



How Do We Treat Obesity?

Bariatric Surgery



AACE OBESITY RESOURCE CENTER

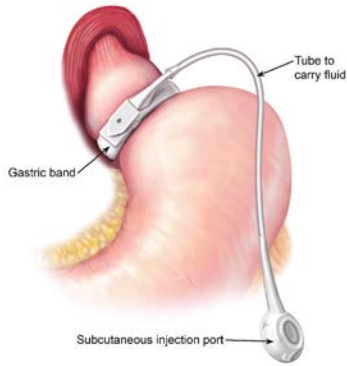
AACE ONLINE ENDOCRINE ACADEMY



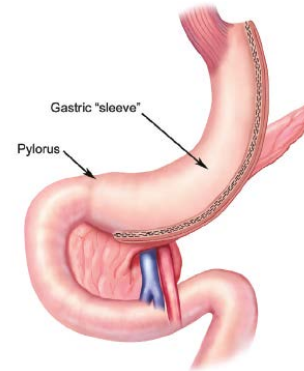
Bariatric Surgery

Surgery Options

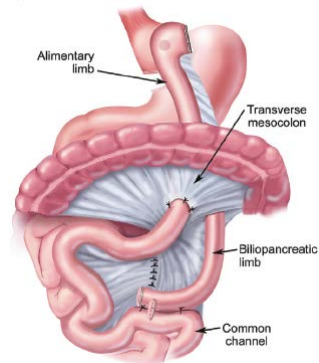
Surgical Options



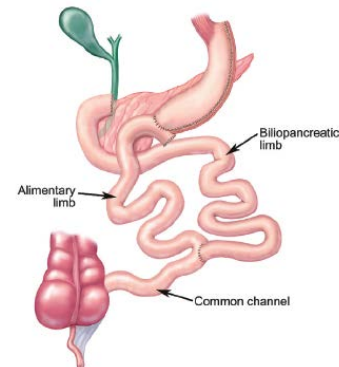
Laparoscopic Adjustable Gastric Band (LABG)



Laparoscopic Sleeve Gastrectomy (LSG)

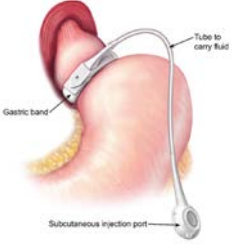


Roux-en-Y Gastric Bypass (RYGB)



Biliopancreatic Diversion with Duodenal Switch

Laparoscopic Adjustable Gastric Band (LAGB)

Expected weight loss / mechanism	EWL: 14% - 60% after 7-10 y	Use adjustable band to create upper gastric pouch of 15-45 mL and restrict inlet to stomach <ul style="list-style-type: none"> • Produce early satiety and limit food intake 	
Safety	1-Year mortality: 0.08%; 30-day reoperation/intervention rate: 0.92%; overall complication rate: 3.2%; high reoperation rate due to complications or weight loss failure		
Common complications	Band slippage and erosion Band and port infections Balloon failure	Port malposition Esophageal dilatation	
Postoperative metabolic management	Greater adherence to lifestyle change required to maintain weight loss Daily multivitamin plus calcium with vitamin D; additional nutrient supplementation as needed		
Reversible?	Yes		
Cost	\$\$*		

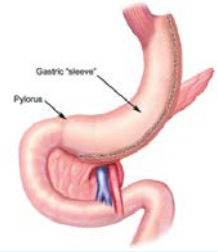
*Increased risk of procedure failure may increase overall costs.

EWL = excess weight loss (ie, weight loss as percentage of excess body weight).

Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83. Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372.

Jackson TD, Hutter MM. *Adv Surg.* 2012;46:25-268.

Laparoscopic Sleeve Gastrectomy (LSG)

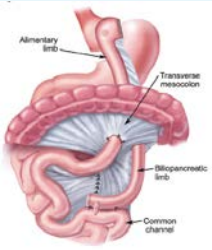
Expected weight loss / mechanism	EWL: 50% - 55% after 5-9 y	Excision of lateral aspect of stomach to create smaller gastric tube <ul style="list-style-type: none"> Limits food intake Increases GLP-1 and PYY; decreases ghrelin 	
Safety	1-Year mortality: 0.21%; 30-day reoperation/intervention rate: 2.97%; major complication rate: 12.1% Long-term safety/effectiveness data lacking (>5-10 years)		
Common complications	Staple line leak Staple line bleeding	Sleeve stenosis Sleeve kinking Sleeve dilation	
Postoperative metabolic management	Daily multivitamin-mineral preparation plus iron, vitamin B ₁₂ , and calcium with vitamin D; iron may be required in some patients		
Reversible?	No		
Cost	\$\$\$		

EWL = excess weight loss (ie, weight loss as percentage of excess body weight).

Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83. Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372.

Jackson TD, Hutter MM. *Adv Surg.* 2012;46:25-268.

Roux-en-Y Gastric Bypass (RYGB)

Expected weight loss / mechanism	EWL: 60%-70% after 7-10 y	Stomach transected to create proximal gastric pouch of 10-30 mL, which is anastomosed to a Roux-en-Y proximal jejunal segment, bypassing remainder of stomach and duodenum <ul style="list-style-type: none"> • Limits food intake • Induces micronutrient malabsorption • Decreases ghrelin and increases PYY and GLP-1 	
Safety	1-Year mortality: 0.34%; 30-day reoperation/intervention rate: 5.02%; overall complication rate: 16%		
Common complications	Anastomotic leak Pouch dilation Internal hernia	Staple line disruption/failure Stomal ulceration Gastrogastric fistula	
Postoperative metabolic management	Daily multivitamin-mineral preparation plus iron, vitamin B ₁₂ , and calcium with vitamin D; additional nutrient supplementation as needed		
Reversible?	Yes		
Cost	\$\$\$		

EWL = excess weight loss (ie, weight loss as percentage of excess body weight).

Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83. Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372. Jackson TD, Hutter MM. *Adv Surg.* 2012;46:25-268.

Biliopancreatic Diversion with Duodenal Switch (BPD-DS)

Expected weight loss / mechanism	<p>EWL: 60% - 80% after 7-10 y</p>	<p>Sleeve gastrectomy with intestinal bypass of all but ~100-150 cm of distal ileum</p> <ul style="list-style-type: none"> Limits digestion and absorption to 50-100 cm of small intestine Induces extensive nutrient and caloric malabsorption 	
Safety	<p>1-Year mortality : 1.1%; overall complication rate: 16%</p>		
Common complications	<p>Anastomotic leak Pouch dilation Incisional hernia</p>	<p>Staple line disruption/failure Stomal ulceration Gastrogastric fistula Malabsorption with nutritional deficiencies</p>	
Postoperative metabolic management	<p>Daily multivitamin-mineral preparation plus iron, vitamin B₁₂, calcium with vitamin D, and fat-soluble vitamins</p>		
Reversible?	<p>Partially</p>		
Cost	<p>\$\$\$</p>		

EWL = excess weight loss (ie, weight loss as percentage of excess body weight).

Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83. Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372.



