Bariatric Surgery: What an Internist needs to Know

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Disclosures

- Lilly: funding for developing educational program
- Novo Nordisk: funding for developing educational program and funding for clinical trials

Currently Available Options

- Accept weight where it is
- Diet/Exercise
- Drugs
- Surgery

Effectiveness

Low

High

Currently Available Options

- Accept weight where it is
- Diet/Exercise
- Drugs
- Surgery

Time/Cost/Risk

Low

High

A Guide to Selecting Treatment

Treatment	BMI category				
	25-26.9	27-29.9	30-34.9	35-39.9	≥40
Diet, physical activity, and behavior therapy	With co-morbidity	+	+	+	+
Pharmacotherapy		With co-morbidity	+	+	+
Surgery				With co-morbidity	+

Circulation. 2014 Jun 24;129(25 Suppl 2):S102-38

A 41-year-old woman who was born in India, and has a BMI of 29 kg/m^2 comes to see you for ongoing care of type 2 DM. According to the new ASMBS/ IFSO guidelines which of the following is the most accurate statement about her eligibility for bariatric surgery?

A. She is not eligible because her BMI is <35 kg/m^2
B. She is eligible because she is Asian and has a BMI >27 kg/m^2
C. She is not eligible because her BMI is <30 kg/m^2
D. She is eligible because she is Asian and has a BMI>25 kg/m^2

When poll is active, respond at **pollev.com/christinewes031**

Text **CHRISTINEWES031** to **22333** once to join

According to the new ASMBS/ IFSO guidelines which of the following is the most accurate statement about her eligibility for bariatric surgery?

She is not eligible because her BMI is <35 kg/m2

She is eligible because she is Asian and has a BMI >27 kg/m2

She is not eligible because her BMI is <30 kg/m2

She is eligible because she is Asian and has a BMI>25 kg/m2

ELSEVIER

Check for updates

Surgery for Obesity and Related Diseases 18 (2022) 1345–1356

SURGERY FOR OBESITY AND RELATED DISEASES

Original article

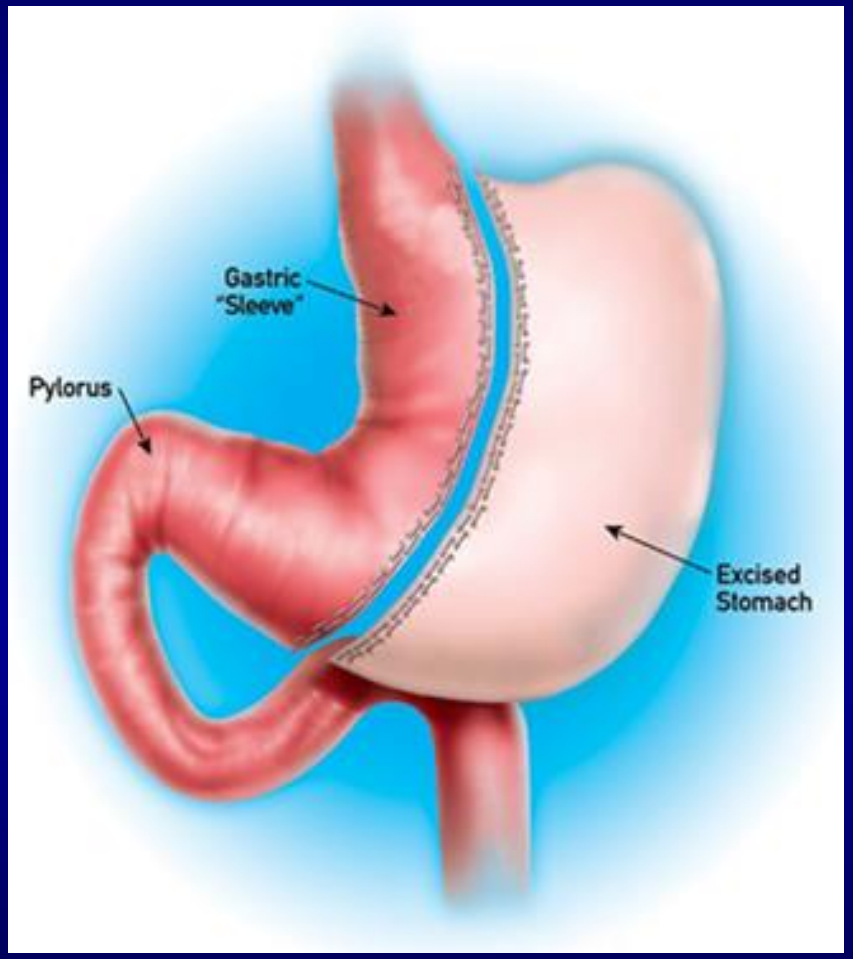
2022 American Society for Metabolic and Bariatric Surgery (ASMBS) and International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO): Indications for Metabolic and Bariatric Surgery

Major updates to 1991 National Institutes of Health guidelines for bariatric surgery

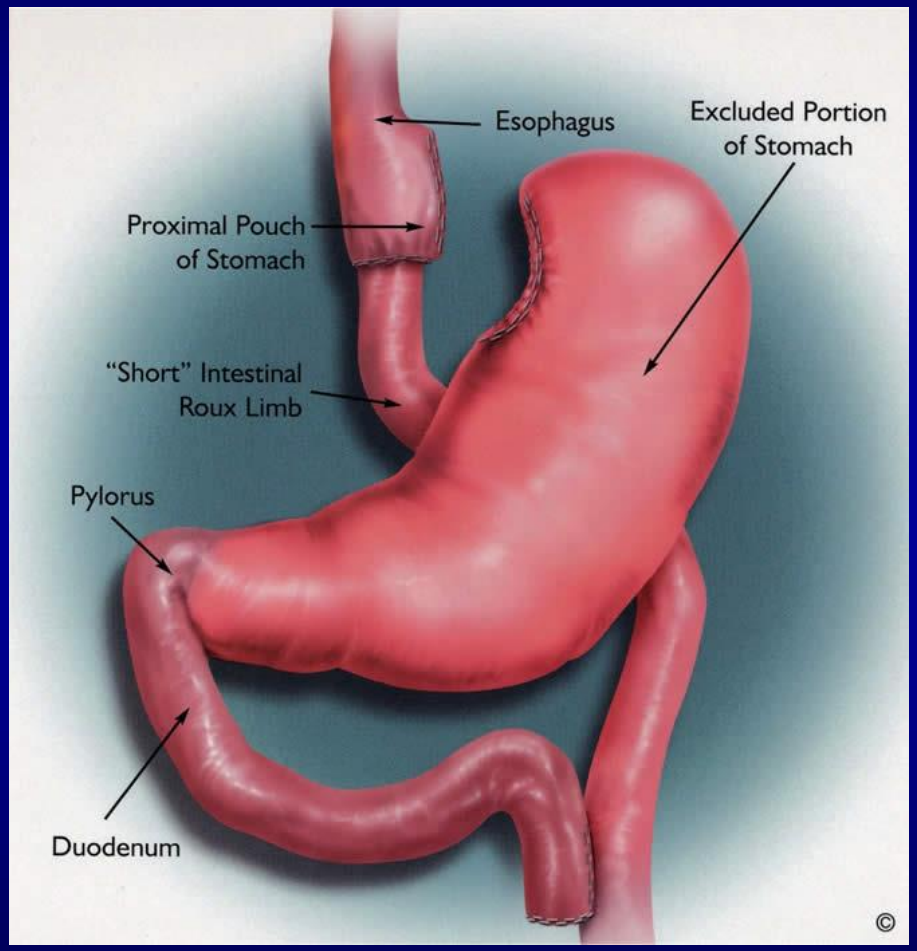
- Metabolic and bariatric surgery (MBS) is recommended for individuals with a body mass index (BMI) $\geq$35 kg/m^2, regardless of presence, absence, or severity of co-morbidities.
- MBS should be considered for individuals with metabolic disease and BMI of 30-34.9 kg/m^2.
- BMI thresholds should be adjusted in the Asian population such that a BMI $\geq$25 kg/m^2 suggests clinical obesity, and individuals with BMI $\geq$27.5 kg/m^2 should be offered MBS.
- Long-term results of MBS consistently demonstrate safety and efficacy.
- Appropriately selected children and adolescents should be considered for MBS.

