bariatric Surgery. Obes Surg. 2023 Jan;33(1):3-14. doi: 10.1007/s11695-022-06332-1
5. **Statpearls [Internet].** Bethesda, MD: National Library of Medicine; c2024. Seeras K, Sankararaman S, Lopez PP. Sleeve Gastrectomy; 2018 Jan 23 [cited 2024 Dec 13]. Available from: https://www.ncbi.nlm.nih.gov/books/NBK519035/
6. **Chung AY, Thompson R, Overby DW, Duke MC, Farrell TM.** Sleeve Gastrectomy: Surgical Tips. J Laparoendosc Adv Surg Tech A. 2018 Aug;28(8):930-937. doi: 10.1089/lap.2018.0392
7. **Hetherington A, Verhoeff K, Mocanu V, Birch DW, Karmali S, Switzer NJ.** MBSAQIP risk calculator use in bariatric surgery is associated with a reduction in serious complications: a retrospective analysis of 210,710 patients. Surg Obes Relat Dis. 2023 Nov;19(11):1228-1234. doi: 10.1016/j.soard.2023.05.024
8. **Sepúlveda M, Alamo M, Saba J, Astorga C, Lynch R, Guzmán H.** Long-term weight loss in laparoscopic sleeve gastrectomy. Surg Obes Relat Dis. 2017 Oct;13(10):1676-1681. doi: 10.1016/j.soard.2017.07.017
9. **Biter LU, Hart JW, Noordman BJ,** et al. Long-term effect of sleeve gastrectomy vs Roux-en-Y gastric bypass in people living with severe obesity: a phase III multicentre randomised controlled trial (SleeveBypass). Lancet Reg Health Eur. 2024 Jan 22:38:100836. doi: 10.1016/j.lanepe.2024.100836
10. **Han Y, Jia Y, Wang H, Cao L, Zhao Y.** Comparative analysis of weight loss and resolution of comorbidities between laparoscopic sleeve gastrectomy and Roux-en-Y gastric bypass: A systematic review and meta-analysis based on 18 studies. Int J Surg. 2020 Apr:76:101-110. doi: 10.1016/j.ijsu.2020.02.035
11. **Fazl Alizadeh R, Li S, Inaba CS,** et al. Robotic versus laparoscopic sleeve gastrectomy: a MBSAQIP analysis. Surg Endosc. 2019 Mar;33(3):917-922. doi: 10.1007/s00464-018-6387-6
12. **Aeschbacher P, Garoufalia Z, Rogers P,** et al. Laparoscopic versus robotic-assisted primary bariatric-metabolic surgery. Are we still expecting to overcome the learning curve? A propensity score-matched analysis of the Metabolic and Bariatric Surgery Accreditation and Quality Improvement Program database. Surg Obes Relat Dis. 2024 Sep;20(9):831-839. doi: 10.1016/j.soard.2024.03.017
13. **Brown A, Vu AH, Carey D,** et al. Hospital charges for laparoscopic sleeve gastrectomy compared to robotic sleeve gastrectomy: a multicenter study. Surg Endosc. 2024 Sep;38(9):5304-5309. doi: 10.1007/s00464-024-11058-5
14. **Inaba CS, Koh CY, Sujatha-Bhaskar S, Gallagher S, Chen Y, Nguyen NT.** Operative time as a marker of quality in bariatric surgery. Surg Obes Relat Dis. 2019 Jul;15(7):1113-1120. doi: 10.1016/j.soard.2019.04.010
15. **Abu Dayyeh BK, Bazerbachi F, Vargas EJ,** et al. Endoscopic sleeve gastroplasty for treatment of class 1 and 2 obesity (MERIT): a prospective, multicentre, randomised trial. Lancet. 2022 Aug 6;400(10350):441-451. doi: 10.1016/S0140-6736(22)01280-6.
