Chapter 52
Bariatric Surgery

Robert T. Yanagisawa, Daniel Herron, David W. Lam, and Derek LeRoith

Objectives

1. To review the appropriate patient criteria for weight loss surgery.
2. To understand the appropriate diabetes management of patients undergoing bariatric surgery.
3. To discuss the effect of gastric bypass surgery on insulin resistance and long-term postoperative medical management.

Case

A 45-year-old white male presented with morbid obesity. After his brother suffered a myocardial infarction, the patient realized he needed to take control of his health. His weight history revealed that he had gradually gained over 40 lbs over the last 10 years. He had lost 10–15 lbs on several attempts with diet and exercise programs, but he was unable to maintain his weight loss for more than 6 months. He was diagnosed with type-2 diabetes 2 years ago and he has been treated with a combination of glimepride, rosiglitazone, and metformin. He also suffers from a mixed dyslipidemia for which he takes simvastatin 40 mg daily.

R.T. Yanagisawa, M.D. (✉) • D.W. Lam, M.D. • D. LeRoith, M.D., Ph.D.
Division of Endocrinology, Diabetes, and Bone Diseases,
Icahn School of Medicine at Mount Sinai, One Gustave Levy Place,
Box 1055, New York, NY 10029-6574, USA
e-mail: Robert.yanagisawa@mssm.edu

D. Herron, M.D.
Professor of Surgery, Chief of Laparoscopic and Bariatric Surgery,
Icahn School of Medicine at Mount Sinai, New York, NY, USA

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On a physical examination, he was morbidly obese. At 5′8″ tall and 290 lbs, he had a BMI of 44 kg/m^2 with an android body weight distribution and a waist circumference of 48″. He had no hepatosplenomegaly or any significant peripheral edema. His fasting glucoses ranged from 145 to 225 mg/dL and Hgb A1C was 8.9 %.

He was evaluated and considered as an appropriate candidate for surgical weigh loss by the multidisciplinary team consisting of bariatric surgeons, endocrinologists, nutritionists, and psychiatrists who are all experts with a variety of bariatric procedures. The patient was well informed regarding bariatric surgery and understood the importance of his lifelong adherence to nutritional management. His diabetes control was optimized preoperatively by starting a combination of basal and bolus insulin.

He underwent Roux-en-Y Gastric Bypass (RYGB) surgery and his diabetes was controlled with a reduced basal insulin dose during his immediate postoperative period. Within 2 weeks of discharge from the hospital, he was able to discontinue all his insulin and maintained on rosiglitazone and metformin for his diabetes. Three months after surgery, his diabetes demonstrates remarkable improvement with a Hgb A1C of 6.0 %. His diabetes medications were discontinued. He takes nutritional supplements including calcium citrate with vitamin D, iron, and multivitamins.

Review of the Diagnosis

Roux-en-Y Gastric Bypass

The best operations reduce body weight by 35–40 % with most of this effect is maintained for more than 10 years. According to NIH guidelines for bariatric surgery is indicated for patients with BMI>40 kg/m^2 or those with BMI>35 kg/m^2 plus one or more obesity associated comorbidities such as diabetes or hypertension [1]. Among the variety of bariatric surgery procedures, Roux-en-Y gastric bypass (RYGB) appears to offer the best balance of effectiveness *vs.* risk, and it is the most widely used surgery for the morbidly obese people in the USA.

Roux-en-Y Gastric Bypass Surgery is currently considered to be the "Gold Standard" bariatric operation. Performed most commonly though a laparoscopic approach, the surgery involves creation of a small gastric pouch with a Y-shaped intestinal reconstruction. It is a restrictive and mildly malabsorptive procedure (Fig. 52.1).

Optimizing Glycemic Control Prior to Surgery

An appropriate preoperative screening includes prior history of failure to lose weight despite proper medical therapy. Patients must be educated regarding the bariatric procedure and the need for lifelong adherence to nutritional management. Glycemic