Surg Obes Relat Dis. 2022 Dec;18(12):1345-1356

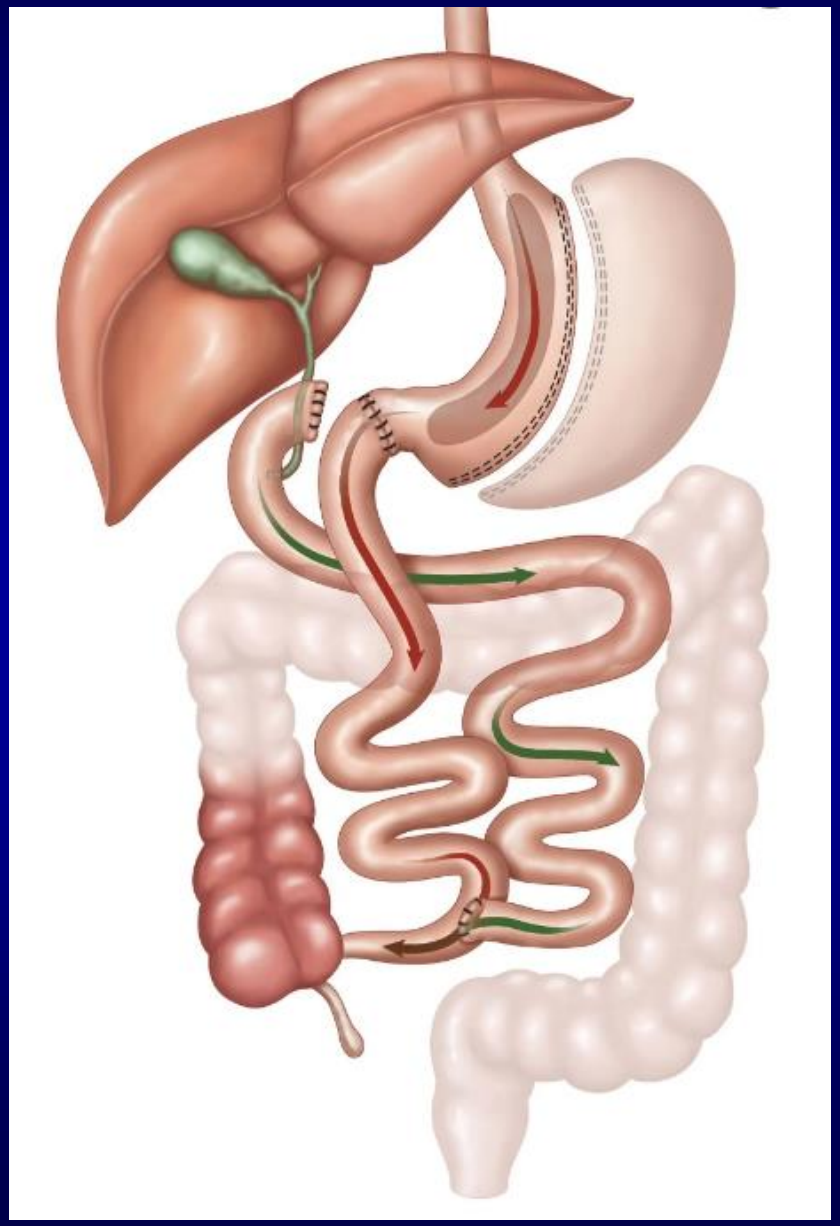
Sleeve Gastrectomy



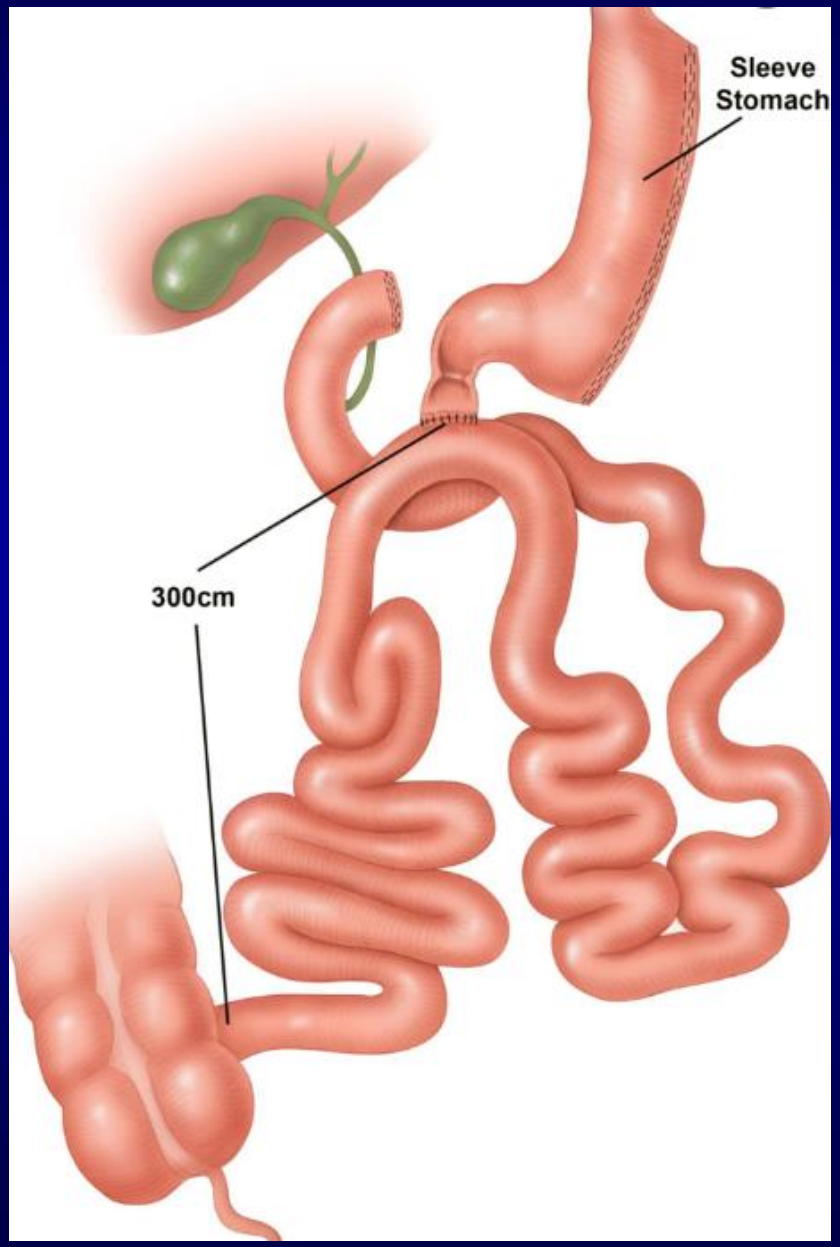
Gastric Bypass



Biliopancreatic diversion with duodenal switch (bpd/ds)

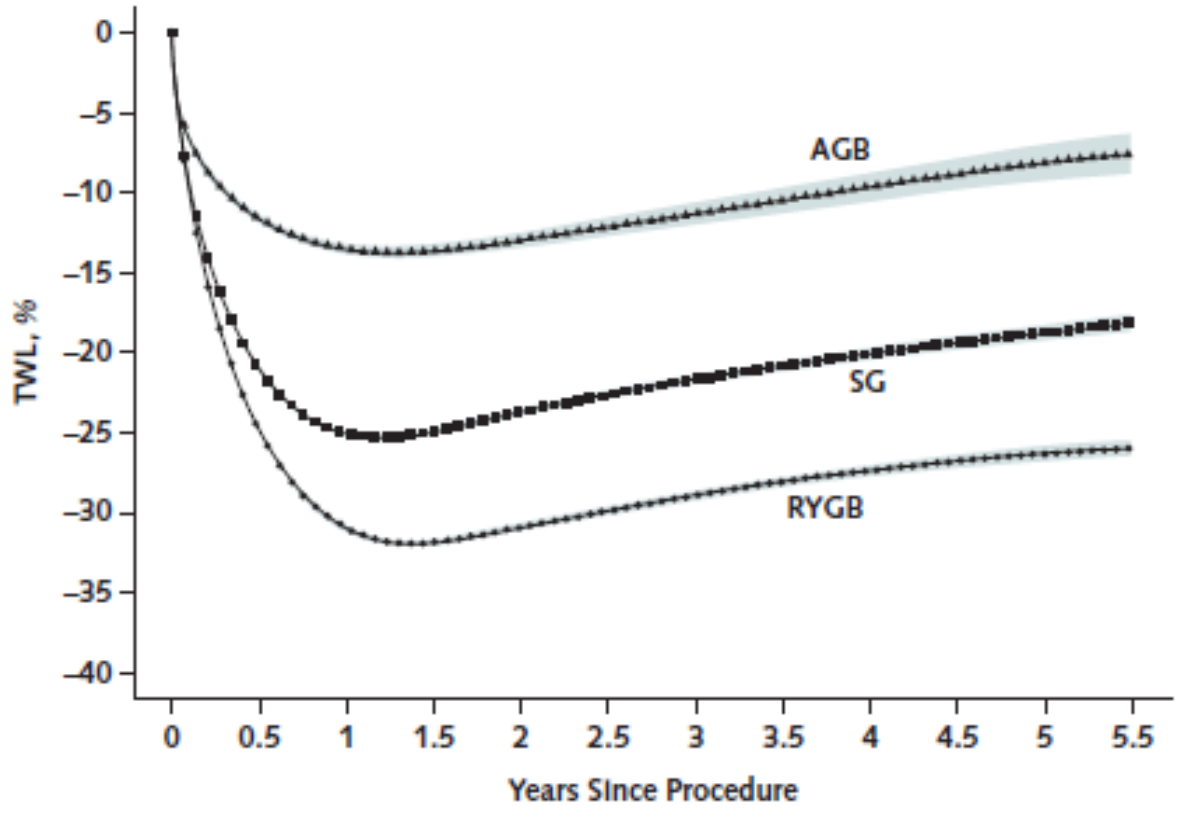


Single anastomosis duodenal switch



Comparative Effectiveness

Figure 2. Estimated percentage of TWL through 5 y after bariatric surgery, by procedure type.



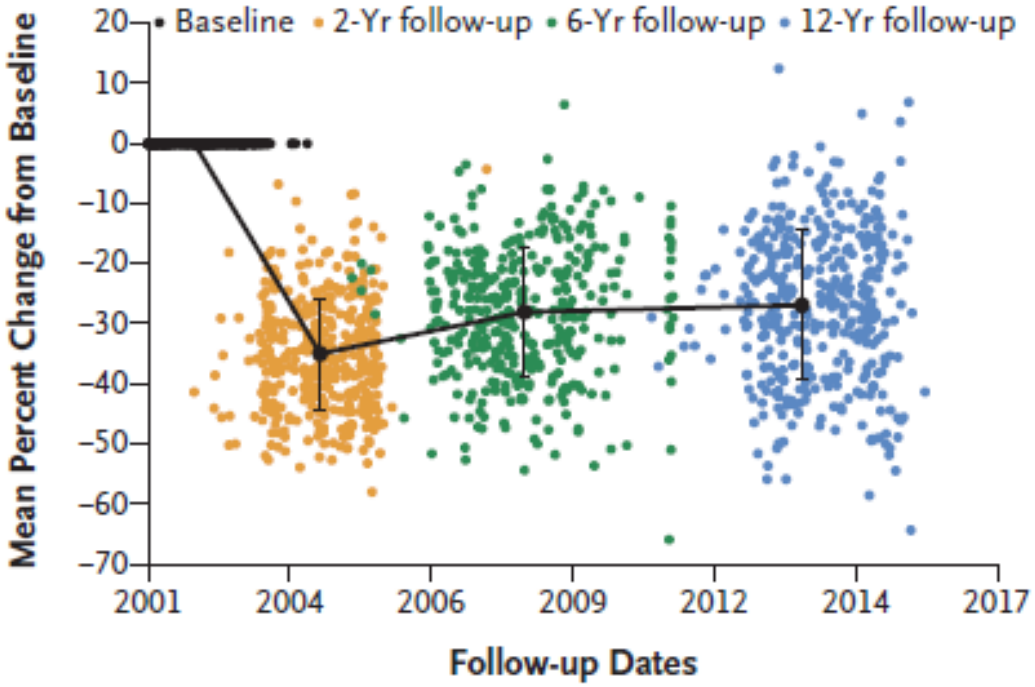
32,208 Roux-en-Y gastric bypass (RYGB), 29,693 sleeve gastrectomy (SG), and 3,192 adjustable gastric banding (AGB) procedures.

Ann Intern Med. 2018;169:741-750.