Bariatric Surgery

Outcomes Data

Effects of Different Types of Bariatric Surgery on Weight

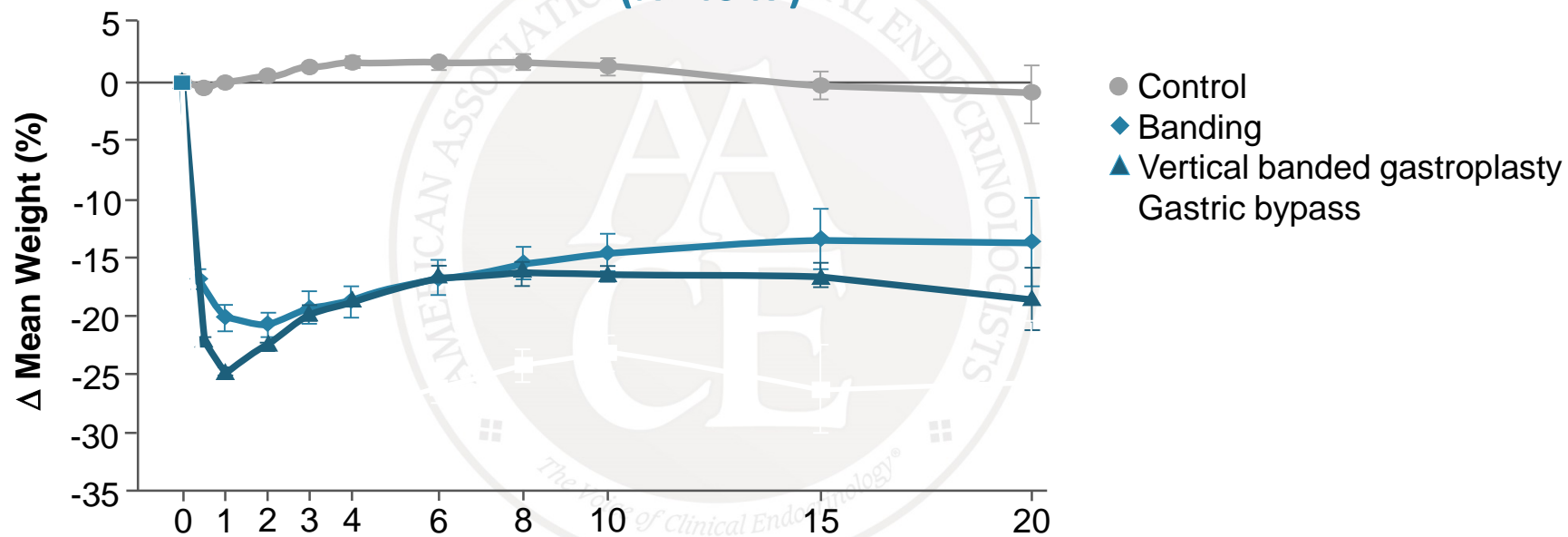
Weight Loss as a Percentage of Excess Body Weight

Procedure	Follow-up Period (years)		
	1-2	3-6	7-10
Vertical banded gastroplasty	50-72	25-65	—
Gastric banding	29-87	45-72	14-60
Laparoscopic sleeve gastrectomy	33-58	66	50-55
Roux-en-Y gastric bypass	48-85	53-77	25-68
Banded Roux-en-Y gastric bypass	73-80	66-78	60-70
Long-limb Roux-en-Y gastric bypass	53-74	55-74	—
Biliopancreatic diversion ± duodenal switch	65-83	62-81	60-80

Weight Loss with Different Bariatric Surgeries in Severely Obese Patients

Swedish Obese Subjects Study

(N=4047)



No. patients

	Years									
	0	1	2	3	4	6	8	10	15	20
Control	2037	1490	1242	1267	556	176				
Banding	376	333	284	284	150	50				
Gastroplasty	1369	1086	987	1007	489	82				
Bypass	265	209	184	180	37	13				

BMI entry criteria: ≥ 34 kg/m² men, ≥ 38 kg/m² women.

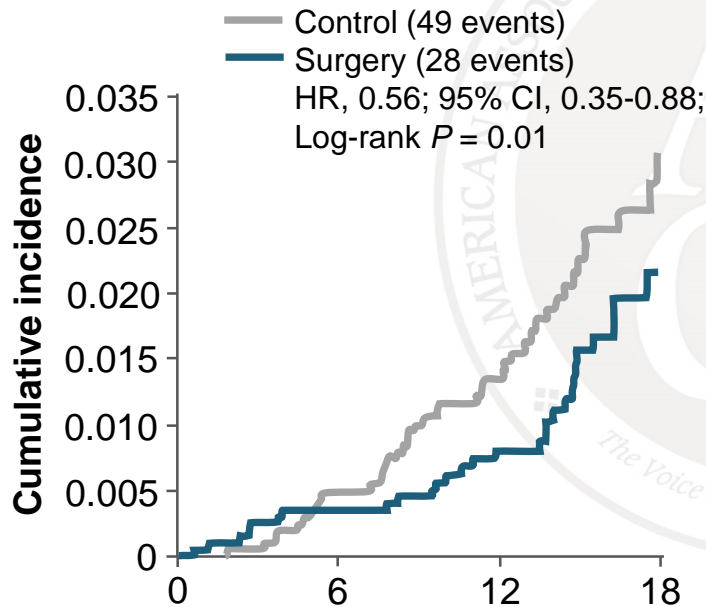
Sjostrom L, et al. *JAMA*. 2012;307:56-65.

Bariatric Surgery Reduces Mortality in Severely Obese Patients

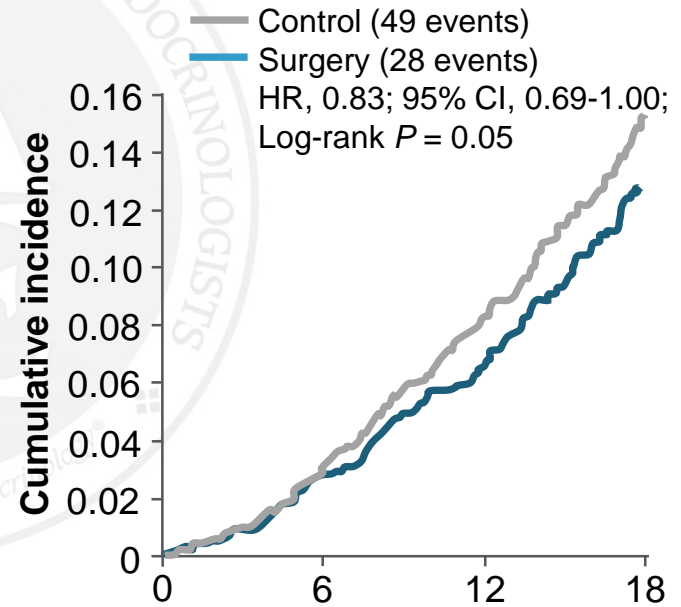
Swedish Obese Subjects Study

(N=4047)