16. **Marincola G, Gallo C, Hassan C,** et al. Laparoscopic sleeve gastrectomy versus endoscopic sleeve gastroplasty: a systematic review and meta-analysis. Endosc Int Open. 2021 Jan;9(1):E87-E95. doi: 10.1055/a-1300-1085
17. **Lopez-Nava G, Asokkumar R, Bautista-Castaño I,** et al. Endoscopic sleeve gastroplasty, laparoscopic sleeve gastrectomy, and laparoscopic greater curve plication: do they differ at 2 years? Endoscopy. 2021 Mar;53(3):235-243. doi: 10.1055/a-1224-7231
18. **Howard R, Chao GF, Yang J,** et al. Comparative Safety of Sleeve Gastrectomy and Gastric Bypass Up to 5 Years After Surgery in Patients With Severe Obesity. JAMA Surg. 2021 Dec 1;156(12):1160-1169. doi: 10.1001/jamasurg.2021.4981
19. **Aurora AR, Khaitan L, Saber AA.** Sleeve gastrectomy and the risk of leak: a systematic analysis of 4,888 patients. Surg Endosc. 2012 Jun;26(6):1509-15. doi: 10.1007/s00464-011-2085-3
20. **Salminen P, Grönroos S, Helmiö M,** et al. Effect of Laparoscopic Sleeve Gastrectomy vs Roux-en-Y Gastric Bypass on Weight Loss, Comorbidities, and Reflux at 10 Years in Adult Patients With Obesity: The SLEEVEPASS Randomized

Clinical Trial. JAMA Surg. 2022 Aug 1;157(8):656-666. doi: 10.1001/jamasurg.2022.2229

21. **Mason EE, Ito C.** Gastric bypass in obesity. Surg Clin North Am. 1967 Dec;47(6):1345-51. doi: 10.1016/s0039-6109(16)38384-0
22. **Park CW, Torquati A.** Physiology of weight loss surgery. Surg Clin North Am. 2011 Dec;91(6):1149-61, vii. doi: 10.1016/j.suc.2011.08.009
23. **Memon MA, Osland E, Mohamad R, Hoque Z, Alam K, Khan S.** The effect of laparoscopic vertical sleeve gastrectomy and laparoscopic roux-en-Y gastric bypass on gastroesophageal reflux disease: An updated meta-analysis and systematic review of 5-year post-operative data from randomized controlled trials. Surg Endosc. 2024 Nov;38(11):6254-6269. doi: 10.1007/s00464-024-11303-x
24. **Adams TD, Davidson LE, Hunt SC.** Weight and Metabolic Outcomes 12 Years after Gastric Bypass. N Engl J Med. 2018 Jan 4;378(1):93-96. doi: 10.1056/NEJMc1714001
25. **Sharples AJ, Mahawar K.** Systematic Review and Meta-Analysis of Randomised Controlled Trials Comparing Long-Term Outcomes of Roux-En-Y Gastric Bypass and Sleeve Gastrectomy. Obes Surg. 2020 Feb;30(2):664-672. doi: 10.1007/s11695-019-04235-2
26. **Singhal R, Cardoso VR, Wiggins T,** et al. 30-day morbidity and mortality of sleeve gastrectomy, Roux-en-Y gastric bypass and one anastomosis gastric bypass: a propensity score-matched analysis of the GENEVA data. Int J Obes (Lond). 2022 Apr;46(4):750-757. doi: 10.1038/s41366-021-01048-1
27. **Lee S, Carmody B, Wolfe L,** et al. Effect of location and speed of diagnosis on anastomotic leak outcomes in 3828 gastric bypass cases. J Gastrointest Surg. 2007 Jun;11(6):708-13. doi: 10.1007/s11605-007-0085-3
28. **Bauman RW, Pirrello JR.** Internal hernia at Petersen's space after laparoscopic Roux-en-Y gastric bypass: 6.2% incidence without closure—a single surgeon series of 1047 cases. Surg Obes Relat Dis. 2009 Sep-Oct;5(5):565-70. doi: 10.1016/j.soard.2008.10.013
29. **Alexandrou A, Armeni E, Kouskouni E, Tsoka E, Diamantis T, Lambrinoudaki I.** Cross-sectional long-term micronutrient deficiencies after sleeve gastrectomy versus Roux-en-Y gastric bypass: a pilot study. Surg Obes Relat Dis. 2014 Mar-Apr;10(2):262-8. doi: 10.1016/j.soard.2013.07.014
30. **Portela R, Marrerro K, Vahibe A,** et al. Bile Reflux After Single Anastomosis Duodenal-Ileal Bypass with Sleeve (SADI-S): a Meta-analysis of 2,029 Patients. Obes Surg. 2022 May;32(5):1516-1522. doi: 10.1007/s11695-022-05943-y
31. **Verhoeff K, Mocanu V, Zalasky A,** et al. Evaluation of Metabolic Outcomes Following SADI-S: a Systematic Review and Meta-analysis. Obes Surg. 2022 Apr;32(4):1049-1063. doi: 10.1007/s11695-021-05824-w