Weight Loss with Bariatric Surgery

- 418 pts gastric bypass, examined at 2 years, 6 years, and 12
- 51% Remission of DM at 12 yrs, less HTN and less HLD

A Mean Percent Change in Body Weight from Baseline to Years 2, 6, and 12 in the Surgery Group

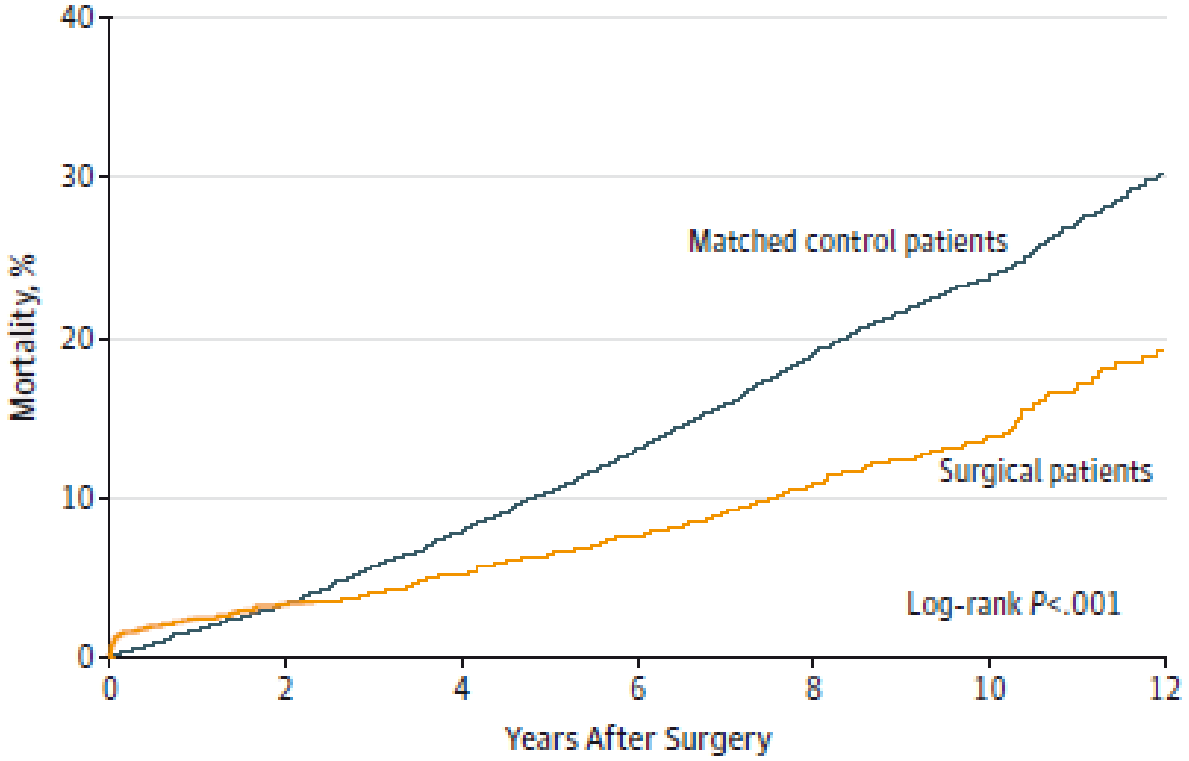


No. of Patients	Baseline	2 Yr	6 Yr	12 Yr
Surgery group	418	409	379	387
Deaths	—	3	9	14
Total	418	412	388	401

N Engl J Med 2017;377:1143-55.

Bariatric Surgery and Mortality (VA)

Figure. Kaplan-Meier Estimated Mortality Curves for Surgical Patients and Matched Control Patients



No. at risk							
Matched control patients	7462	7114	5306	3878	2641	1407	472
Surgical patients	2500	2416	1868	1412	1004	552	185

JAMA. 2015;313(1):62-70.

Stampede Trial: Benefits of Surgery for Type 2 Diabetes

1 year data

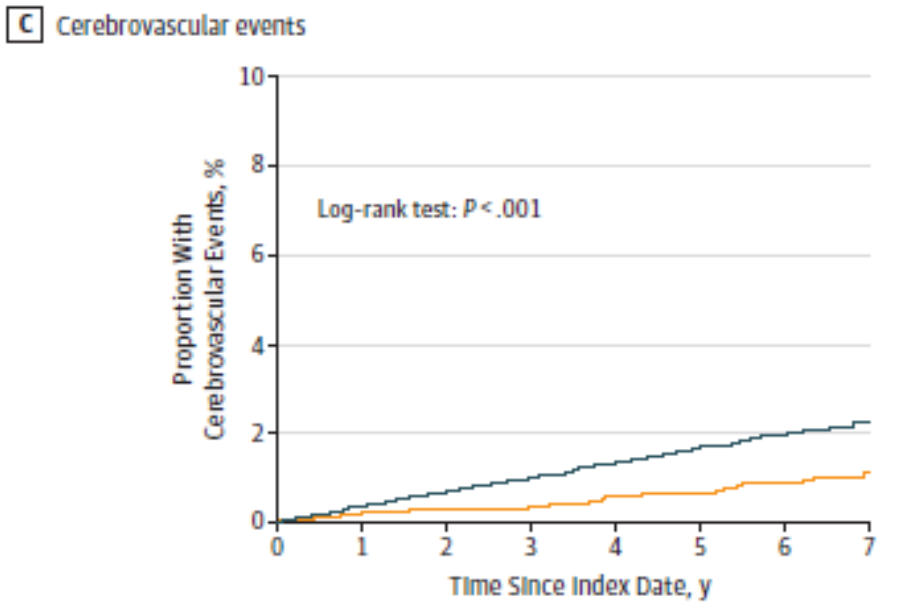
Parameter	Medical Therapy (n=41)	Bypass (n=50)	Sleeve (n=49)	P Value
HbA1c<6	12%	42%	37%	0.008
HbA1C<6 without DM med	0%	42%	27%	0.003
% change in Tg	-14%	-44%	-42%	0.08
% change in HDL	11%	28%	28%	0.001

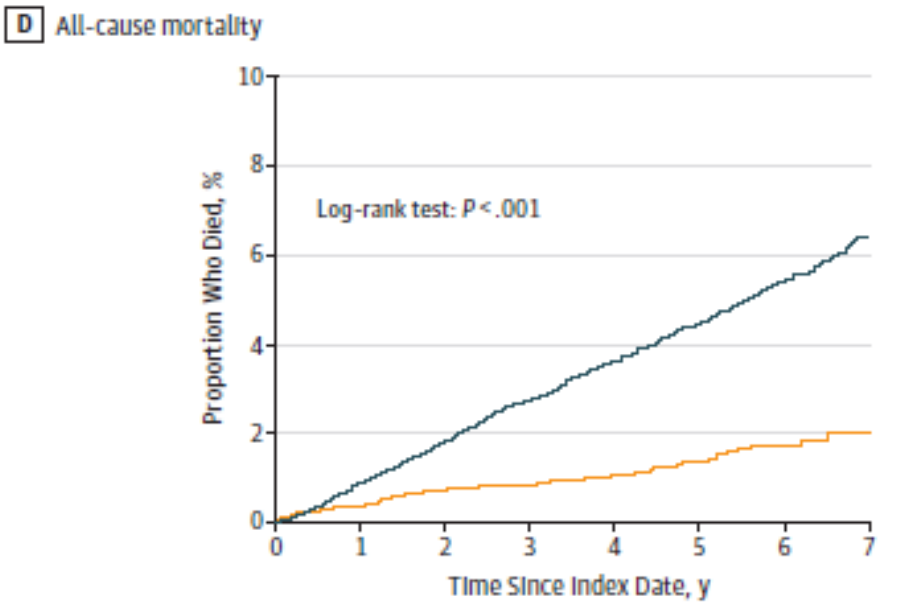
N Engl J Med 2012;366:1567-76

Bariatric Surgery and Macrovascular Disease

- Pts with DM undergoing weight loss surgery (n = 5301) were matched to 14 934 control patients on site, age, sex, body mass index, hemoglobin A1c, insulin use, observed diabetes duration, and prior health care utilization

Figure 2. Cumulative Incidence Rates at All Study Sites





Patients at risk

Matched nonsurgical patients	14934	13436	12190	11225	9614	6019	3797	2301
Bariatric surgery patients	5301	4796	4395	4072	3517	2267	1420	839

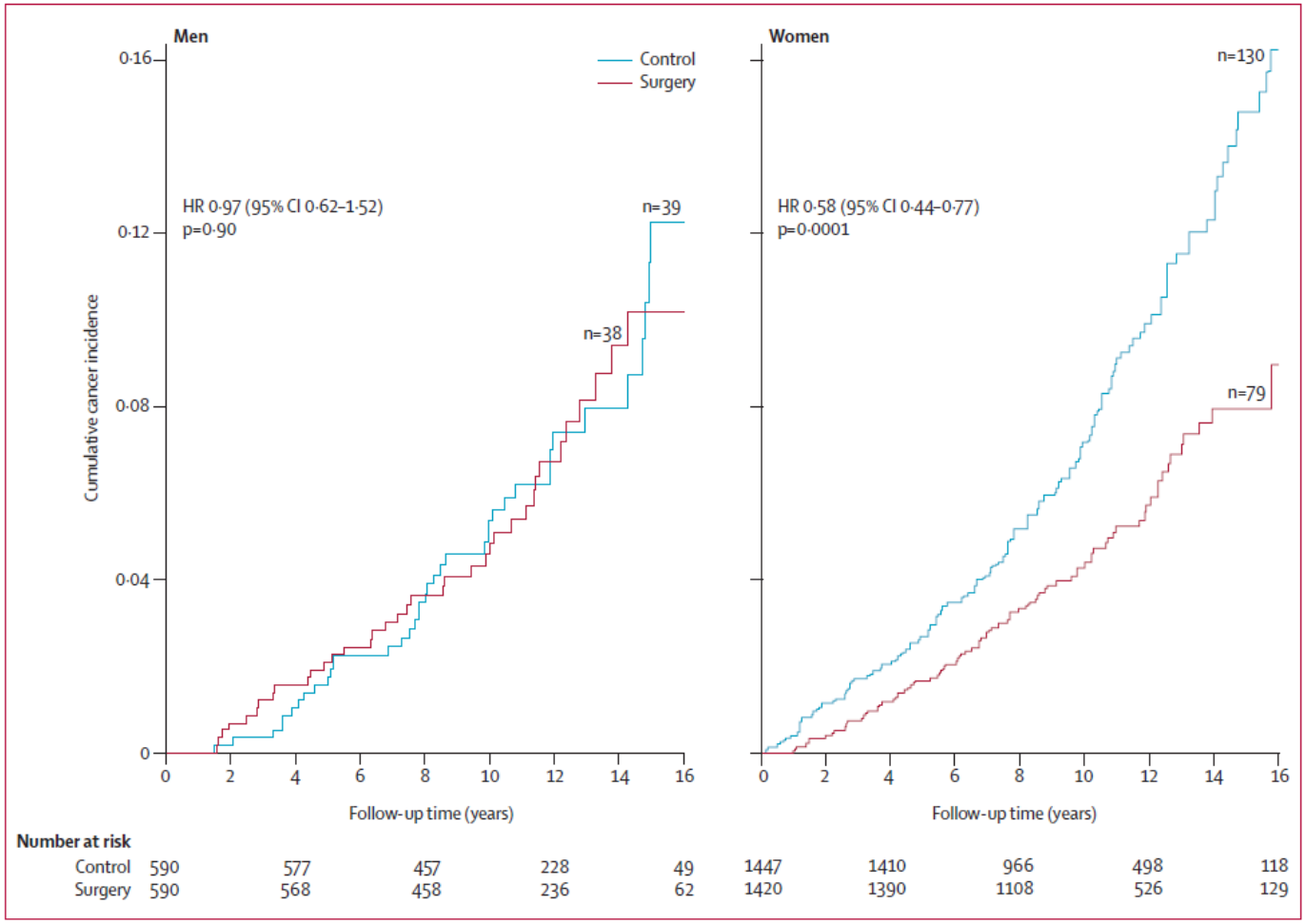
Patients at risk

Matched nonsurgical patients	14934	13476	12257	11310	9712	6099	3860	2342
Bariatric surgery patients	5301	4804	4404	4082	3535	2278	1434	848

JAMA. 2018;320(15):1570-1582.