Fatal CV Events



Total CV Events



No. at risk

Control	2037	1993	1423	405
Surgery	2010	1970	1557	412

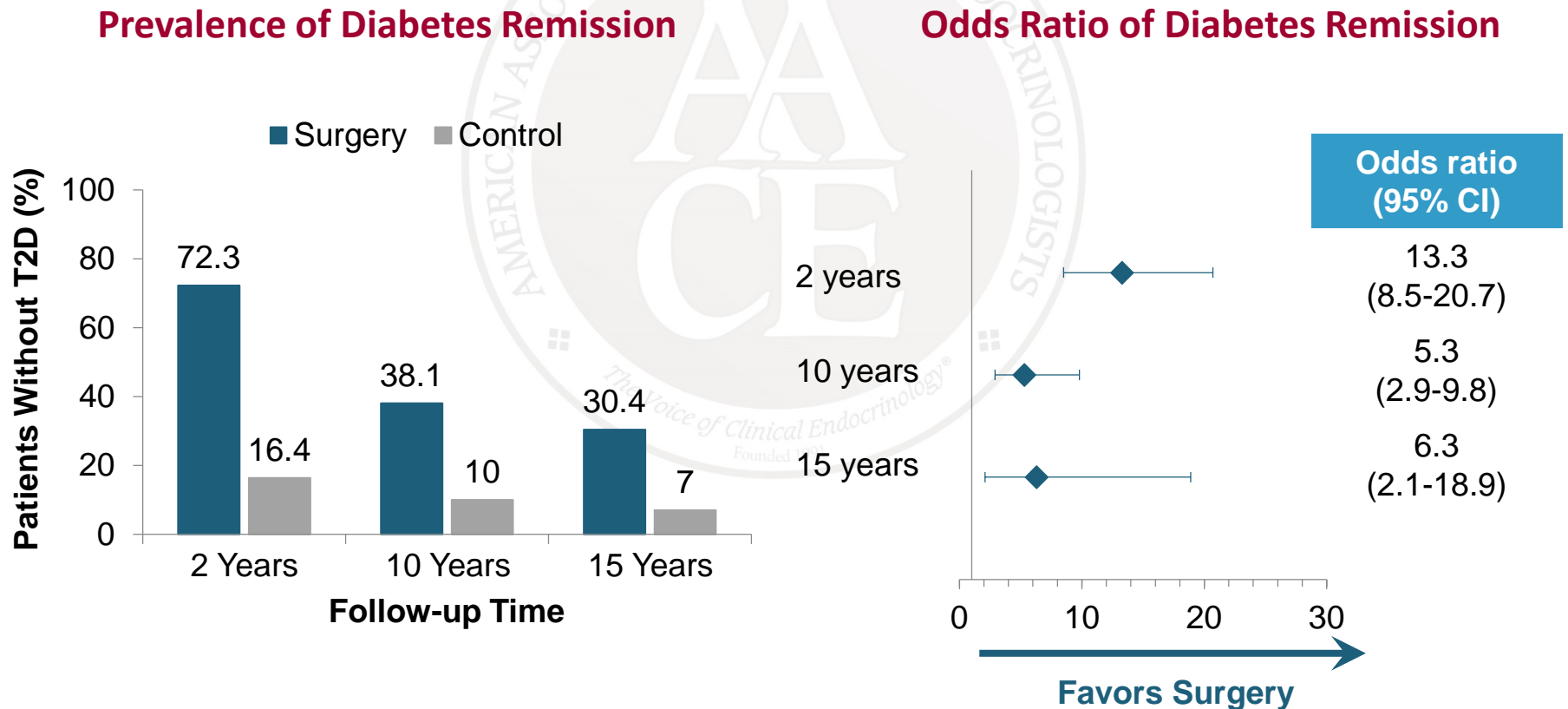
Control	2037	1945	1326	361
Surgery	2010	1921	1468	375

BMI entry criteria: ≥ 34 kg/m² men, ≥ 38 kg/m² women.

Sjostrom L, et al. *JAMA*. 2012;307:56-65.

Long-Term Diabetes Remission After Bariatric Surgery

Swedish Obese Subjects Study (N=603 Patients with T2D at Baseline)



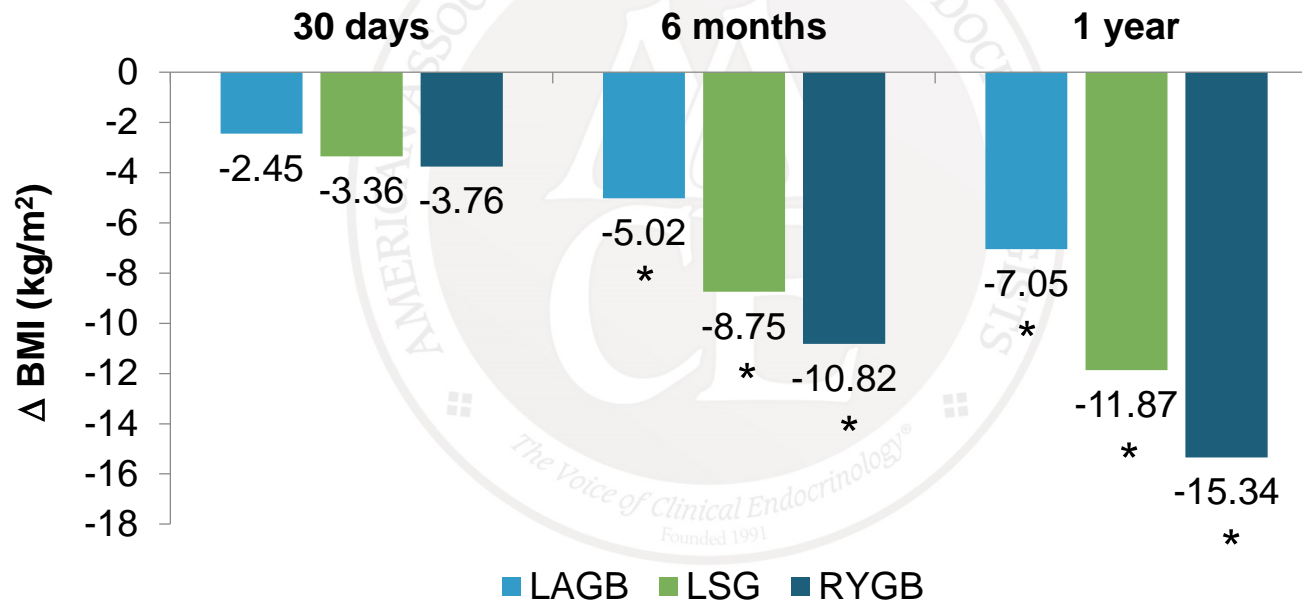
T2D = type 2 diabetes.

Sjostrom L, et al. *JAMA*. 2014;311:2297-2304.

Weight Loss with Different Bariatric Surgeries in Obese Patients

ACS Bariatric Surgery Center Network Prospective Observational Study

(N=28,616)



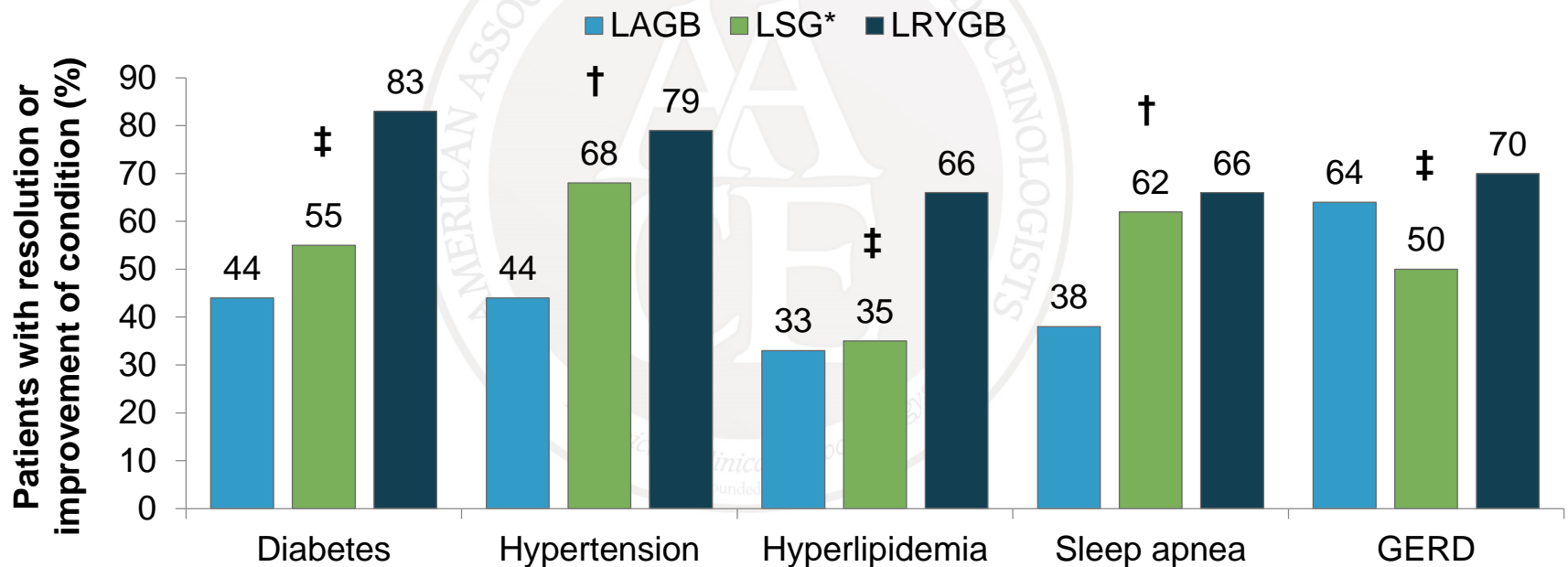
*P<0.05 vs baseline.

