

# Complications of Bariatric Surgery

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## Objectives

By the end of this educational encounter the learner will be able to:

1. Define three complications of bariatric surgery.
2. Identify interventions for common bariatric complications.
3. Recognize measures to prevent complications of bariatric surgery.

The purpose of this educational unit is to give the learner an overview of basic complications of gastric weight loss procedures and provide education regarding intervention and prevention of complications associated with bariatric procedures.

## Introduction

In the United States, over five to ten million persons are defined as being morbidly obese. Morbid obesity is defined clinically as being 100 or more pounds over ideal body weight or having a Body Mass Index (BMI) greater than 40 (University of Rochester, 2009). The National Institutes of Health recommends that a BMI of 35 or greater be a qualifying criterion for bariatric procedures if there is severe comorbid disease present. The emergence of bariatric surgery as a definitive treatment for the long-term management of obesity and has resulted in a decline in complications from morbid obesity.

The three-year success rate for medical management of morbid obesity is 6-8%; bariatric surgery increases this success rate to 54-75% of all patients undergoing the procedure. During the years between 1990 and 1997, 12,203 persons received bariatric procedures for morbid obesity treatment. During that time, the yearly rate for persons undergoing bariatric procedures rose from 2.7 per 100,000 population to 6.3 per 100,000 people. The American Society of Bariatric Surgery states that 177,600 surgeries were performed in the year 2006.

Bariatric surgery, according to the American Society for Bariatric Surgery, is the only

proven method that results in durable weight loss. Weight loss aside, there are other benefits to bariatric surgery “ potentially cured of numerous medical diseases including diabetes, hypertension, high cholesterol, sleep apnea, chronic headaches, venous stasis disease, urinary incontinence, liver disease, and arthritis.”

### When is Bariatric Surgery Indicated?

Medical therapy, which consists of diet and exercise, minus any pharmacological therapies, is capable of producing a weight loss, which is consistent with 5-10% of a person's excess body weight. When pharmacological therapy is added weight loss can be expected to be 8-10% of excess body weight. With bariatric surgery, a patient can be expected to lose 60-80% of his or her excess weight. So it is plain to see that in a patient with 80-100 pounds of weight to lose and has a 3-5 year history of attempted weight management, or in the face of comorbidities, bariatric surgery becomes the treatment of choice in these instances.

However, that is not to say that a patient should be immediately scheduled for a bariatric procedure. Bariatric surgery frequently has complications and should only be considered after the patient has been followed for at least 6 months of traditional medical management. The treatment should include keeping food logs, exercise, psychological or psychiatric evaluation as medically indicated, and a meal management plan. All of these components help to prepare the patient for surgery and begin the shaping and reinforcement of new behaviors that will increase the safety and efficacy of the bariatric procedure.

The ideal surgical candidate should have the needed psychological capacity to comprehend and implement the necessary dietary and behavioral modifications necessary following the procedure and display a willingness to attend the necessary follow up routines with physicians, dietitians, counselors, and other members of the medical team as necessary on a long term basis. The patient should be an adult, not pregnant, and free of drug addiction or disease processes unrelated to obesity.

### **Types of Bariatric Procedures**

Bariatric surgery falls into two basic categories of procedures: malabsorptive and restrictive. Malabsorptive procedures alter the amount of calories, proteins, and nutrients that can be absorbed by the body. Restrictive procedures alter the capacity of the gastrointestinal system and thereby limiting the amount of food and calories that can be consumed at any one time. Some procedures can be a combination of both surgeries. The “gastric bypass (open and laparoscopic), the laparoscopic adjustable band and the biliopancreatic diversion (with or without the duodenal switch) are the primary procedures

used currently" (ASMBS, 2005).

## Malabsorptive Procedures

There are three general types of malabsorptive bariatric procedures: jejunio-ileal bypass, duodenal Switch (DS), no bypass, and biliopancreatic diversion. The first operations performed solely for weight loss purposes were performed in the 1950's at the University of Minnesota. This procedure induces a state of malabsorption by bypassing a large portion of the intestines and leaving the stomach intact. The weight loss results were excellent, however, this procedure was not without complications including: diarrhea, night blindness (from vitamin A deficiency), osteoporosis (from vitamin D deficiency), protein-calorie malnutrition, and kidney stones. Some of the most worrisome complications were associated with the toxic overgrowth of bacteria in the bypassed intestine. These bacteria then caused liver failure, severe arthritis, skin problems, and flu-like symptoms (ASBS). The complications experienced by the patients were so severe that many required reversal of the procedures. As a consequence of the many severe complications experienced by patients having the procedure, it is no longer recommended as a weight loss treatment. Long-term follow-up by an experienced bariatric surgeon is required for any patient who has had a JIB in the past due to the effects of global malabsorption.

The biliopancreatic diversion or BPD was designed to be a safer alternative to the JIB without the severity of malabsorption. Malabsorption is the incomplete transfer of calories and nutrients from the intestines into the bloodstream where it is utilized by the body for nutritional and energy needs. The process of absorption begins when bile and pancreatic fluids are released into the duodenal portion of the stomach to break down fat, carbohydrates, and proteins. In BPD, the surgical procedure is designed to divert these digestive enzymes away from the duodenal portion of the stomach and to reintroduce them to the food in the distal small intestine (ileum). Here the digestive enzymes will still have some opportunity to work on the food and provide nutrients, but the digestion will be incomplete leaving a large portion of the larger fat and carbohydrate molecules still intact. Because bile and lipase, the crucial fat digesting aids, are not present fat malabsorption is predominate over carbohydrate malabsorption. However, incomplete fat digestion can cause gas and loose foul smelling stools called steatorrhea. The second mechanism that causes malabsorption is the decrease in surface area of the small intestine through which the food passes. Less surface area means less nutrient absorption. Since the BPD is a malabsorptive surgical procedure, lifelong follow is required on the part of the patient.