Bariatric Surgery and Cancer

- SOS study 11 year follow up of 2010 surgical pts and 2037 controls



Lancet Oncol 2009: 10: 653-62

Pregnancy

- Fertility increases following weight loss.
- Avoid getting pregnant for the first year after surgery: BCP or other effective contraception.
- Pregnancies need to be monitored, but outcomes appear good
  - Less gestational diabetes and fewer LGA babies
  - More SGA babies and stillbirth (1.7 vs 0.7%)
  - Should be treated as high risk pregnancies
- Lap band: May need adjustment if pregnant
- Vitamins, micronutrients critical

NEJM 2015: 372: 814-24

Benefits of Bariatric Surgery

- Hyperlipidemia: 40% reduction in Tg, better with RYGB
- Hypertension: High 1 year remission rate 43-83% but 44% need to restart medications within 10 years
- Sleep Apnea: Improved AHI, but many still have clinically significant OSA
- Urinary incontinence: 49% in women and 22% in men pre-op, 25% and 12% 3 yrs post op.
- Osteoarthritis: little data, many orthopedic surgeries.

JAMA 2020, 324:879-887

Risks of Bariatric Surgery

- Bypass: Death 0.3% (0-2%) (within 30 days)
  Late Death (1-2%) (within 2 years)
- Failure of the Surgery to Produce Weight Loss (10-15%)
- Pulmonary embolus
- Anastamotic leaks/Sepsis
- Wound problems: infections, dehiscence
- Anastamotic Stricture: dilate or re-operate

Goals of pre-operative care

- Make sure the patient knows what they are getting into: pt support groups, ASMBS website
- Get them to a good surgical team.
- Pre-operative psychological evaluation
- Pre-operative dietary counseling.
- Diagnosis of medical conditions that might complicate surgery and post operative course.
- Optimize management of concurrent medical problems.

Goals of pre-operative psychological evaluation

- To make sure the patient has realistic expectations of risks and benefits
- To screen for psychopathology
  - Substance abuse: ETOH, DOA
  - Depression, suicide risk, life stressors
  - Binge eating disorder, controversial but may not matter Clin Nutr ESPEN 2020 Aug;38:146-152
  - Schizophrenia, bipolar actually may do no worse than others Obes Surg 2017 Jul;27(7):1889-1895
- Make contact for future support

Pre-operative health issues

- OSA: screen with questionnaire or clinically. Screening sleep test, formal polysomnography and treatment with CPAP pre-operatively
- Stop smoking at least 6 weeks before surgery
- Cardiovascular disease: EKG, routine exercise testing probably not valuable Obes Surg 2017 Jan;27(1):187-193
- Vitamin D: screen and replace, DXA controversial.
- Fe: screen and replace in menstruating women

Pre-operative health issues

- Reproductive function: ask and counsel regarding fertility and avoiding pregnancy.
  - Stop E2 therapy 1 mo. before surgery
- Fatty liver disease: even cirrhosis is not a contraindication to surgery.
- Diabetes: optimize glucose control pre-operatively. A1C 6.5-7% (7-8%)
- DJD: stop NSAIDs and work to find another therapy that will control symptoms

Pre-operative health issues

- DVT risk reduction: prophylactic vena cava filter in those with a history of DVT? Controversial.
- Pre-operative endoscopy for those undergoing sleeve gastrectomy?
- Screen for H Pylori and treat?
- Prophylactic treatment for gout in those with a history?
- Age and sex appropriate cancer screening.

Case

- A 29-year-old woman is admitted to the hospital for confusion and ataxia. Nine weeks earlier, she had a laparoscopic gastric bypass procedure in Mexico. She did well postoperatively and was discharged to home in the United States on post-op day 3.
- For the last 3 weeks she has experienced worsening episodes of vomiting. Recently she has been vomiting 4-7 x/day.
- Her family reports that over the last 2 days she has become increasingly confused and unsteady on her feet and has complained of double vision.
- In the emergency room she is found to be confused, dysarthric, and unsteady on her feet. On neurological exam she also has a right 3rd nerve palsy, nystagmus, and decreased sensation over her lower extremities.

Case 1: what is the diagnosis

A. B12 deficiency
B. Cerebellar venous thrombosis
C. Thiamine deficiency
D. Zinc deficiency

Case 1: What is the diagnosis?

B12 deficiency

Cerebellar venous thrombosis

Thiamine deficiency

Zinc deficiency

Wernicke Encephalopathy After Bariatric Surgery

A Systematic Review

Annals of Surgery 248; 5: 714-720 2008

Erlend Tuseth Aasheim, MD

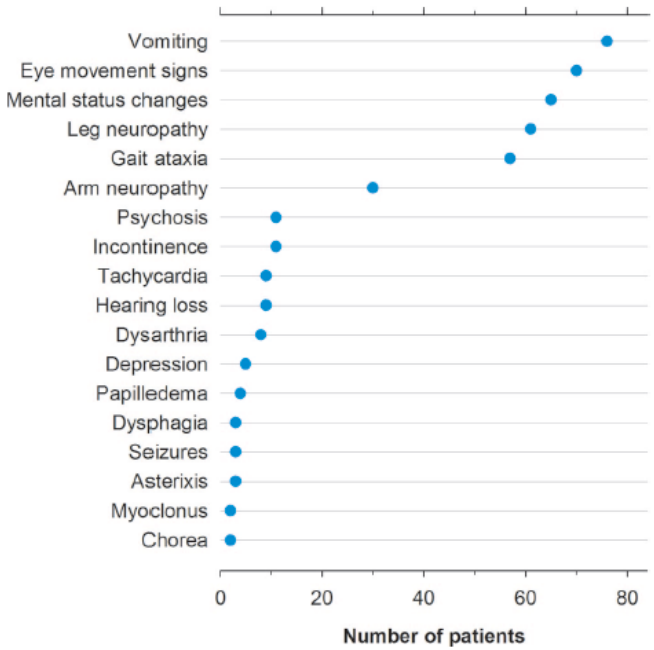


FIGURE 3. Clinical features reported in Wernicke encephalopathy cases (n = 84). Eye movement signs include nystagmus and gaze palsy; mental status changes include confusion, memory deficits, and impaired consciousness; gait ataxia includes incoordination of gait and posture.

Rx: 100 mg IV or IM daily x 7-14 days, then 10 mg/d orally till recovery

Nausea/Vomiting/Dehydration

- Recurrent Nausea:
  - Re-hydration and antiemetic medications
- Nausea and Vomiting:
  - Thiamin/folate and a multiple vitamin in the IVF needed to prevent thiamin deficiency and Wernicke's encephalopathy

Calcium/Vitamin D

- Post-operatively supplement to prevent deficiency
  - Ca citrate 1200-1500 mg/d (has 400 u D)
  - 2000-3000 u/d D
  - Monitor 25OH D level every 3 months
- May reduce Ca supplement if person is tolerating and eating dairy.
- Consider DEXA at 1-2 years post-op and every 2 years thereafter.

Endo and Metab Clin No Am 2017, 46: 947-82

Iron

- Test and supplement prior to surgery
- Post-op the goal is to pick up early with monitoring.
- Most sensitive test is ferritin.
- To prevent all pt should be on MVI (45-60 mg).
  - 200 mg $FeSO_4$ or 300 mg Fe gluconate for menstruating women.
- If deficiency develops try oral replacement (increase frequency of dosing). Add vitamin C
- 20-30% may need parenteral replacement (Ferrlecit, INFed, Venofer etc).

Surg obesity and related disorders 2017, 13:727-741

B12

- Causes
  - Low intake of meat and dairy
  - Poor digestion of meats resulting in decreased release of cobalamins from food
  - Low acid
  - Low intrinsic factor
- Deficiency develops in 30% at 1 year, and 50% by 5 years if not supplemented
- Monitoring: B12 level (homocysteine, MMA)
- Prevention: RDI about 1 mcg/d
  - Oral crystaline B12: 350-1000 mcg/d
  - Sublingual 500 mcg/d
  - Nasal spray (cyanocobalamin): 500 mcg/wk
  - IM: 100 mcg/mo

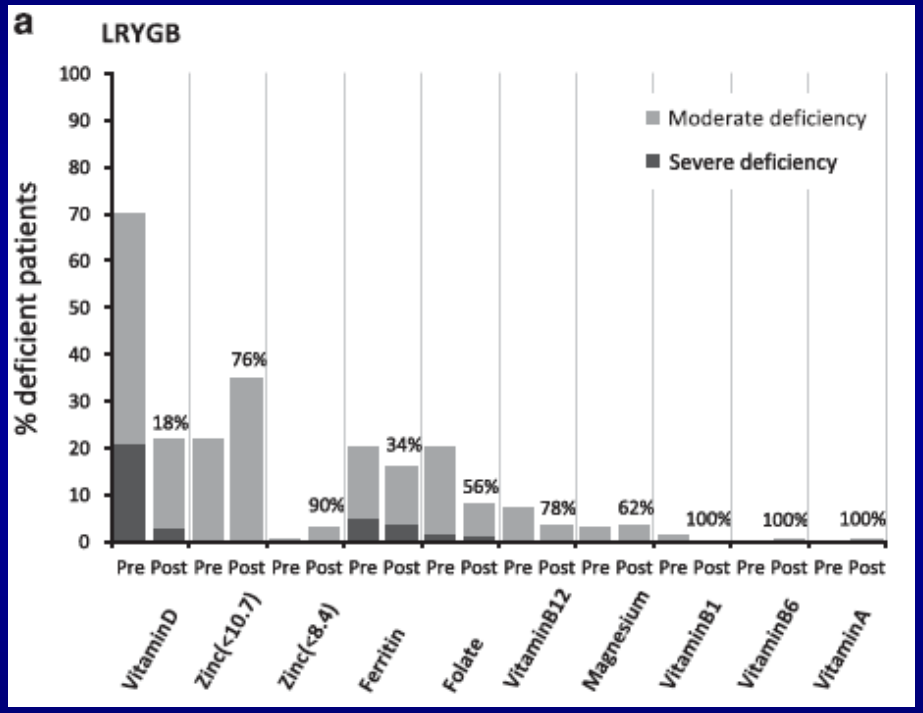
Obes Surg. 2018 Jan 9. doi: 10.1007/s11695-017-3102

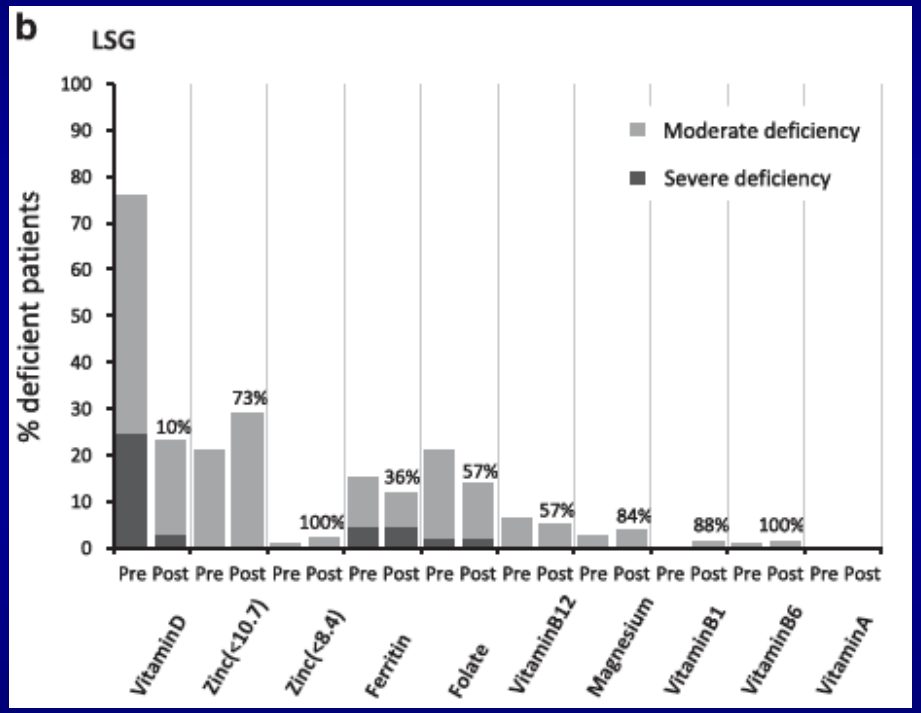
Other vitamins and micronutrients

- Zinc
  - Sx: Hair loss, impaired sense of taste, sexual dysfunction
  - Monitor in those who have had GBPS
- Copper
  - S/Sx: anemia, neutropenia, neuropathy, impaired wound healing
  - Measure concentration if patient has one of these S/Sx
- Vitamin A
  - S/Sx: night blindness, impaired vision, corneal dryness, dry hair
  - Most common following biliopancreatic diversion
- Folate
  - Megaloblastic anemia, fetal malformations
- Vitamin E
  - S/Sx: ophthalmoplegia, peripheral neuropathy, anemia