ACS = American College of Surgeons; BL = baseline; BMI = body mass index; LAGB = laparoscopic adjustable gastric band; LSG = laparoscopic sleeve gastrectomy; RYGB = Roux-en-Y gastric bypass.

Hutter MM, et al. *Ann Surg.* 2011;254:410-420.

Effect of Different Bariatric Surgeries on Weight-Related Comorbidities at 1 Year

ACS Bariatric Surgery Center Network Prospective Observational Study (N=28,616)



*Small numbers of patients with 1 year of follow-up for all comorbidities (n≤38).

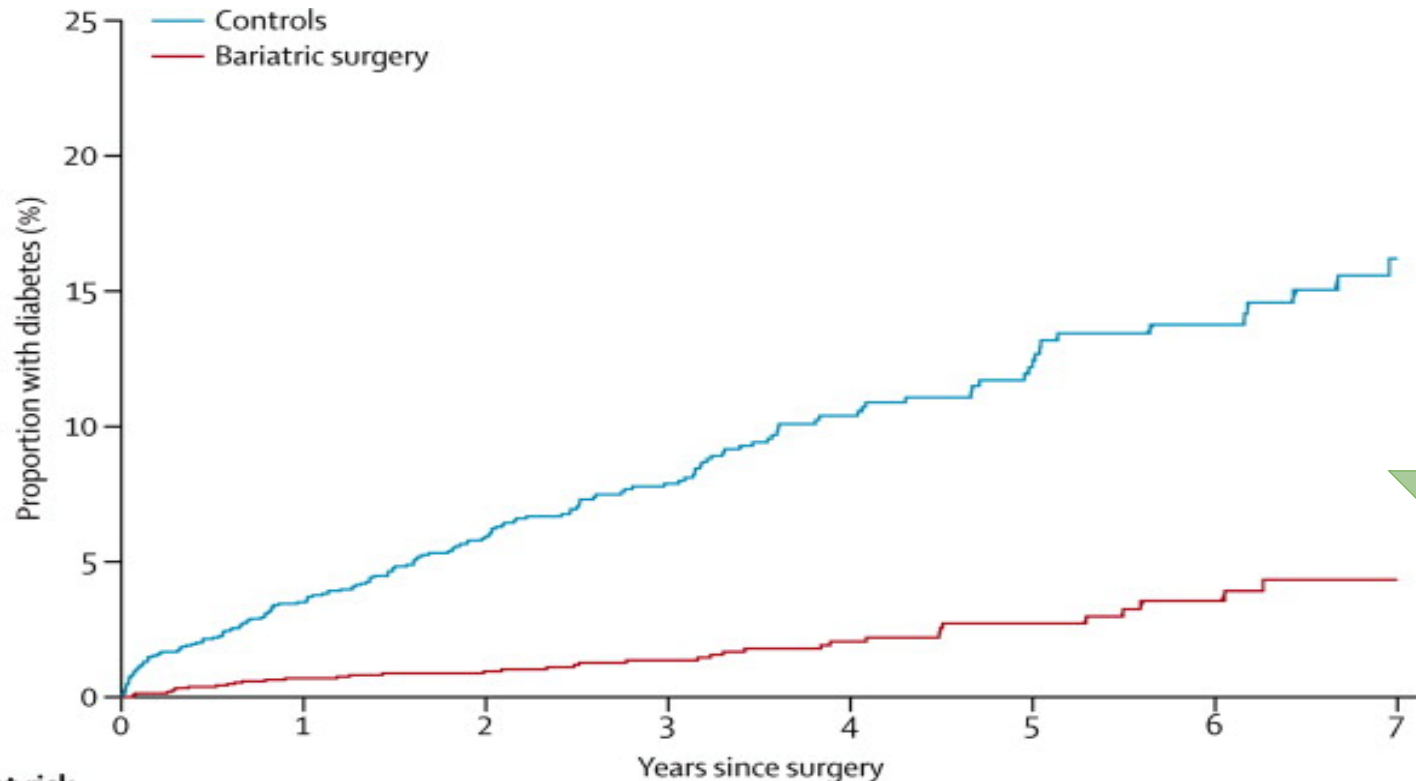
†P<0.05 vs LAGB; ‡P<0.05 vs LRYGB.

ACS = American College of Surgeons; BMI = body mass index; GERD = gastroesophageal reflux disease; LAGB = laparoscopic adjustable gastric band; LSG = laparoscopic sleeve gastrectomy; LRYGB = laparoscopic Roux-en-Y gastric bypass.

Hutter MM, et al. *Ann Surg.* 2011;254:410-420.

Incidence of Diabetes After Bariatric Surgery

UK Population-Based Matched Cohort Study*



Number at risk		Years since surgery							
		0	1	2	3	4	5	6	7
Controls	..	1847	1317	857	558	358	238	132	
Bariatric surgery	..	1759	1369	1017	692	440	264	154	

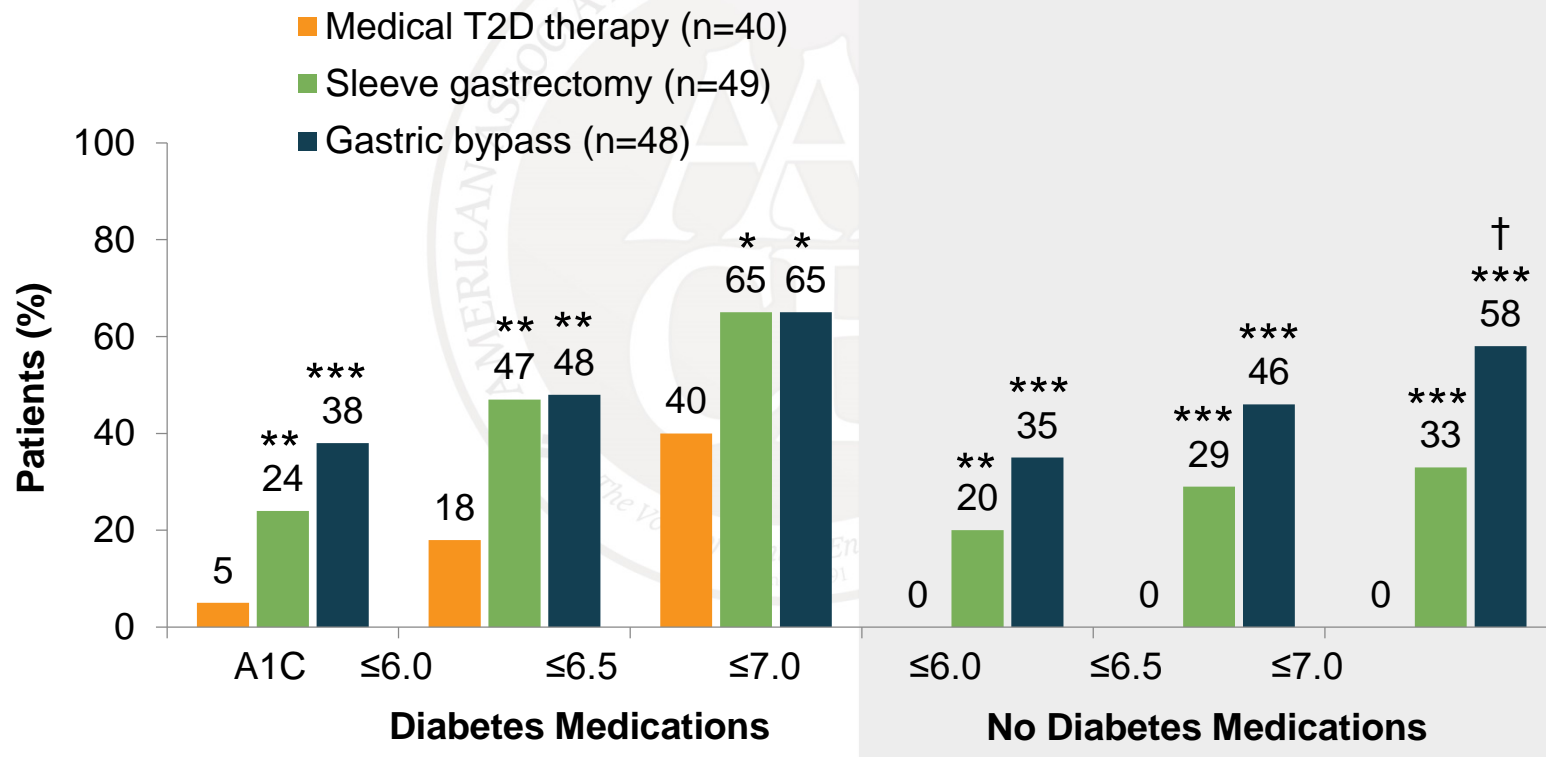
*Matched for BMI, age, gender, index year, and A1C.