32. **Chen G, Zhang G, Peng B, Cheng Z, Du X.** Roux-En-Y Gastric Bypass Versus Sleeve Gastrectomy Plus Procedures for Treatment of Morbid Obesity: Systematic Review and Meta-Analysis. Obes Surg. 2021 Jul;31(7):3303-3311. doi: 10.1007/s11695-021-05456-0
33. **Esparham A, Roohi S, Ahmadyar S,** et al. The Efficacy and Safety of Laparoscopic Single-Anastomosis Duodeno-ileostomy with Sleeve Gastrectomy (SADI-S) in Mid- and Long-Term Follow-Up: a Systematic Review. Obes Surg. 2023 Dec;33(12):4070-4079. doi: 10.1007/s11695-023-06846-2
34. **Pereira SS, Guimarães M, Almeida R,** et al. Biliopancreatic diversion with duodenal switch (BPD-DS) and single-anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S) result in distinct post-prandial hormone profiles. Int J Obes (Lond). 2019 Dec;43(12):2518-2527. doi: 10.1038/s41366-018-0282-z
35. **Guimarães M, Pereira SS, Holst JJ, Nora M, Monteiro MP.** Can Metabolite and Hormone Profiles Provide a Rationale for Choosing Between Bariatric Procedures? Obes Surg. 2021 May;31(5):2174-2179. doi: 10.1007/s11695-021-05246-8
36. **Wang T, Shen Y, Qiao Z, Wang Y, Zhang P, Yu B.** Comparison of Diabetes Remission and Micronutrient Deficiency in a Mildly Obese Diabetic Rat Model Undergoing SADI-S Versus RYGB. Obes Surg. 2019 Apr;29(4):1174-1184. doi: 10.1007/s11695-018-03630-5
37. **Magouliotis DE, Tasiopoulou VS, Tzovaras G.** One anastomosis gastric bypass versus Roux-en-Y gastric bypass for morbid obesity: a meta-analysis. Clin Obes. 2018 Jun;8(3):159-169. doi: 10.1111/cob.12246
38. **Robert M, Espalieu P, Pelascini E,** et al. Efficacy and safety of one anastomosis gastric bypass versus Roux-en-Y gastric bypass for obesity (YOMEGA): a multicentre, randomised, open-label, non-inferiority trial. Lancet. 2019 Mar 30;393(10178):1299-1309. doi: 10.1016/S0140-6736(19)30475-1
39. **Cornejo J, Evans LA, Castillo-Larios R, Celik NB, Elli EF.** One anastomosis gastric bypass as a primary bariatric surgery: MBSAQIP database analysis of short-term safety and outcomes. Surg Endosc. 2024 Jan;38(1):270-279. doi: 10.1007/s00464-023-10535-7
40. **Shah K, Nergård BJ, Fagerland MW, Gislason H.** Limb Length in Gastric Bypass in Super-Obese Patients-Importance of Length of Total Alimentary Small Bowel Tract. Obes Surg. 2019 Jul;29(7):2012-2021. doi: 10.1007/s11695-019-03836-1
41. **Miras AD, Kamocka A, Perez-Pevida B,** et al. The Effect of Standard Versus Longer Intestinal Bypass on GLP-1 Regulation and Glucose Metabolism in Patients With Type 2 Diabetes Undergoing Roux-en-Y Gastric Bypass: The Long-Limb Study. Diabetes Care. 2021 May;44(5):1082-1090. doi: 10.2337/dc20-0762

42. **Fisher DP, Johnson E, Haneuse S,** et al. Association Between Bariatric Surgery and Macrovascular Disease Outcomes in Patients With Type 2 Diabetes and Severe Obesity. JAMA. 2018 Oct 16;320(15):1570-1582. doi: 10.1001/jama.2018.14619
43. **Aminian A, Zajichek A, Arterburn DE,** et al. Association of Metabolic Surgery With Major Adverse Cardiovascular Outcomes in Patients With Type 2 Diabetes and Obesity. JAMA. 2019 Oct 1;322(13):1271-1282. doi: 10.1001/jama.2019.14231
44. **Wilson RB, Lathigara D, Kaushal D.** Systematic Review and Meta-Analysis of the Impact of Bariatric Surgery on Future Cancer Risk. Int J Mol Sci. 2023 Mar 24;24(7):6192. doi: 10.3390/ijms24076192
45. **Wiggins T, Guidozzi N, Welbourn R, Ahmed AR, Markar SR.** Association of bariatric surgery with all-cause mortality and incidence of obesity-related disease at a population level: A systematic review and meta-analysis. PLoS Med. 2020 Jul 28;17(7):e1003206. doi: 10.1371/journal.pmed.1003206
46. **Carlsson LMS, Sjöholm K, Jacobson P,** et al. Life Expectancy after Bariatric Surgery in the Swedish Obese Subjects Study. N Engl J Med. 2020 Oct 15;383(16):1535-1543. doi: 10.1056/NEJMoa2002449