Surg obesity and related disorders 2017, 13:727-741

Prevalence of nutrient deficiencies following weight loss surgery





European J Clin Nutri 2017, 17:198-202

N=2055 patients with gastric bypass or sleeve gastrectomy

Managing Co-Morbidities

- Diabetes: immediately after surgery
  - Stop sulfonylureas, cut other meds in half
  - SMBG to adjust further
- Hypertension: immediately after surgery
  - Stop diuretics
- Arthritis
  - Stop NSAIDS 10 days pre-op
  - avoid for 6-12 months
- OSA:
  - Optimize treatment pre-operatively
  - Post-operatively CPAP mask and pressure may need adjustment
- GERD, Urinary incontinence, hyperlipidemia may improve and medications might be stopped

Other issues

- Depression
  - Many expect things to get better post-op
  - Pre-existing depression exacerbated by stress of surgery
  - Suicides increased post operatively in some series
  - Ask about mood post-op
- Too much weight loss too fast.
  - Look for signs of volume depletion
  - Puts at risk for infection

A 42-year-old man had RYGB surg 8 days ago in Mexico. He did well and was discharged to home. He comes in today complaining of general malaise, shortness of breath and some L shoulder pain. On exam his pulse is 120 and his RR is 20. What is the diagnosis?

- Pancreatitis
- Pulmonary embolus
- Anastomotic leak
- Gastric band erosion
- Stricture

What is the diagnosis?

Pancreatitis

Pulmonary embolus

Anastomotic leak

Gastric band erosion

Stricture

Anastomotic leak

- Six Cardinal Symptoms of leaks:
  - Malaise
  - Feverishness
  - Shoulder pain (leak til proven otherwise)
  - Abdominal pain
  - Shortness of breath
  - Increased thirst

Anastomotic Leak continued….

- 10 Cardinal Signs of a leak
  - Tachycardia: pulse rate > 120
  - Respiratory rate > 22
  - Fever
  - Extravasation of contrast on UGI
  - Pleural effusion
  - Abdominal tenderness / Rebound tenderness
  - Sitting in a Buddha position
  - Pursed lips
  - Tenesmus

Suggested Work Up…..

- CBC with Differential
- Comprehensive metabolic panel
- Chest X-ray
- Abdominal CT scan with IV and oral contrast
- Contact the bariatric surgeon that performed the surgery and facilitate a transfer or formulate a treatment plan.

Case

- 52 year old man had RYGB surg 3 years ago. He has lost 30% of his baseline weight and was feeling well until a couple of months ago when he had spells of sweating, cloudy thinking, light headedness, tremor and sweating. Yesterday he had a seizure and the EMTs found his glucose to be 15 mg/dl.
- What is the diagnosis?
- What tests do you want to do?
- How can you treat this?

- Post bariatric surgery hypoglycemia: beta-cell proliferation causing hyperinsulinemic hypoglycemia.
- Typically occurs years after RYGB surgery.
- Hypoglycemia is post-prandial.
- Can do a meal test, no standard and check insulin and C-peptide if becomes hypoglycemic.

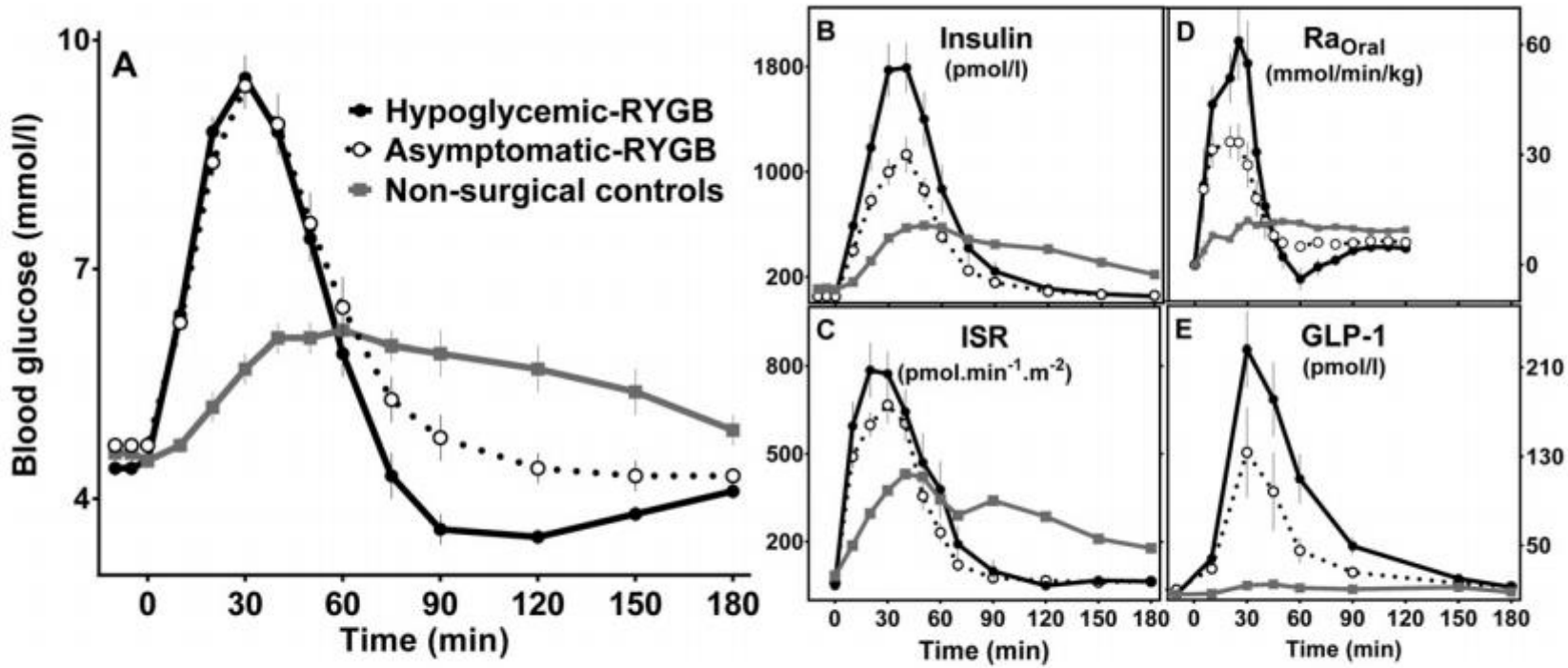


Figure 1. Typical glycemic and hormonal patterns in the fasting state and after mixed meal. (A) Blood glucose, (B) plasma insulin, and (C) insulin secretory response (ISR) to meal ingestion. (D) Systemic appearance of ingested glucose (Ra_{Oral}) and (E) circulating glucagon-like peptide 1 (GLP-1) levels during meal tolerance test in RYGB subjects with (black ● and solid line) and without (black ○ and dashed line) hypoglycemia and nonsurgical controls (gray ■ and solid line). Reproduced from Salehi *et al.* (6, 10).

J Clin Endocrinol Metab 103: 2815–2826, 2018

Monitoring

- Glucometer to check capillary glucose when symptomatic
- Food diary to identify provocative foods
- Consider CGM; low and trend alarms may help prevent low glucose

Dietary Modification

- Complex CHO in controlled portions, avoid simple CHO
- Complete avoidance of CHO not recommended
- Emphasize adding protein and healthy fats to all meals
- Ongoing vigilance for vitamin deficiency, supplementation as needed
- Dietitian referral for additional teaching
- Review/adjust meal plan at each visit based on glycemic patterns

Hypoglycemia Safety/Education

- Treatment
  - Severe: treat acutely for safety with 15 g CHO – glucose tabs/gel, glucagon if unable to take oral glucose
  - Mild/moderate: may be able to use complex carbs in lower amount to avoid "yo-yo" effect
  - Recheck glucose 15 min & retreat if necessary
- Educate patient about driving, need to maintain safety
- Educate family members:
  - Medical nutrition therapy
  - Hypoglycemia treatment
  - Use of glucagon emergency kit

Medical Therapy

- Acarbose
- Diazoxide
- Octreotide

Severe & refractory to diet and medical therapy

Surgical Therapy

- Feeding through gastrostomy tube into remnant stomach
- Gastric outlet restriction
- Reversal of RYGB

Figure 4. Suggested approach to the treatment of established post-RYGB hypoglycemia.

J Clin Endocrinol Metab 103: 2815–2826, 2018

Case

- 38 year old man had RYGB surg 4 months ago. He has lost 20% of his baseline weight and was feeling well until a week ago. He comes to the office complaining of 5 episodes of nausea and vomiting over the last 3 days.
- What is the differential diagnosis?
- What tests do you want to do?
- How can you treat this?