BMI = body mass index.

Booth H, et al. *Lancet Diabetes Endocrinol.* 2014;2:963-968.

Resolution of Type 2 Diabetes After 3 Years

STAMPEDE Trial (N=150 Patients with T2D at Baseline)

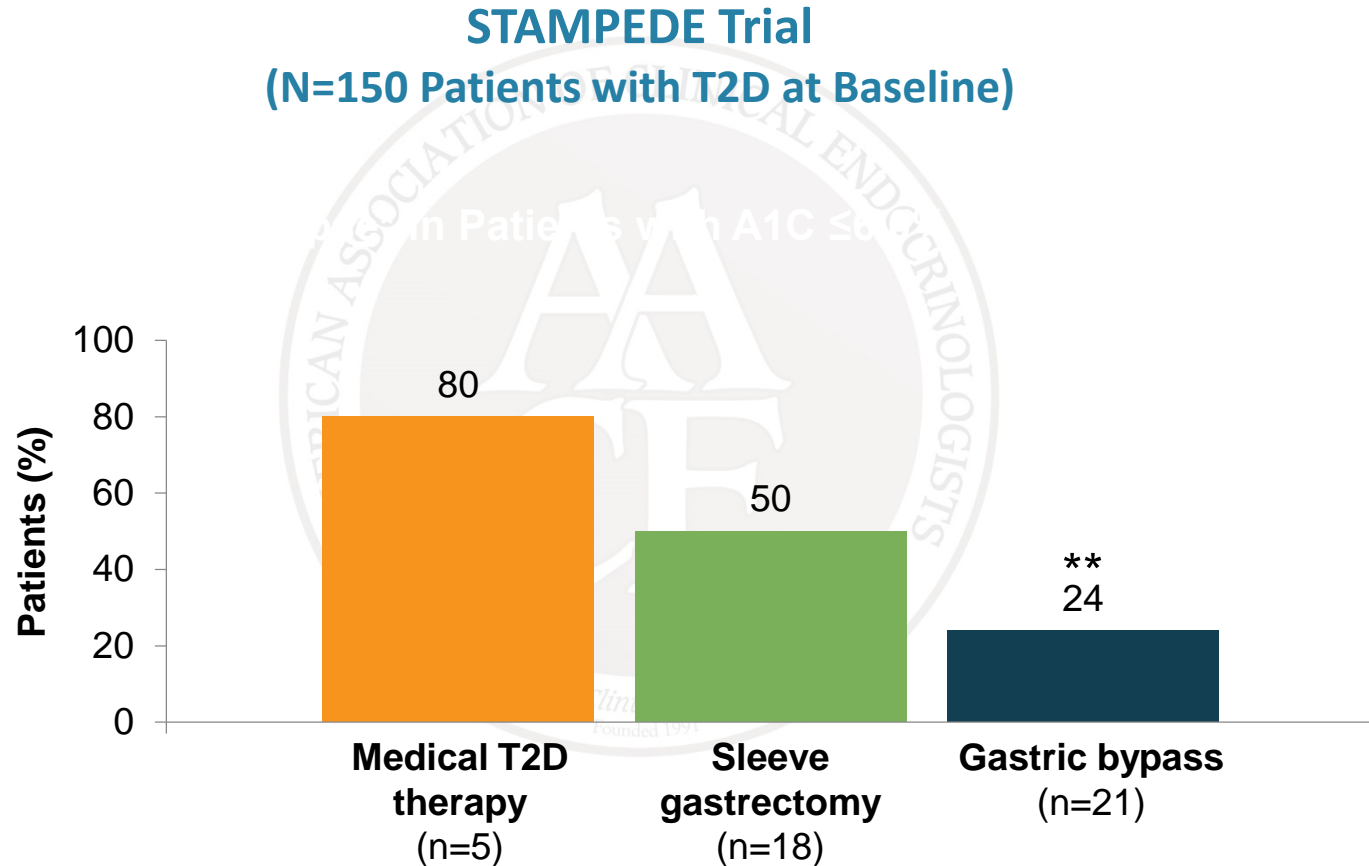


* $P < 0.05$, ** $P \leq 0.01$, *** $P < 0.001$ vs medical therapy. † $P = 0.01$ vs sleeve gastrectomy.

STAMPEDE = Surgical Treatment and Medications Potentially Eradicate Diabetes Efficiently; T2D = type 2 diabetes.

Schauer PR, et al. *N Engl J Med.* 2014;370:2002-2013.

Loss of Glycemic Control After 3 Years



*Defined as failure to maintain A1C \leq 6.0%.

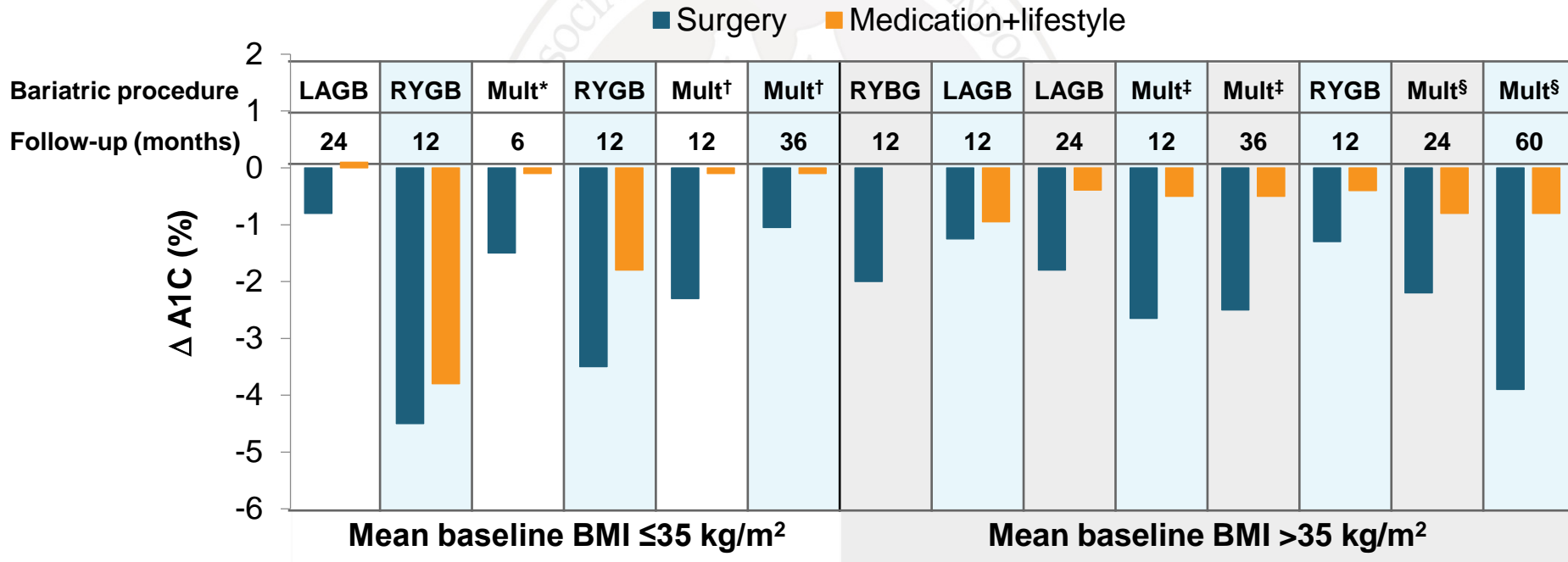
** $P=0.03$ vs medical therapy.