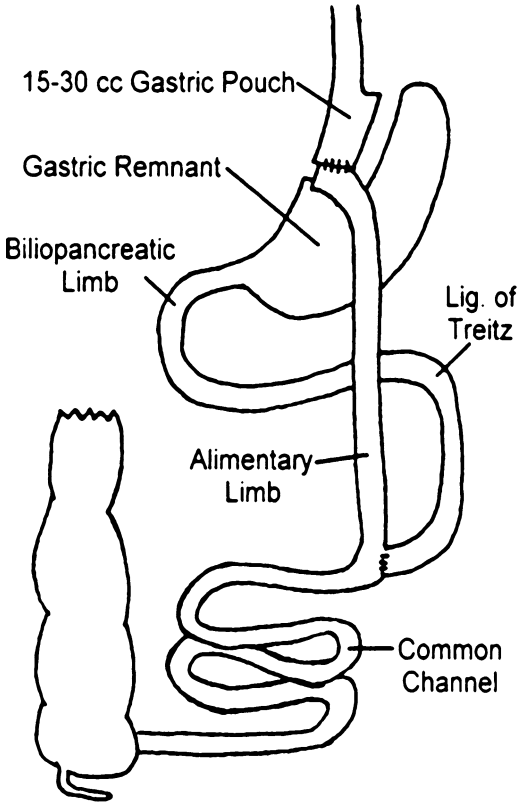
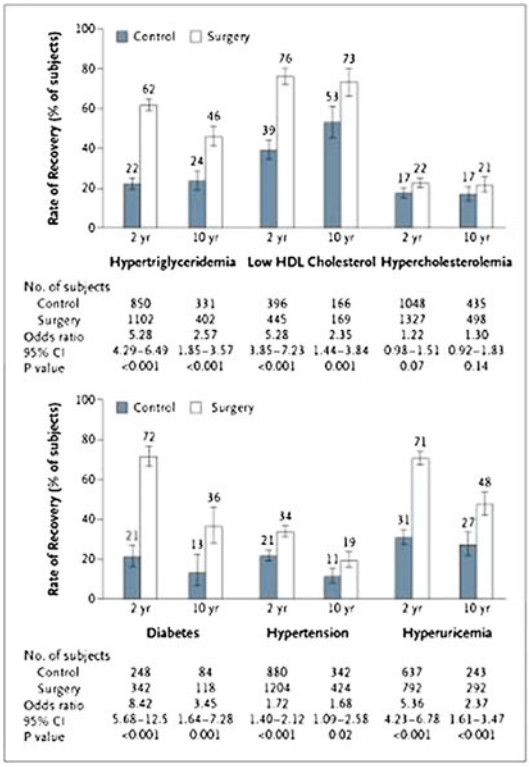


Fig. 52.1 Roux-en-Y gastric bypass (RYGB) surgery. Diagram courtesy of Dr. Daniel Herron

control must be optimized in patients with diabetes prior to surgery in order to minimize the perioperative complications. Preoperatively, patients are more motivated to optimize their medical condition and endocrinologists can help manage their diabetes aggressively. Starting an insulin regimen is appropriate in order to optimize the glycemic control even in a relatively short period of time for patients preparing for the surgery. Perioperative tight glycemic control often requires some insulin coverage, but it must be adjusted accordingly to their insulin requirement (see discussion 2 below). Successful outcome after a surgical weight loss procedure depends on extensive patient counseling and multidisciplinary support postoperatively.

Long-Term Outcomes of Bariatric Surgery

Bariatric surgery appears to be an effective option for the treatment of severe obesity, resulting in a long-term weight loss, an improved lifestyle, and, an amelioration in risk factors associated with obesity (Fig. 52.2).



Recovery from diabetes, lipid disturbances, hypertension, and hyperuricemia over 2 and 10 years in surgically treated subjects and their obese controls.

Adapted from Sjöström et al. Lifestyle, Diabetes, and Cardiovascular Risk Factors 10 Years after Bariatric Surgery. NEJM 2004 351 (26): 2683

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The prospective controlled Swedish Obese Subjects Study involved obese subjects who underwent gastric surgery and contemporaneously matched, conventionally treated obese control subjects. One of the largest series, with 4,047 subjects, it demonstrates the benefit of bariatric surgery for morbid obesity [2]. Significant number of patients with diabetes can recover with surgical weight loss, based on either the cutoff values or use of medication to treat diabetes. The mean changes in weight and risk factors were also more favorable among the subjects treated by gastric bypass than among those treated by banding or other form of surgical procedures.

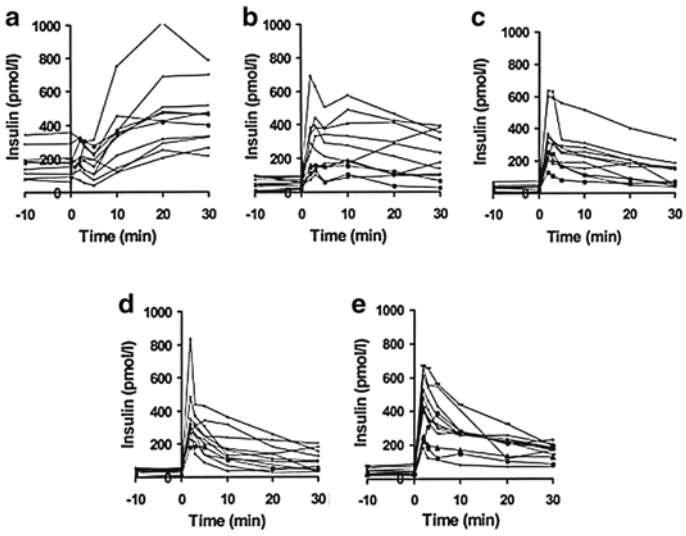

Fig. 52.3 Insulin response after intravenous glucose infusion in normal control subjects (**e**) and patients with type 2 diabetes , before gastric bypass (**a**), 3 months (**b**), 6 months (**c**), and 12 months (**d**) after gastric bypass. Adapted from Polyzogopoulou et al. Diabetes. 2003 May; 52(5): 1098–103