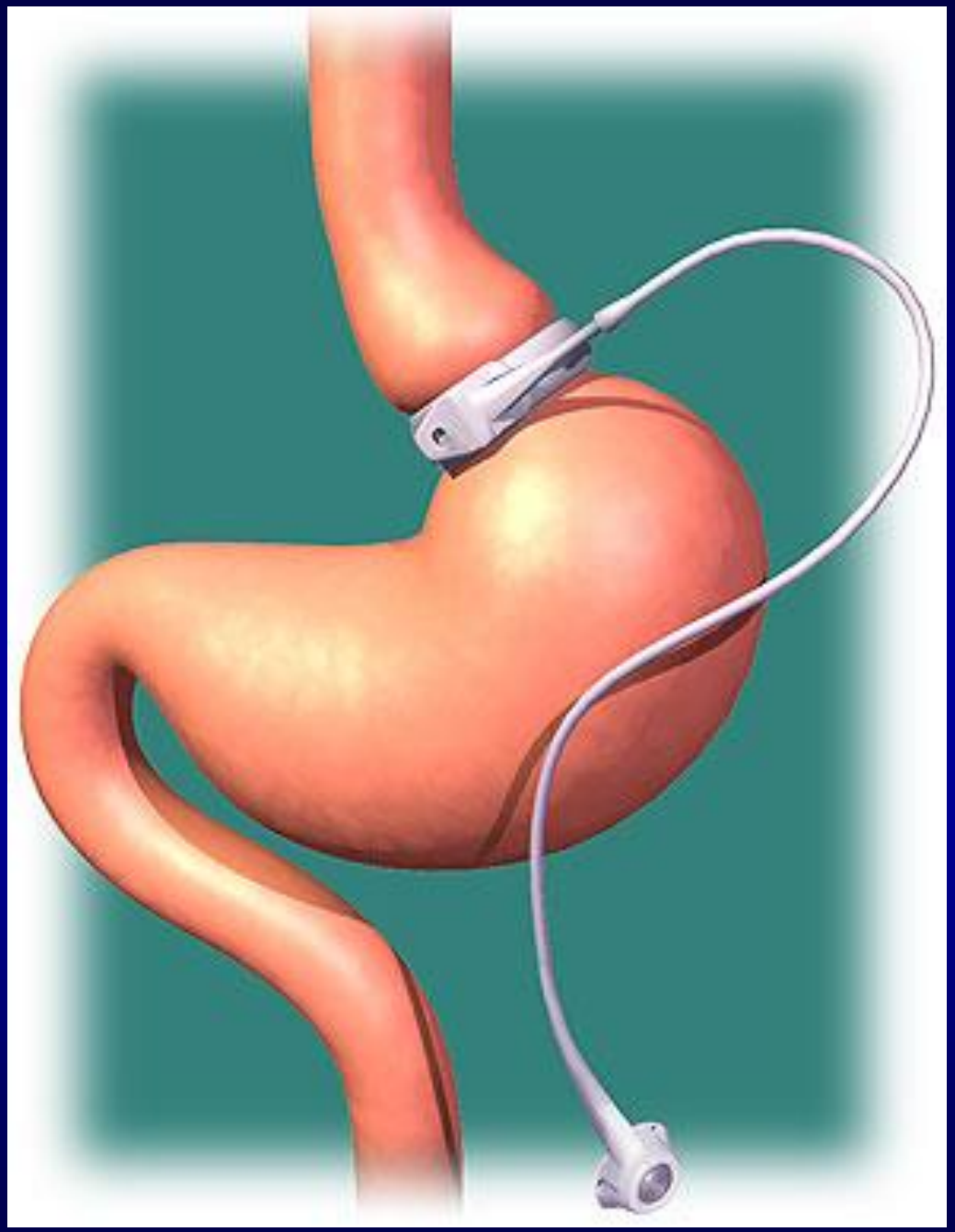
- DDX: anastamotic stricture, anastamotic ulcer or dietary indiscretion.
- Hx should focus on dietary patterns around the onset of the nausea. Hx of pain, hematemesis, melena
- Likely needs UGI/endoscopy or both.

Chronic Surgical Complications

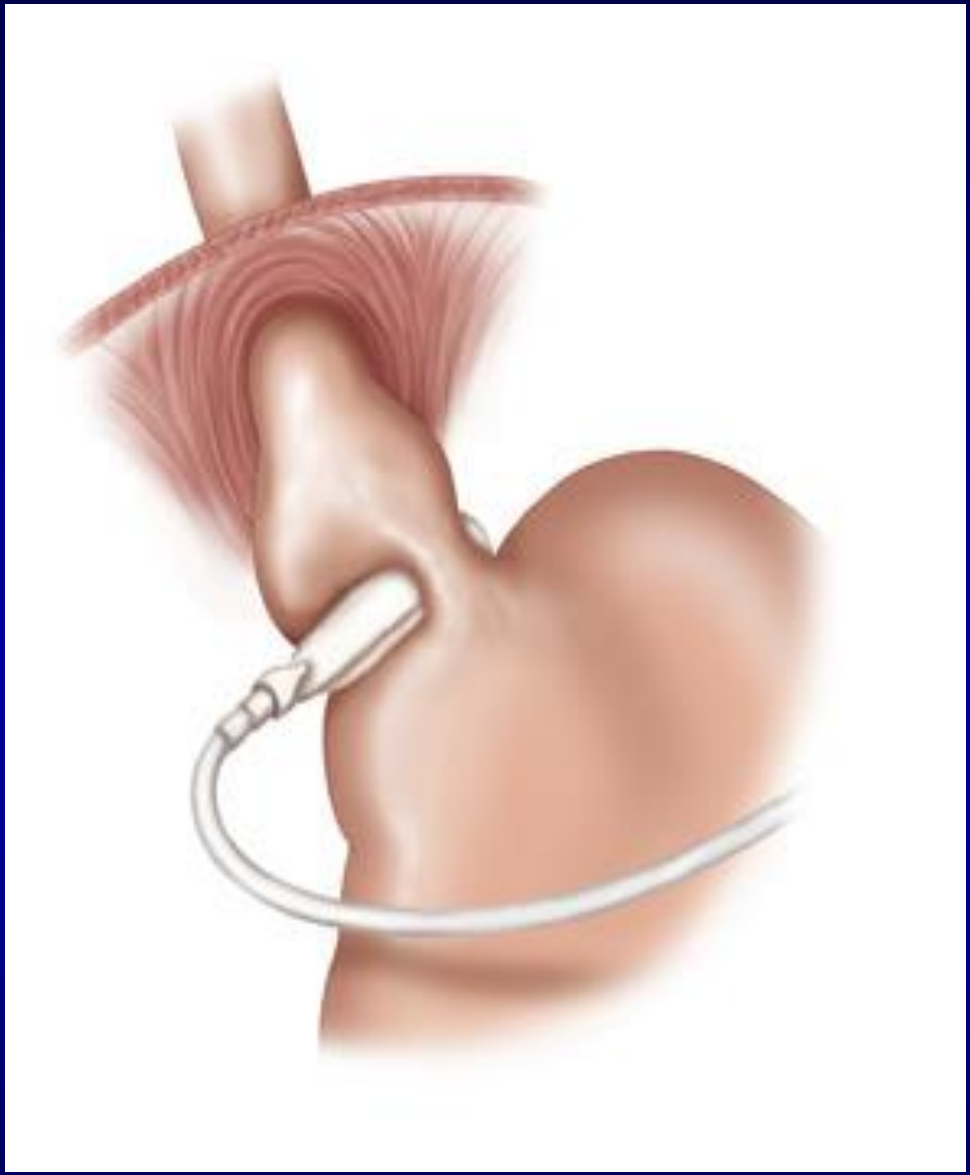
- Stomal ulcers (3-5%)
  - abdominal pain; UGI bleeding
  - Rx: PPI
- Stomal Stricture
  - dilatation by EDG
- Abdominal / incisional hernia (10%)
- Redundant skin

A 57-year-old woman had a laparoscopic gastric banding procedure done in another state 5 years ago. One year after surgery, she had lost 71 lb (32.3 kg) (from a peak lifetime weight of 290 lb [131.8 kg] to a weight nadir of 219 lb [99.5 kg]). She initially did well, but over the last 3 years, she has gained weight and currently weighs 282 lb (128.2 kg). Over the last 10 days, she has noted increasing abdominal pain and bloating associated with redness and tenderness over her injection port. On physical examination, she has moderate abdominal tenderness and decreased bowel sounds.

What is the diagnosis?



Lap Band



Gastric Band Erosion

Gastric Band Erosion

Obesity Surgery 14:381-386; 2004

- Typically presents in the first year after surgery but can occur 2-5 years later
- What causes this?
  - Injury at the time of the original surgery?
  - Injury over time from the band itself?
- Becoming less common over time 5%-.9%
  - Fewer bands being done

Other issues

- Depression
  - Many expect things to get better post-op
  - Pre-existing depression exacerbated by stress of surgery
  - Suicides increased post operatively in some series
  - Ask about mood post-op
- Alcoholism and substance abuse.
  - 3-fold higher risk post operatively
  - Greater risk with RYGB
  - Ask about alcohol intake post-op

Cir Esp (Engl Ed). 2021 Nov;99(9):635-647.

Summary

- You should feel comfortable discussing bariatric surgery as a weigh loss option for your patients: benefits, risks, refer to a good surgeon, suggest pt attend a support group.
- Optimize co-morbid conditions and vitamin status pre-operatively
- Lifelong follow up supplementation/screening for vitamins
- Think anatomically/like a surgeon when problems develop.

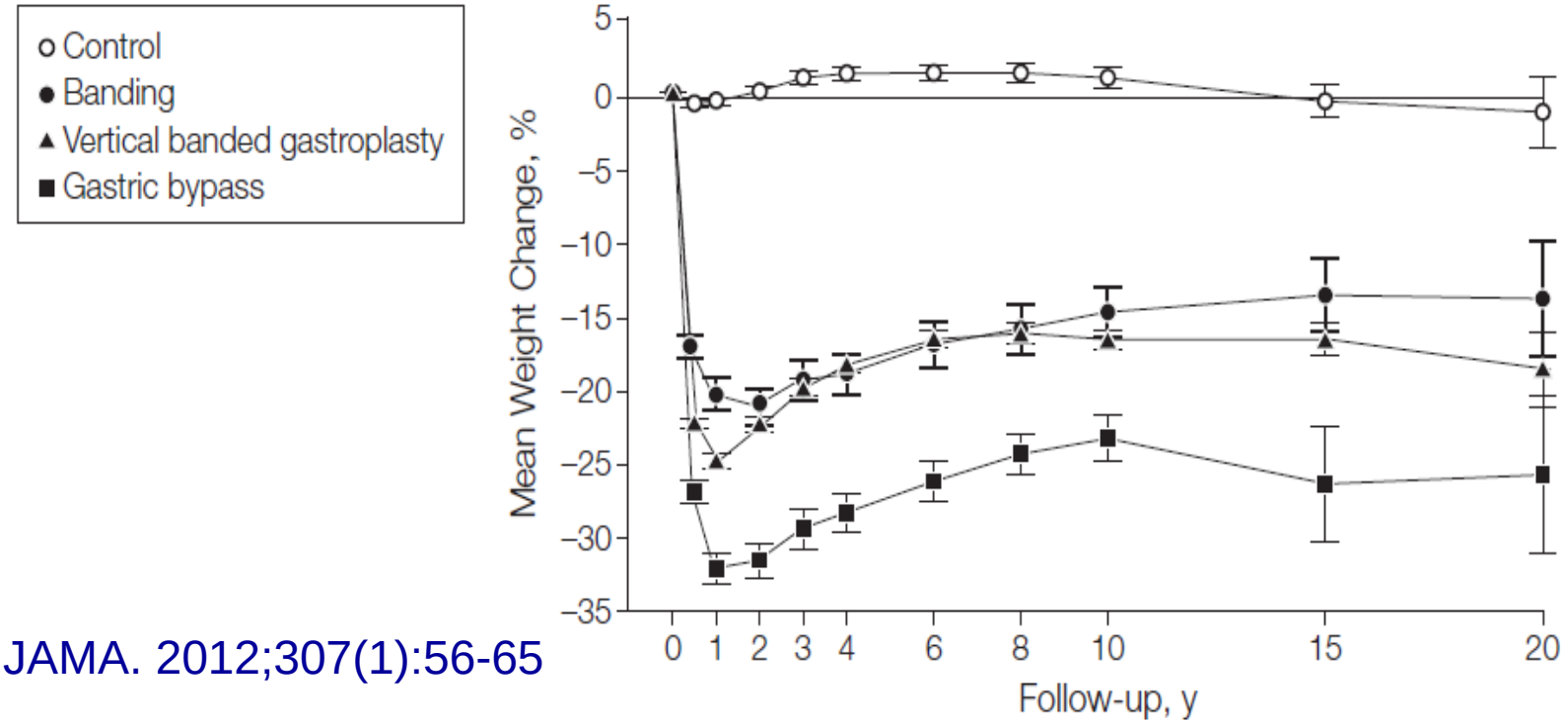
Resources

- American Society for Metabolic and Bariatric Surgery website: https://asmbs.org/patients: find a surgeon, videos, FAQs
- Clinical Guideline: American Association of Clinical Endocrinologists/the Obesity Society/ American Society for Metabolic and Bariatric Surgery: Endocr Pract. 2019 Dec;25(12):1346-1359.