T2D = type 2 diabetes.

Schauer PR, et al. *N Engl J Med.* 2014;370:2002-2013.

Effect of Bariatric Surgery vs Medication Plus Lifestyle Therapy on A1C in T2D

Second Diabetes Surgery Summit (Systematic Review; N=11 RCTs)



*RYGB, LAGB, or SG. †RYGB or LAGB. ‡SYGB or SG. §RYGB or BPD.

BPD = biliopancreatic diversion; BMI = body mass index; LAGB = laparoscopic adjustable gastric band; Mult = multiple treatment arms; RCT = randomized controlled trial; RYGB = Roux en Y gastric bypass; SG = sleeve gastrectomy; T2D = type 2 diabetes.


Rubino F, et al. *Diabetes Care*. 2016;39:861-877.



Bariatric Surgery

Emerging Approaches

Gastric Plication

Expected weight loss / mechanism	EWL: 57% after 3 y	Sutured invagination of stomach to create smaller gastric tube <ul style="list-style-type: none"> Limits food intake <i>Still experimental; no consensus on procedural approach/method</i>	
Safety	No mortality reported to date but small number of completed procedures (N<500); complication rate: 8% - 15%		
Common complications	Vomiting Gastric obstruction Gastric perforation	Gastric leak Gastrointestinal bleeding	
Postoperative metabolic management	Daily multivitamin-mineral preparation; iron may be required in some patients		
Reversible?	Yes		
Cost	\$\$\$		

EWL = excess weight loss (ie, weight loss as percentage of excess body weight).

Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372. Abdelbaki TN, et al. *Obes Surg.* 2012;22:1633-1639.

Endoscopically Implanted Intragastric Balloons

Expected weight loss	Excess weight loss*: 30% - 50% after 6 months; 17% after 5 years Total weight loss: 10% after 6 months; 9 kg after 5 years
Mechanism	Gas- or fluid-filled silicone balloons that occupy space in stomach Maximum treatment duration: 6 months
Safety	Serious AEs: device migration, bowel obstruction and perforation Common AEs: nausea, vomiting, stomach pain in first 72 h
Cost	\$\$

*Weight loss as percentage of excess body weight.

Neylan CJ, et al. *Surg Obes Relat Dis*. 2016 Feb 11. [Epub ahead of print].

Endoscopic Treatments for Obesity Under Investigation

Procedure	Mechanism	EWL/ TWL (%)	Safety
Bypass liner: Endobarrier,* ValenTx	Sleeve extending from stomach into small bowel; food bypasses the stomach, duodenum and proximal jejunum Maximum treatment duration: 6 months	32-40 / 10	Serious AEs: hepatic abscesses with EndoBarrier*
Aspiration therapy	Gastronomy tube inserted into stomach; patient aspirates 30% of each meal 20 min after consumption	41 / 15	Serious AEs: severe pain requiring hospitalization, aseptic intra-abdominal fluid collection
Duodenal mucosal resurfacing	Superficial mucosal thermal ablation of diseased duodenal enteroendocrine cells to promote regeneration of healthy cells and restore signaling pathways	Not yet reported	Not yet reported
Vagal nerve stimulation	Gastric “pacemaker” in which electrodes placed in stomach to simulate satiety	Not yet reported	Not yet reported

*No longer under investigation due to safety concerns.

EWL = excess weight loss (ie, weight loss as percentage of excess body weight); TWL = total weight loss.

Neylan CJ, et al. *Surg Obes Relat Dis*. 2016 Feb 11. [Epub ahead of print]. Abu-Dayyeh BK, et al. *Rev Esp Enferm Dig*. 2014;106:467-476.



Bariatric Surgery

Physiological Effects

Effects of Bariatric Surgery on Appetite Control Mechanisms

Hormone	Potential post-surgical effect
↑ GLP-1	<ul style="list-style-type: none"> Increased satiety and decreased food intake
↑ Peptide YY	<ul style="list-style-type: none"> Increased satiety and decreased food intake Possible alterations to energy expenditure
↑ Oxyntomodulin	<ul style="list-style-type: none"> Increased satiety and decreased food intake
↑ GLP-2	<ul style="list-style-type: none"> Increased mucosal cell mass in response to injury, leading to <ul style="list-style-type: none"> Long-term increases in GLP-1 and PYY Gut proliferation, reducing malabsorption
↓ GIP	<ul style="list-style-type: none"> Reduced fat accumulation and long-term weight loss/maintenance
↓ Ghrelin(?)	<ul style="list-style-type: none"> Reduced appetite, possibly mediated by vagal denervation
Vagus denervation	<ul style="list-style-type: none"> Reduced hunger signals? Alterations in GI hormone release?
Altered gut flora	<ul style="list-style-type: none"> Shift in Bacteroidetes and Firmicutes bacterial populations to proportions more like those found in lean individuals

GIP = glucose-dependent insulinotropic polypeptide; GLP = glucagon-like peptide; PYY = protein YY.

Ionut V, Bergman RN. *J Diabetes Sci Technol*. 2011;5:1263-1282.



Bariatric Surgery

Patient Selection and Preparation

AACE/TOS/ASMBS Selection Criteria for Bariatric Surgery

Factor	Criteria
Weight (adults)	<p>BMI ≥ 40 kg/m² with no comorbidities</p> <p>BMI ≥ 35 kg/m² with ≥ 1 severe obesity-associated comorbidity</p> <p>BMI 30-34.9 kg/m² with diabetes or metabolic syndrome</p>
Weight loss history	<p>Failure of previous nonsurgical attempts at weight reduction, including nonprofessional programs (eg, Weight Watchers)</p>
Commitment	<p>Expectation that patient will adhere to postoperative care</p> <ul style="list-style-type: none"> ▪ Follow-up visits with healthcare team ▪ Recommended medical management, including use of dietary supplements ▪ Instructions regarding any recommended procedures or tests
Exclusion	<ul style="list-style-type: none"> ▪ BMI < 30 kg/m²; there is insufficient evidence to recommend bariatric surgery for control of glucose, lipids, or CV risk reduction independent of BMI ▪ Reversible endocrine or other disorders that can cause obesity ▪ Current drug or alcohol abuse ▪ Uncontrolled, severe psychiatric illness ▪ Lack of comprehension of risks, benefits, expected outcomes, alternatives, and required lifestyle changes ▪ Inability to tolerate general anesthesia due to cardiopulmonary illness

ASMBS = American Society for Metabolic & Bariatric Surgery; BMI = body mass index; CV = cardiovascular; TOS = The Obesity Society.