47. **Syn NL, Cummings DE, Wang LZ,** et al. Association of metabolic-bariatric surgery with long-term survival in adults with and without diabetes: a one-stage meta-analysis of matched cohort and prospective controlled studies with 174 772 participants. Lancet. 2021 May 15;397(10287):1830-1841. doi: 10.1016/S0140-6736(21)00591-2
48. **Schauer PR, Bhatt DL, Kirwan JP,** et al. Bariatric Surgery versus Intensive Medical Therapy for Diabetes - 5-Year Outcomes. N Engl J Med. 2017 Feb 16;376(7):641-651. doi: 10.1056/NEJMoa1600869
49. **Lincoff AM, Brown-Frandsen K, Colhoun HM,** et al. Semaglutide and Cardiovascular Outcomes in Obesity without Diabetes. N Engl J Med. 2023 Dec 14;389(24):2221-2232. doi: 10.1056/NEJMoa2307563
50. **Salman AA, Salman MA, Marie MA,** et al. Factors associated with resolution of type-2 diabetes mellitus after sleeve gastrectomy in obese adults. Sci Rep. 2021 Mar 16;11(1):6002. doi: 10.1038/s41598-021-85450-9
51. **Głuszyńska P, Diemieszczyk I, Szczerbiński Ł, Krętowski A, Major P, Razak Hady H.** Risk factors for early and late complications after laparoscopic sleeve gastrectomy in one-year observation. J Clin Med. 2022 Jan 15;11(2):436. doi: 10.3390/jcm11020436
52. **Ebadinejad A, Shahshahani M, Hosseinpanah F,** et al. Comparison of hypertension remission and relapse after sleeve gastrectomy and one-anastomosis gastric bypass: a prospective cohort study. Hypertens Res. 2023 May;46(5):1287-1296. doi: 10.1038/s41440-023-01180-7
53. **Zevallos A, Sanches EE, Parmar C, Ribeiro R, Pouwels S.** Remission of hypertension after laparoscopic sleeve gastrectomy versus Roux-en-Y-gastric bypass: a systematic review of randomized control trials. Surg Obes Relat Dis. 2024 Oct 12;S1550-7289(24)00851-7. doi: 10.1016/j.soard.2024.10.010
54. **McTigue KM, Wellman R, Nauman E,** et al. Comparing the 5-year diabetes outcomes of sleeve gastrectomy and gastric bypass: the National Patient-Centered Clinical Research Network (PCORNet) Bariatric Study. JAMA Surg. 2020 May 1;155(5):e200087. doi: 10.1001/jamasurg.2020.0087
55. **Balasubaramaniam V, Pouwels S.** Remission of type 2 diabetes Mellitus (T2DM) after sleeve gastrectomy (SG), one-anastomosis gastric bypass (OAGB), and roux-en-Y gastric bypass (RYGB): a systematic review. Medicina (Kaunas). 2023 May 19;59(5):985. doi: 10.3390/medicina59050985
56. **van der Laan L, Sizoo D, van Beek AP, Emous M; Dutch Audit for Treatment of Obesity Research Group.** Comparable results 5 years after one anastomosis gastric bypass compared to Roux-en-Y gastric bypass: a propensity-score matched analysis. Surg Obes Relat Dis. 2024 Oct 5:S1550-7289(24)00814-1. doi: 10.1016/j.soard.2024.09.009
57. **Balamurugan G, Leo SJ, Sivagnanam ST, et.** al Comparison of efficacy and safety between Roux-en-Y gastric bypass (RYGB) vs one anastomosis gastric bypass (OAGB) vs single anastomosis duodeno-ileal bypass with sleeve gastrectomy (SADI-S): a systematic review of bariatric and metabolic surgery. Obes Surg. 2023 Jul;33(7):2194-2209. doi: 10.1007/s11695-023-06602-6
58. **Benotti P, Wood GC, Winegar DA,** et al. Risk factors associated with mortality after Roux-en-Y gastric bypass surgery. Ann Surg. 2014 Jan 1;259(1):123-30. doi: 10.1097/SLA.0b013e31828a0ee4
59. **Thomopoulos T, Mantziari S, Joliat GR.** Long-term results of Roux-en-Y gastric bypass (RYGB) versus single anastomosis duodeno-ileal bypass (SADI) as revisional procedures after failed sleeve gastrectomy: a systematic literature review and pooled analysis. Langenbeck's Arch Surg. 2024 Nov 23;409(1):354. doi: 10.1007/s00423-024-03557-9

**TO CITE THIS ARTICLE:**
Au C, Brumer R, Schroer J, Tariq N. Surgical Strategies for the Management of Obesity. Methodist DeBakey Cardiovasc J. 2025;21(2):84-93. doi: 10.14797/mdcvj.1513

**Submitted:** 28 October 2024 **Accepted:** 02 December 2024 **Published:** 18 February 2025



*Methodist DeBakey Cardiovascular Journal* is a peer-reviewed open access journal published by Houston Methodist DeBakey Heart & Vascular Center.