Diabetes Resolution with RYGB Surgery

The duration of diabetes since diagnosis seems to predict successful improvement of glycemic control postsurgery. The first phase insulin response is typically disrupted early in the course of diabetes and it improves to a near-normal level in patients who undergo gastric bypass surgery with diabetes of less than 3–5 years duration [3]. Recovery of the first-phase insulin response may be the best indicator of diabetes resolution in patients who have had gastric bypass surgery (Fig. 52.3).

The mechanisms underlying the effects of RYGB on body weight and glucose metabolism are still not completely understood, but we can predict the course of diabetes outcome with surgery. In the immediate postoperative period, patients are essentially fasting and resulting in the fast-induced alleviation of diabetes. Patients who are on significant doses of insulin preoperatively often only require a minimal basal insulin. Patients gradually tolerate their oral intake, but they continue to be in a state of negative energy balance, a condition that decreases glucose toxicity and improves ß-cell function. Eventually, a marked weight reduction with baritaric surgery allows patients to increase their level of physical activity. Increased physical activity coupled with decreased glucose load from small quantity of each meal after gastric bypass surgery leads to a dramatically improved diabetes control.

Table 52.1 Preoperative predictors of improvement in type-2 diabetes

Factors	Improvement	Resolution
Duration of T2 DM	<10 years	<4 years
HbA1C	<8.8 %	<8.0 %
Waist circumference	<53 in.	<48 in.

In the majority of studies, resolution is defined as some combination of returning to a fasting blood glucose <110 mg/dL or a glycated hemoglobin A_{1c} (HbA_{1c}) <7 % without diabetic medications. Improvement is defined as approaching these values or reaching these targets with less medication

Adapted from Stohmayer, E, Via, M, Yanagisawa, R 2010 "Metabolic Management Following Bariatric Surgery" MSJM Vol 77, No 5

Incretin Effects of RYGB Surgery

Cummings hypothesizes more interesting possibilities of RYGB effect on glucose metabolism [4]. Alterations in gut hormones release after RYGB may act in concert with the above mechanism to improve insulin secretion or action. Ghrelin, secreted by the stomach, exerts several diabetogenic effects including increased levels of GH, cortisol, and epinephrine—three of the four classical counter regulatory hormones. Ghrelin levels are decreased after gastric bypass, resulting in an antidiabetogenic effect. The other effect of surgery is increased GLP-1 secretion from bypassing part of the foregut and facilitated delivery of nutrients directly to the hindgut. GLP-1 is an incretin that stimulates insulin secretion in response to enteral nutrients. GLP-1 and PYY also suppress gastrointestinal motility, gastric emptying, small intestinal transit, and food intake.

Patients with a relatively short duration of diabetes since diagnosis seem to have a better improvement of glycemic control post-RYGB [6]. While there are no standardized guidelines for the optimal timing to recommend patient with diabetes and obesity for bariatric surgery, these findings may call for an earlier referral of morbidly obese patients with diabetes to a surgical weight loss (Table 52.1).

Long-Term Post Operative Medical Management

On the other hand, we must also understand nutritional consequences of surgical intervention for morbid obesity. While RYGB surgery should not cause severe malabsorptive problems postsurgery, patients will have a decreased absorption of protein, iron, calcium, and fat-soluble vitamins. Postoperatively, patients who have had RYGB surgery need to be periodically monitored for nutritional deficiency for the rest of their life. The Endocrine Society clinical practice guidelines recommend to monitor iron, ferritin, Vitamin B12, folate, calcium, intact parathyroid hormone, 25(OH) Vitamin D, albumin, and pre-albumin on a regular basis. Monitoring of vitamin A, zinc, and thiamine is considered optional [5].

Patients are instructed to eat at least 60 g of protein daily. Due to their limited gastric capacity, they usually require protein supplementation initially to be able to meet their nutritional goal. Chewable multivitamin and calcium supplementation is started on discharge from the surgery.