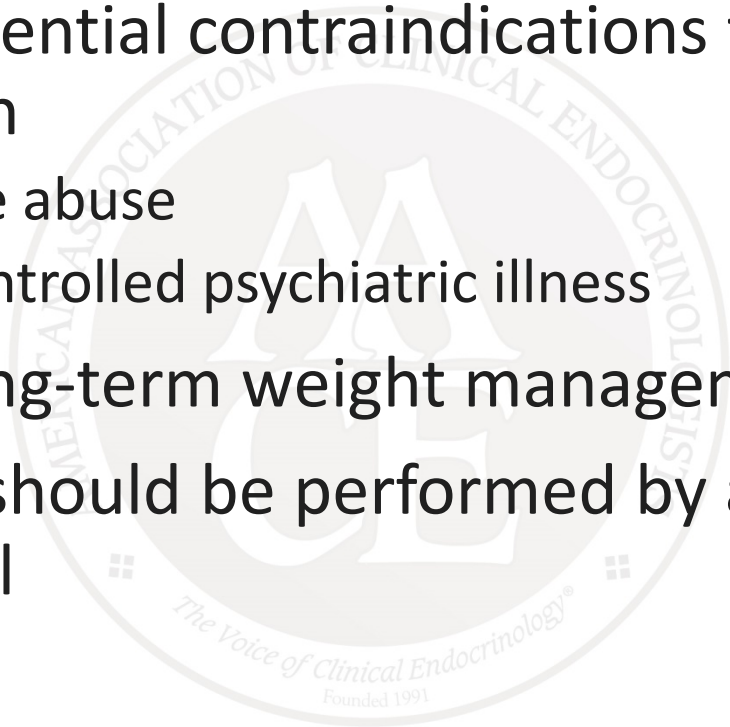
Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83. Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372.

Preoperative Management of Surgical Candidates

- Evaluate patient, including comprehensive medical history, physical examination, psychological assessment, and laboratory tests
- Document medical necessity for bariatric surgery
- Thoroughly discuss risks and benefits of surgery with patient
- Provide preoperative patient education and financial counseling
 - Ensure reimbursement criteria are met
- Consider preoperative weight loss for patients in whom reduction of liver volume will improve technical aspects of surgery

Psychological Evaluation of Bariatric Surgery Candidates

- Identify potential contraindications to surgical intervention
 - Substance abuse
 - Poorly controlled psychiatric illness
- Enhance long-term weight management
- Evaluation should be performed by a mental health professional



Medical Clearance for Bariatric Surgery

General Population

Nutritional	<ul style="list-style-type: none">▪ Micronutrients should be measured in all patients prior to surgery▪ Malabsorptive bariatric procedures require extensive perioperative nutritional evaluations
Pulmonary	<ul style="list-style-type: none">▪ All patients should have chest radiograph before surgery▪ Smokers should quit smoking ≥ 6 weeks before surgery and continue smoking cessation postoperatively
Psychosocial	<ul style="list-style-type: none">▪ All patients should undergo psychosocial evaluation to assess psychiatric, environmental, familial, and behavioral factors▪ Patient's ability to incorporate nutritional and behavioral changes after surgery should be assessed
Women's health	<ul style="list-style-type: none">▪ Avoid pregnancy for 12 months preoperatively and 18 months postoperatively; monitor for weight gain and fetal health if pregnancy occurs▪ Use nonoral contraception for women with RYGB or BPD-DS▪ Discontinue estrogens before surgery<ul style="list-style-type: none">▪ 1 cycle oral contraceptives in premenopausal women▪ 3 weeks hormone replacement therapy in postmenopausal women▪ LAGB band adjustment may be necessary in pregnant women▪ Monitor nutrition in pregnant women after bariatric surgery

Medical Clearance for Bariatric Surgery

Medical Conditions

Cardiovascular disease	<ul style="list-style-type: none">Existing cardiac disease: cardiology consultation prior to surgeryAt risk for CHD: evaluate for perioperative β-adrenergic blockadeDVT and PE: prophylactic vena cava filter may present greater risk than benefit
Diabetes	<ul style="list-style-type: none">Optimize preoperative glycemic control: A1C \leq7% (with more liberal targets in patients with more severe diabetic complications or comorbidities), FPG \leq110 mg/dL, 2-hr PPG \leq140 mg/dLReview perioperative glycemic control protocol <i>before</i> surgery
Gastrointestinal disorders	<ul style="list-style-type: none">Evaluate GI symptoms prior to surgeryPatients with increased LFT results or symptomatic biliary disease should undergo abdominal ultrasonography and viral hepatitis screenConsider <i>H pylori</i> screening in high prevalence areas
Gout	<ul style="list-style-type: none">Consider prophylactic treatment for gout attacks in patients with history of gout

Medical Clearance for Bariatric Surgery

Lipids	<ul style="list-style-type: none">▪ Treat according to NCEP ATP III recommendations
Obstructive sleep apnea	<ul style="list-style-type: none">▪ Initiate continuous positive airway pressure (CPAP) if appropriate
Polycystic ovary syndrome	<ul style="list-style-type: none">▪ Advise patients that fertility status may improve postoperatively
Psychiatric disorders	<ul style="list-style-type: none">▪ Patients with known or suspected psychiatric illness should undergo formal mental health evaluation before surgery
Pulmonary disease	<ul style="list-style-type: none">▪ Patients with pulmonary disease or sleep apnea should undergo formal pulmonary evaluation
Thyroid disease	<ul style="list-style-type: none">▪ Routine screening for primary hypothyroidism <i>not</i> recommended; screen only patients at risk for primary hypothyroidism▪ If hypothyroid found, initiate treatment with L-thyroxine before surgery

Psychosocial and Medical Factors Affecting Postoperative Weight Loss

Systematic Review of Bariatric Surgery Trials

Likely to have effect *		Not likely to have effect, or evidence unclear†
↑ Weight loss	↓ Weight loss	
Mandatory weight loss immediately before surgery	Preoperative BMI ≥ 50 kg/m ² Personality disorder	Number of previous weight loss attempts Binge eating, sweet eating, and other maladaptive eating habits Hunger Emotional eating Depression Anxiety Sexual abuse Self-esteem Alcohol use/abuse Other psychiatric disorders

*Based on ≥ 7 studies, with $\geq 50\%$ of studies showing an association.

†Based on insufficient number of studies (< 7) or $\geq 50\%$ showing no association.

Preoperative Weight Loss May Be Beneficial

2012 Systematic Review¹

- Evaluation of preoperative weight loss in the weeks immediately before surgery
- Results
 - Promote postop weight loss: 7 studies
 - No effect on postop weight loss: 6 studies
 - Reduce postop weight loss: 1 study
- Considerable heterogeneity in terms of study design and endpoints

AACE Recommendation²

- Preoperative weight loss should be considered for patients with hepatomegaly
 - Reduced liver volume improves operative exposure

AACE Bariatric Surgery Preoperative Checklist

✓	Complete history and physical examination	Obesity-related comorbidities, causes of obesity, weight, BMI, weight loss history, commitment, and exclusions related to surgical risk
✓	Routine labs	FPG and lipid panel, kidney function, liver profile, lipid profile, urine analysis, prothrombin time/INR, blood type, CBC
✓	Nutrient screening	Iron studies, B ₁₂ and folic acid (RBC folate, homocysteine, methylmalonic acid optional), and 25-vitamin D (vitamins A and E optional); consider more extensive testing in patients undergoing malabsorptive procedures based on symptoms and risks
✓	Cardiopulmonary evaluation with sleep apnea screening	ECG, CXR, echocardiography if cardiac disease or pulmonary hypertension suspected; DVT evaluation if clinically indicated
✓	GI evaluation	<i>H pylori</i> screening in high-prevalence areas; gallbladder evaluation and upper endoscopy if clinically indicated
✓	Endocrine evaluation	A1C with suspected or diagnosed prediabetes or diabetes; TSH with symptoms or increased risk of thyroid disease; androgens with PCOS suspicion; screening for Cushing's syndrome if clinically suspected
✓	Clinical nutrition	Evaluated by registered dietitian

AACE Bariatric Surgery Preoperative Checklist

✓	Psychosocial-behavioral evaluation
✓	Document medical necessity for bariatric surgery
✓	Informed consent
✓	Provide relevant financial information
✓	Continue efforts for preoperative weight loss
✓	Optimize glycemic control
✓	Pregnancy counseling
✓	Smoking cessation counseling
✓	Verify cancer screening by primary care physician