Supplemental slides

Weight loss in the SOS

Figure 1. Mean Weight Change Percentages From Baseline for Controls and the 3 Surgery Groups Over 20 Years in the Swedish Obese Subjects Study



JAMA. 2012;307(1):56-65

No. of patients						
Control	2037	1490	1242	1267	556	176
Banding	376	333	284	284	150	50
Vertical banded gastroplasty	1369	1086	987	1007	489	82
Gastric bypass	265	209	184	180	37	13

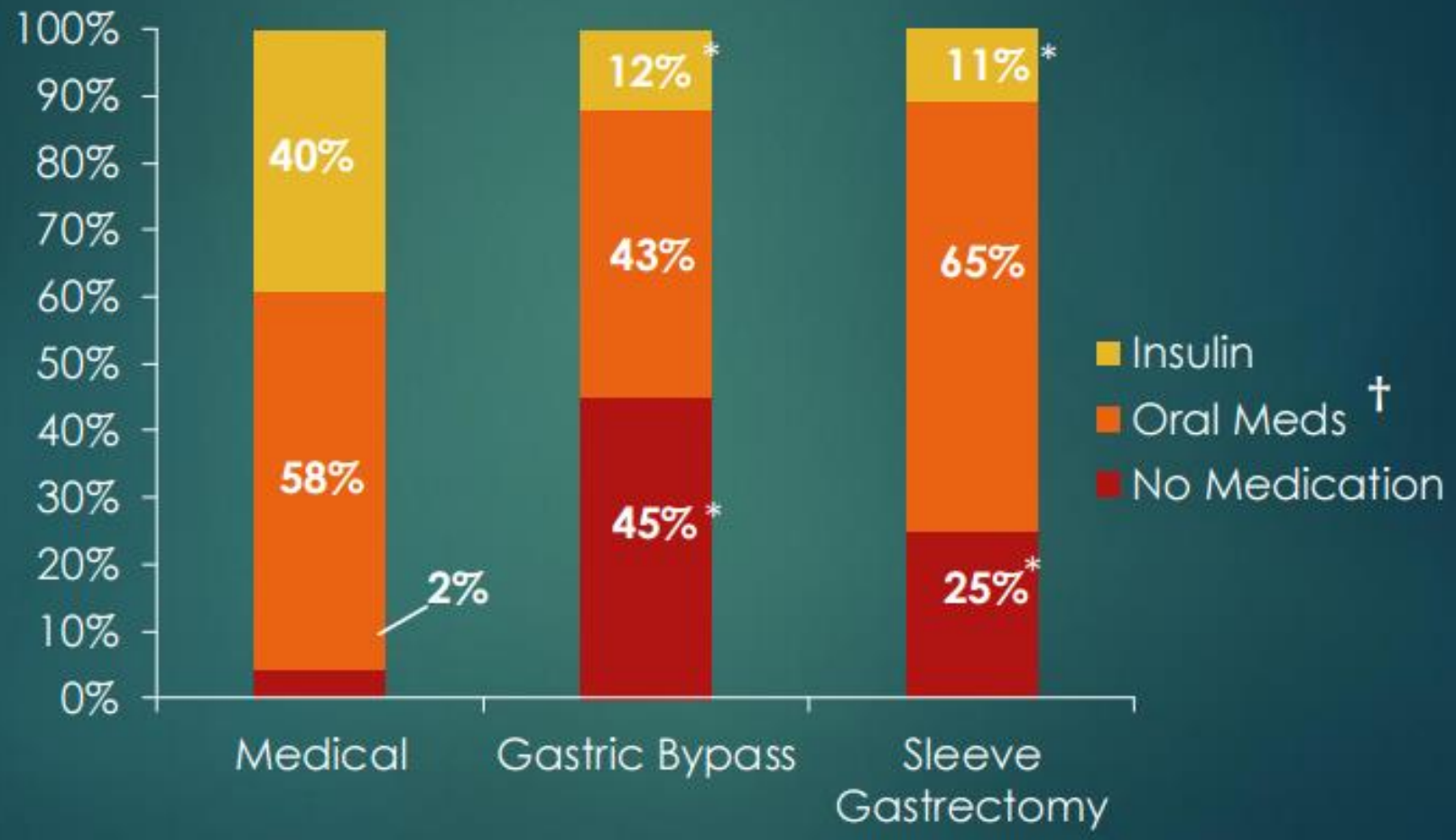
Primary and Secondary Endpoints at 5 Years

N Engl J Med 2017;376:641-51.

Parameter	Medical Therapy (n=38)	Bypass (n=49)	Sleeve (n=47)	P Value[1]	P Value[2]
HbA1c ≤ 6%	**5%**	**29%**	**23%**	**0.005**	**0.02**
HbA1c ≤ 6% (without DM meds)	0%	22%	15%	0.002	0.02
HbA1c ≤ 7%	21%	51%	49%	0.004	0.008
Median change in FPG (mg/dL)	-14	-72	-49	<0.001	0.01
Relapse of glycemic control	80%	40%	50%	0.16	0.34
% change in HDL	+7	+32	+30	0.003	0.008
Median % change in TG	-8	-40	-29	0.01	0.02

[1] Gastric Bypass vs Medical Therapy; [2] Sleeve vs Medical Therapy

Diabetes Medications at 5 Years



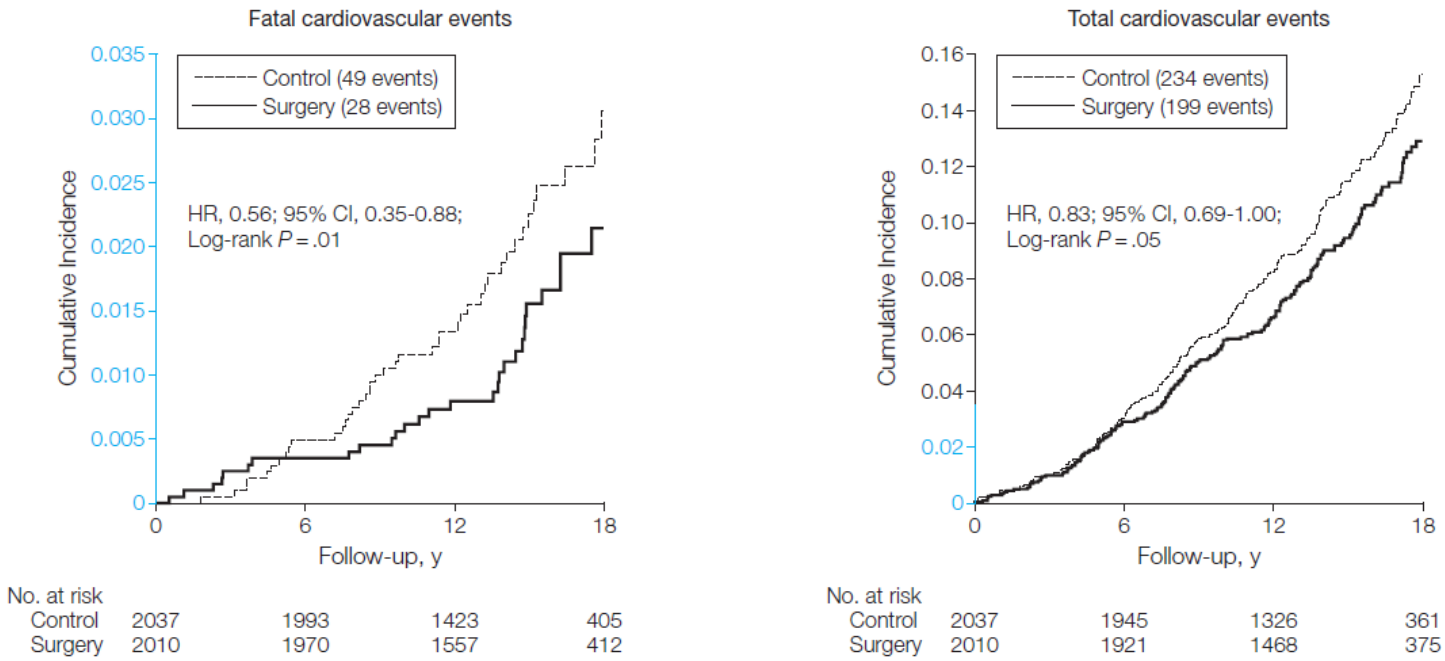
* P<0.05 compared to medical therapy

† Includes injectables such as GLP-1 agonists

Bariatric Surgery and Cardiovascular Disease

- SOS study 11 year follow up of 2010 surgical pts and 2037 controls

Figure 2. Kaplan-Meier Unadjusted Cumulative Incidence of Fatal and Total Cardiovascular Events in the Control and Surgery Groups of the Swedish Obese Subjects Study