After RYGB surgery, patients tend to have an increased PTH values, and one must avoid the development of overt secondary hyperparathyroidism from vitamin D deficiency. They need to be consistent with calcium with vitamin D. The goal is to maintain 25OH vitamin D level above 25 and PTH level below 80–90. The amount required varies with extent of malabsorption, but typically 1,000–1,200 IU/day of vitamin D are required to maintain an adequate level.

While this patient may not require any hypoglycemic agents to control his diabetes, he must continue to avoid excess glucose and carbohydrate load. His small gastric pouch is likely to prevent him from eating large meals and hence creating a significant caloric deficit. However, despite RYGB surgery, he will be able to absorb simple sugars and still have a tendency for hyperglycemia. His success in ameliorating his diabetes depends on his success with his weight loss and his behavioral modification.

Sleeve Gastrectomy

Sleeve gastrectomy is a more recently developed bariatric operation that has rapidly been gaining popularity in the United States. In this procedures, the greater curvature (left side) of the stomach is surgically resected, leaving a banana-shaped stomach of roughly 150 ml volume (Fig. 52.4). Since no intestine is surgically bypassed, intestinal absorption remains unaffected. This procedure results in weight loss that is comparable to that observed after RYGB with a lower complication rate. However, improvement of T2DM may not be as significant with this procedure [7].

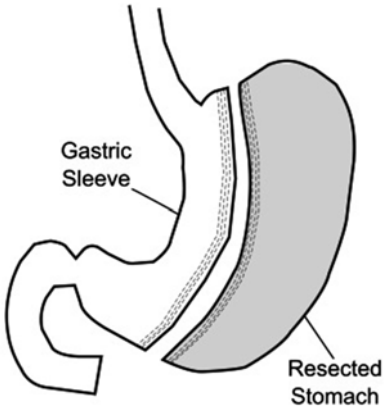

Fig. 52.4 Sleeve gastrectomy. The greater curvature, or left side, of the stomach is resected, leaving a 150 ml banana-shaped stomach pouch (image courtesy of Daniel M. Herron, MD)

Lessons Learned

1. Bariatric surgery is an effective option for the treatment of severe obesity and obesity related metabolic risks for patients with BMI > 40 kg/m^2 or those with BMI > 35 kg/m^2 plus one or more obesity associated comorbidities.
2. Successful outcome of surgical weight loss depends on patient education and teamwork with the multidisciplinary team supporting the patient.
3. The duration of diabetes and strict behavioral modification predict successful improvement of the glycemic control postsurgery. Recovery of the first-phase insulin response improves to a near-normal level in patients who undergo gastric bypass surgery with diabetes of less than 3–5 years duration.
4. Sleeve gastrectomy is a new procedure that provides weight loss nearly equal to that of gastric bypass. Resolution of T2DM, however, may be less pronounced after this procedure.

Questions

1. What makes him an appropriate candidate for bariatric surgery?

   A. BMI > 40 kg/m^2
   B. Diabetes and other metabolic risk factors
   C. Failed prior medical management to control his obesity
   D. Ability to comply with his lifelong adherence to nutritional management
   E. All of the above

2. What factors increase his likelihood of achieving his glycemic control postsurgery?

   A. Duration of his diabetes
   B. Patient's ability to exercise with weight loss
   C. Avoidance of his glucose toxicity
   D. Decreased visceral adiposity
   E. All of the above

3. Postoperatively, what are the nutritional concerns for this patient?

   A. Supplemental protein only if they develop signs of malabsorption.
   B. Iron replacement only if they develop anemia.
   C. Any excess calorie will not be absorbed so patients can eat ad lib and lose weight.
   D. Calcium with vitamin D to prevent secondary hyperparathyroidism.
   E. Patient does not need to follow his blood glucose any more.

Answers to Questions

1. E.

Discussion: According to NIH guidelines for bariatric surgery, this patient meets BMI criteria (BMI > 40 kg/m^2), but we should further evaluate him to see if he is an appropriate candidate for bariatric surgery. Choices B–D make him an appropriate surgical candidate.

2. D.

Discussion: Short duration of his diabetes is important indicator for improving his diabetes. The first-phase insulin response improves to a near-normal level in patients who undergo gastric bypass surgery with diabetes of less than 3–5 years duration. Choices B–D all help to improve his insulin resistance. See diabetes resolution section.

3. D.

Discussion: After RYGB surgery, patients will have a decreased absorption of protein, iron, calcium, and fat-soluble vitamins. Choices A and B are incorrect as he will require these supplements to prevent malabsorptive complications. Choices C and E are incorrect as he will be able to absorb simple sugars and still have a tendency for hyperglycemia. Choice D is correct and he needs his calcium, vitamin D, and PTH levels needs to be monitored. See long-term postoperative medical management section.

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