AACE Bariatric Surgery Postoperative Checklist

		LAGB	LSG	RYGB	BPD-DS
✓	Monitored telemetry at least 24 h if high risk for MI			✓	
✓	Protocol-derived staged meal progression supervised by RD			✓	
✓	Healthy eating education by RD			✓	
✓	Multivitamin plus minerals (# tablets for minimal requirement)	1	2	2	2
✓	Calcium Citrate, 1200-1500 mg/day			✓	
✓	Vitamin D, at least 3000 units/day, titrate to >30 ng/mL			✓	
✓	Vitamin B12 as needed for normal range levels			✓	
✓	Maintain adequate hydration (usually >1.5 L/day by mouth)			✓	
✓	Monitor blood glucose with diabetes or hypoglycemic symptoms			✓	
✓	Pulmonary toilet, spirometry, DVT prophylaxis			✓	
✓	If unstable, consider PE, IL	PE	PE	PE/IL	PE/IL
✓	If rhabdomyolysis suspected, check CPK			✓	

BPD-DS = biliopancreatic diversion with duodenal switch; CPK = creatinine phosphokinase; DVT = deep venous thrombosis; IL = intestinal leak; LAGB = laparoscopic adjustable gastric band; LSG = laparoscopic sleeve gastrectomy; PE = pulmonary embolism; RD = registered dietitian; RYGB = laparoscopic Roux-en-Y gastric bypass.



Bariatric Surgery
Follow-up

Common Surgical Complications

LAGB

- Band slippage and erosion
- Band and port infections
- Balloon failure
- Port malposition
- Esophageal dilatation

LSG, RYGB, BPD-DS

- Anastomotic leak
- Pouch dilation
- Incisional hernia
- Staple line disruption or failure
- Stomal ulceration
- Gastrogastic fistula
- Nutritional deficiency

BPD-DS = biliopancreatic diversion with duodenal switch; LAGB = laparoscopic adjustable gastric band; LSG = laparoscopic sleeve gastrectomy; RYGB = Roux-en-Y gastric bypass.

Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83. Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372.

Metabolic Complications of Bariatric Surgery

Complication	Clinical Features	Management
Acid-base disorder	Metabolic acidosis, ketosis	Bicarbonate orally or intravenously; adjust acetate content in PN
	Metabolic alkalosis	Salt and volume loading (enteral or parenteral)
Bacterial overgrowth (primarily with BPD-DS)	Abdominal distention Pseudo-obstruction Nocturnal diarrhea Proctitis Acute arthralgia	Antibiotics (metronidazole) Probiotics
Fat-soluble vitamin deficiency	Vitamin A—night vision Vitamin D—osteomalacia Vitamin E—rash, neurologic Vitamin K—coagulopathy	Vitamin A, 5,000-10,000 U/d Vitamin D, 400-50,000 U/d Vitamin E, 400 U/d Vitamin K, 1 mg/d ADEK, 2 tablets twice a day (http://www.scandipharm.com)
Folic acid deficiency	Hyperhomocysteinemia Anemia Fetal neural tube defects	Folic acid supplementation

BPD-DS = biliopancreatic diversion with duodenal switch; PN = parenteral nutrition.

Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83.

Metabolic Complications of Bariatric Surgery

Complication	Clinical Features	Management
Iron deficiency	Anemia	Ferrous fumarate, sulfate, or gluconate Up to 150-300 mg elemental iron daily Add vitamin C and folic acid
Osteoporosis	Fractures	DXA, calcium, vitamin D, and consider bisphosphonates
Oxalosis	Kidney stones	Low oxalate diet Potassium citrate Probiotics
Secondary hyperparathyroidism	Vitamin D deficiency Negative calcium balance Osteoporosis	DXA Serum intact PTH level 25-Hydroxyvitamin D levels Calcium and vitamin D supplements
Thiamine deficiency (vitamin B ₁)	Wernicke-Korsakoff encephalopathy Peripheral neuropathy Beriberi	Thiamine intravenously followed by large-dose thiamine orally
Vitamin B ₁₂ deficiency	Anemia Neuropathy	Parenteral vitamin B ₁₂ Methylmalonic acid

DXA = dual-energy x-ray absorptiometry; PN = parenteral nutrition; PTH = parathyroid hormone.

Mechanick JI, et al. *Endocr Pract.* 2008;14(suppl 1):1-83.

Follow-up for Nutrition and Metabolic Consultations After Bariatric Surgery

Procedure	Initial	Interval until stable	Once stable
LAGB	1 month	Every 1-2 months	Every 12 months
LSG	1 month	Every 3-6 months	Every 12 months
RYGB	1 month	Every 3 months	Every 6-12 months
BPD-DS	1 month	Every 3 months	Every 6 months



BPD-DS = biliopancreatic diversion with duodenal switch; LAGB = laparoscopic adjustable gastric band; LSG = laparoscopic sleeve gastrectomy; RYGB = Roux-en-Y gastric bypass.

Mechanick JI, et al. *Endocr Pract.* 2013;19:337-372.

AACE Bariatric Surgery Postoperative Follow-up Care

- Monitor progress with weight loss and evidence of complications each visit
- SMA-21, CBC/PLT with each visit (and iron at baseline and after as needed)
- Avoid nonsteroidal anti-inflammatory drugs
- Adjust postoperative medications
- Consider gout and gallstone prophylaxis in appropriate patients
- Need for antihypertensive therapy with each visit
- Lipid evaluation every 6-12 months based on risk and therapy
- Monitor adherence with physical activity recommendations

BPD-DS = biliopancreatic diversion with duodenal switch; CBC = complete blood count; LAGB = laparoscopic adjustable gastric band; LSG = laparoscopic sleeve gastrectomy; PLT = platelet count; RYGB = laparoscopic Roux-en-Y gastric bypass; SMA = smooth muscle antibody.

AACE Bariatric Surgery Postoperative Checklist

		LAGB	LSG	RYGB	BPD-DS
✓	Evaluate need for support groups	✓	✓	✓	✓
✓	Bone density (DXA) at 2 years	✓	✓	✓	✓
✓	24-hour urinary calcium excretion at 6 months and then annually	✓	✓	✓	✓
✓	B ₁₂ (annually; MMA and HCy optional; then every 3-6 months if supplemented)	✓	✓	✓	✓
✓	Folic acid (RBC folic acid optional), iron studies, 25-vitamin D, iPTH			✓	✓
✓	Vitamin A (initially and every 6-12 months thereafter)			Optional	✓
✓	Copper, zinc, and selenium evaluation with specific			✓	✓
✓	Thiamine evaluation with specific findings	✓	✓	✓	✓
✓	Consider eventual body contouring surgery	✓	✓	✓	✓

BPD-DS = biliopancreatic diversion with duodenal switch; DXA = dual energy X-ray absorptiometry; HCy = homocysteine; iPTH = intact parathyroid hormone; LAGB = laparoscopic adjustable gastric band; LSG = laparoscopic sleeve gastrectomy; MMA = methylmalonic acid; RBC = red blood count; RYGB = laparoscopic Roux-en-Y gastric bypass.



Bariatric Surgery Summary

Summary

- Four weight loss surgical options are available
 - Laparoscopic adjustable gastric band (LAGB)
 - Laparoscopic sleeve gastrectomy (LSG)
 - Biliopancreatic diversion with or without duodenal switch (BPD-DS) and with or without LSG (ie, staged BPD)
 - Roux-en-Y gastric bypass (RYGB)
- Weight loss and associated benefits: BPD-DS and RYGB > LSG > LAGB
- Post-surgical morbidity: RYGB and BPD-DS > LSG > LAGB
- Surgical candidates should be selected carefully with consideration of psychosocial as well as medical factors
- Nutritional and metabolic follow-up are vital to ensure positive outcomes