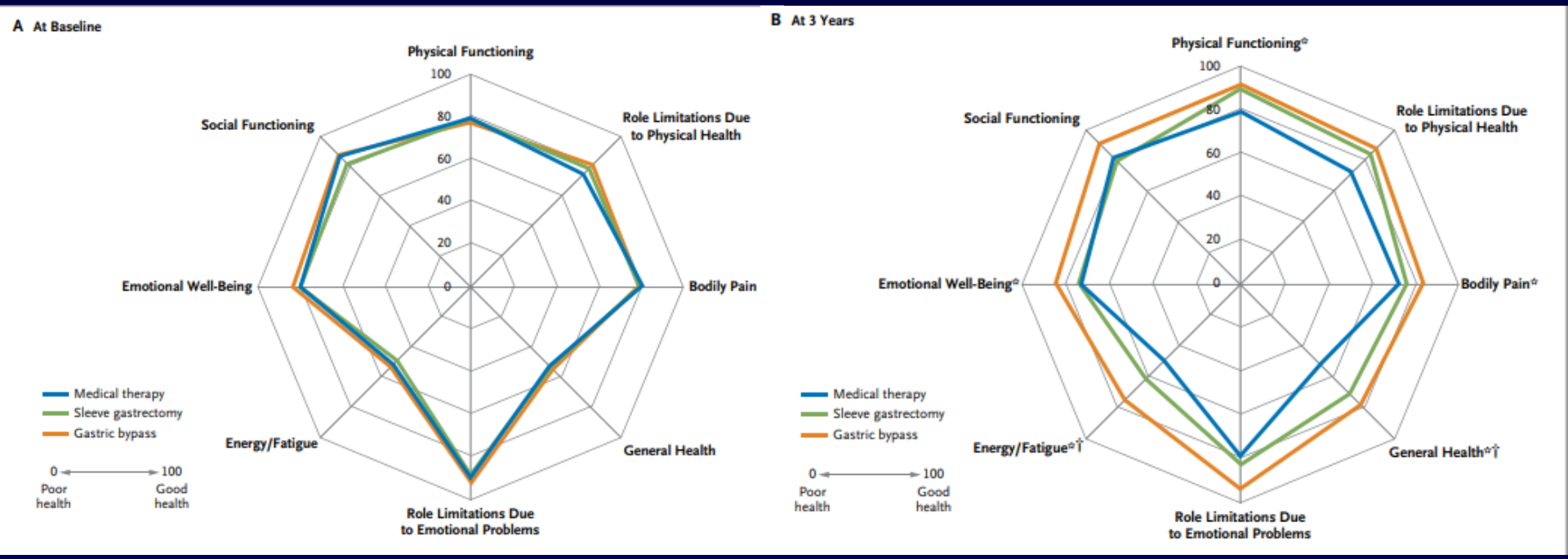


The combined end point of myocardial infarction and stroke, whichever came first, with fatal cardiovascular events and total (fatal and nonfatal) cardiovascular events are shown. The incidence data are based on observations until December 31, 2009. Follow-up time is truncated at 18 years, because number of persons at risk beyond this point was low. All persons are included in the calculation of hazard ratios (HRs). The incidence rates per 1000 person-years for fatal cardiovascular events were 0.9 (95% CI, 0.6-1.3) in the surgery group and 1.7 (95% CI, 1.3-2.2) in the control group; and for total cardiovascular events, 6.9 (95% CI, 6.0-8.0) and 8.3 (95% CI, 7.3-9.4), respectively. Y-axis regions shown in blue indicate range from 0 to 0.035.

JAMA. 2012;307(1):56-65

Bariatric Surgery and Quality of Life

- Stampede trial, prospective randomized trial in people with T2DM



N Engl J Med 2014;370:2002-13

Bariatric Surgery and Pregnancy

- 627,693 pregnancies in the Swedish Medical Birth Register 2006-11, 670 in women with bariatric surgery

All significant at p<.001

Variable	Bariatric-Surgery Group (N=596)	Matched Control Group (N=2356)	Risk Difference
Low-birth-weight infant‡	40/590 (6.8)	105/2336 (4.5)	2.3 (0.1 to 4.5)
Preterm birth§	59/590 (10.0)	176/2344 (7.5)	2.5 (–0.2 to 5.1)
Stillbirth¶	6/596 (1.0)	12/2356 (0.5)	0.5 (–0.4 to 1.3)
Neonatal death <28 days after live birth§	4/590 (0.7)	5/2344 (0.2)	0.5 (–0.2 to 1.2)
Stillbirth or neonatal death	10/596 (1.7)	17/2356 (0.7)	1.0 (–0.1 to 2.0)
Major congenital malformations§			
Total	14/590 (2.4)	83/2344 (3.5)	–1.2 (–2.6 to 0.3)

N Engl J Med 2015;372:814-24.

None of these are significant

Risks of Bariatric Surgery: the LABS Study

Table 2. Adverse Outcomes within 30 Days after Surgery, According to Surgical Procedure.

Outcome	Total (N=4610)*	Laparoscopic Adjustable Gastric Banding (N=1198)	Laparoscopic Roux-en-Y Gastric Bypass (N=2975)	Open Roux-en-Y Gastric Bypass (N=437)	P Value†
	number (percent)				
Death	15 (0.3)	0	6 (0.2)	9 (2.1)	<0.001
Deep-vein thrombosis or venous thromboembolism	20 (0.4)	3 (0.3)	12 (0.4)	5 (1.1)	0.05
Tracheal reintubation	20 (0.4)	2 (0.2)	12 (0.4)	6 (1.4)	0.004
Endoscopy	51 (1.1)	1 (0.1)	45 (1.5)	5 (1.1)	<0.001
Operation					
Tracheostomy	11 (0.2)	0	6 (0.2)	5 (1.1)	0.001
Placement of percutaneous drain	16 (0.3)	0	13 (0.4)	3 (0.7)	0.48
Abdominal operation	118 (2.6)	9 (0.8)	94 (3.2)	15 (3.4)	<0.001
Failure to be discharged by day 30	17 (0.4)	0	13 (0.4)	4 (0.9)	0.02
Composite end point‡	189 (4.1)	12 (1.0)	143 (4.8)	34 (7.8)	<0.0001

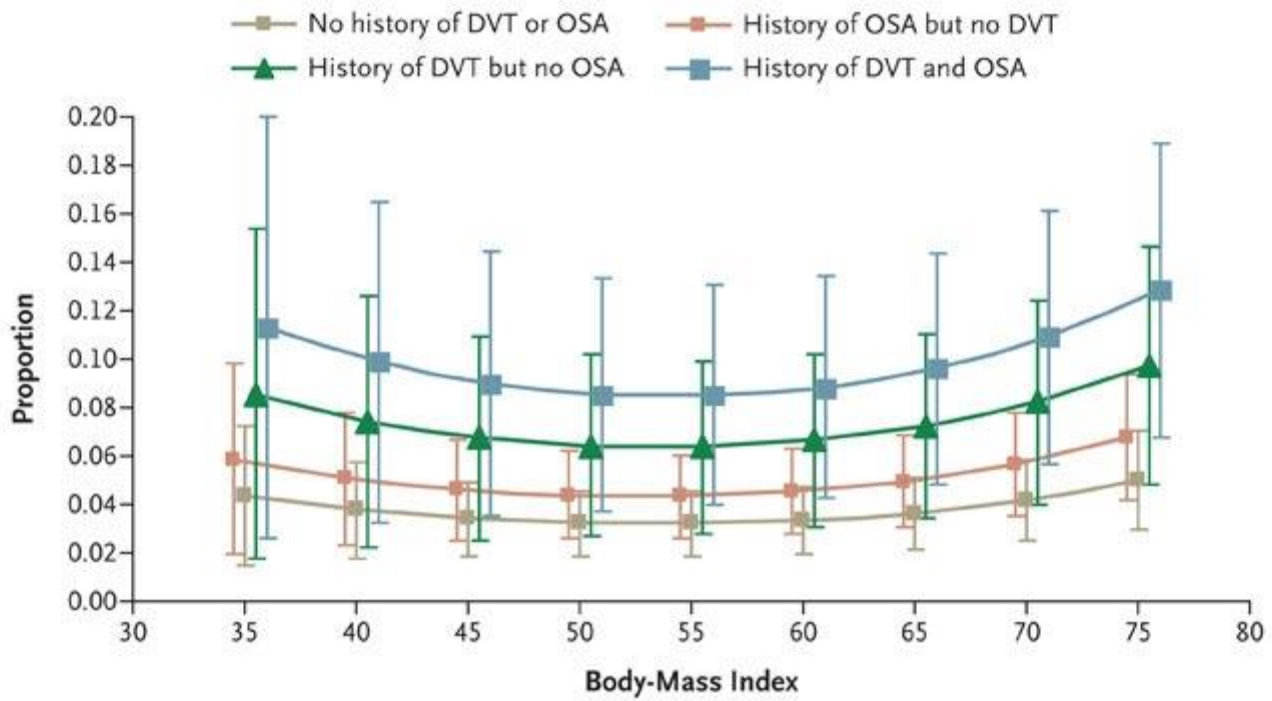
* The total excludes 166 procedures, including 117 sleeve gastrectomies, 47 biliopancreatic diversions with or without a duodenal switch, 1 vertical banded gastroplasty, and 1 open adjustable gastric banding.

† P values are for the comparison between treatment groups. Values were calculated with the use of the chi-square test.

‡ This end point is a composite of death; deep-vein thrombosis or venous thromboembolism; reintervention with the use of a percutaneous, endoscopic, or operative technique; or failure to be discharged from the hospital within 30 days after surgery.

Flum DR, N Engl J Med. 2009 Jul 30;361(5):445-54.

Risks of Bariatric Surgery:
Effects of Weight, Hx DVT and OSA



BMI	30 to <40	40 to <45	45 to <50	50 to <55	55 to <60	60 to <65	65 to <70	70 to <75	≥75	Total
No. of patients	623	1304	1156	722	417	205	90	52	38	4607
No. of events	23	51	30	25	29	13	5	4	9	189
Event rate (%)	3.7	3.9	2.6	3.5	7.0	6.3	5.6	7.7	23.7	4.1

Flum DR, N Engl J Med. 2009 Jul 30;361(5):445-54.

Who actually gets bariatric surgery?

- Only 49% of patients who enroll in a bariatric surgery program actually complete the surgery
- Those that do not have surgery have higher surgery related anxiety and a greater belief in their own ability to lose weight by lifestyle.
- Those with obesity since childhood and more experience with dieting were more likely to complete surgery.

Clin Obes 2013 Feb;3(1-2):32-8.

Calcium/Vitamin D

- Decreased intake of Ca and D containing foods.
- Malabsorption of both calcium and D due to bypassed segments.
- Results in secondary hyper-parathyroidism and over the long run osteomalacia.
- Prevention is the best approach, so screen and replace pre-operatively and supplement and monitor post-operatively
  - Deficiency is present pre-operatively in 30-40%
  - Obesity
  - Dark skinned people
  - Level 30 ng/ml is sufficient

Endo and Metab Clin No Am 2017, 46: 947-82

Iron

- Causes
  - Decreased meat intake
  - Achlorhidria
  - Bypass site of absorption
  - Decreased absorption
- Particularly a problem in menstruating women
- May present with pica/pagophagia

Guidelines for supplementation and replacement

ASN guideline: Adv Nutr 2017, 8: 382-94

	Supplement	Replace
Folic acid	400 µg/d should be included in the routine multivitamin; pregnant women or those planning to conceive should take 800–1000 µg folic acid/d included in a multivitamin supplement or separately	1000 µg folic acid/d
Fat-soluble vitamins (A, K, and E)[4]	6000 IU vitamin A should be included in the routine multivitamin; for pregnant women or those planning to conceive, the β-carotene form of vitamin A is preferred over retinol	Vitamin A deficiency without corneal changes: 10,000–25,000 IU/d orally to achieve clinical improvement
	After BPD: 10,000 IU vitamin A/d, 300 µg vitamin K/d, and 400 IU vitamin E/d (included in a multivitamin or separately)	When changes in the cornea appear, 50,000–100,000 IU i.m. for 3 d followed by 50,000 IU/d for 2 wk i.m. is recommended Vitamin K deficiency: 10 mg i.m. or submuscular, followed by 1–2 mg/wk parenterally or orally Vitamin E deficiency: 800–1200 IU/d to reach normal serum concentrations
Zinc	The routine daily multivitamin should contain 15 mg/d ≥1 mg Cu per 8–15 mg Zn to prevent copper deficiency is recommended	60 mg Zn 2 times/d
Copper	The routine daily multivitamin should contain 2 mg Cu	Severe deficiency requires 2–4 mg Cu/d i.v. for 6 d
Vitamin C	The routine daily multivitamin should follow the DRI recommendation for vitamin C	100 mg vitamin C 3 times/d or 500 mg/d for 1 mo