In difference to the Roux-en Y gastric bypass (RYGBP), which is both a restrictive and malabsorptive procedure, the BPD removes 70% of the stomach. The necessity for this part of the procedure lies in decreasing acid production by the stomach. The upper portion of the stomach, which is left intact, is larger than the pouch created for the RYGBP procedure. This allows the BPD patient to eat a larger volume of food before feeling full.

After entering the upper stomach, food is diverted through the surgically created connection into the small intestine. This is very similar to the anatomy in the RYGBP procedure, except the path from the stomach to the large intestine is much shorter. The

bile and pancreatic juices travel through the bypassed biliopancreatic channel and enter the large intestine 50-100 cm from the colon. Some of the pancreatic secretions and bile are reabsorbed along the path of the channel before joining with the food in the intestine. The part of the intestines where the joining of the food and the pancreatic secretions occurs is called the common channel. The length of the common channel and the alimentary canal is determined by the surgeon using various formulas.

The amount of weight lost with the BPD procedure is variable, and the data is dependent upon a number of factors such as the length and quality of follow up, the country where the procedure was performed, the surgeon performing the procedure, and the initial weight and compliance of the patient. With these variables taken into account, the amount of excess weight loss reported in patients having the BPD procedure is around 70 percent. The maintenance of this weight loss has reported lasted up to 18 years.

### Duodenal Switch

The duodenal switch (DS) is a modification of the BPD created to decrease the occurrence of ulcers, increase gastric restriction, decrease dumping syndrome, and decrease the severity of protein-calorie malnutrition. Some bariatric experts however, feel that dumping syndrome may actually be of some benefit in the fact that it tends to hinder the patient from consuming large amounts of foods that are high in sugar and fat which could negatively impact the weight loss process.

The duodenal switch is created by fashioning the stomach into a small tube, leaving the pylorus intact. The duodenum is transected and the intestine connected to the duodenum above the area where the digestive fluids enter the intestine. In contrast to the BPD, the stomach volume in the DS is much smaller; creating a restriction that is similar to the RYGBP. The main physical difference between the DS and the BPD is the shape of the stomach; the malabsorptive properties of the two procedures are virtually the same. The DS procedure divides the stomach vertically and leaves a section of the stomach shaped like a tube that empties into a segment of duodenum that measures 2-4 centimeters. By contrast the BPD procedure dissects the stomach horizontally, removing the lower half.

The duodenum is resistant to stomach acid and less susceptible to ulceration as compared to the small intestine. Removing part of the stomach decreases the number of acid producing cells present, decreasing the incidence of ulcers. While the BPD involves a connection between the stomach and the intestine, in contrast the DS involves a connection between the duodenum and the intestine. The duodenum is dissected 2-4 cm from the pyloric valve, the intestine is sewn to end of the duodenum which remains attached too the stomach. The remaining portion of the duodenum will convey the digestive juices. A purported benefit of the DS is an increase in the absorption of iron and calcium when compared to the BPD, however

one drawback is that the procedure itself is riskier due to the transection of the duodenum. A large number of vital structures lie immediately next to the duodenum, namely several large blood vessels and the major bile duct; trauma during surgery to any of these structures can produce life-threatening complications. The DS results in a weight loss of 60-80 percent of excess weight within one year and is considered the most effective therapy for super obese patients.

These procedures offer patients some of the highest reported weight losses over the long term, but have the highest incidences of nutritional complications compared to the RYGBP and the purely restrictive procedures. These are the most complex procedures available in bariatric medicine. There is wide variability in long-term outcomes among various bariatric centers. Only through multi center comparative testing will definitive differences among the procedures become apparent

Some patients and surgeons favor the DS procedure over the RYGBP and the BPD due to the lack of dumping syndrome; however, the DS has its own peculiar side effects. Following meals that are high in fat, patients can experience foul smelling gas and diarrhea.

Both the BPD and the DS can be performed laparoscopically. However, these operations are more demanding technically than the RYGBP and should only be performed in the most experienced hands. Long-term follow up and daily vitamin supplements are crucial to the success of these operations. Life-long monitoring is necessary to prevent nutritional and mineral deficiencies – just as with the RYGBP.

To recap here are the advantages of DS and BPD:

- Increased amount of food intake compared to the bypass and band
- Less food intolerance
- Possibly greater long-term weight loss
- More rapid weight loss compared with gastric banding procedures

60-80% of excess weight lost in year 1

Most effective therapy for super obese

Complications of BPD and DS:

- Diarrhea and foul smelling gas, with an average of 3-4 loose bowel movements a day
- Malabsorption of fat soluble vitamins (Vitamins A, D, E, and K)
- Vitamin A deficiency, which causes night blindness
- Vitamin D deficiency, which causes osteoporosis
- Iron deficiency –a similar incidence with the RYGBP

Protein-calorie malnutrition, which might require a second operation to lengthen the common channel

Ulcers (less frequent with DS)

Dumping syndrome (less frequent with DS)

## **Restrictive and Malabsorptive Procedures**

### **GASTRIC BYPASS**

The gastric bypass procedure came about as a result of observations of the weight loss that occurred in patients who underwent partial removal of the stomach as a treatment for ulcers. Since its development in the 1960's, the gastric bypass procedure has evolved into its current form, utilizing a Roux-en-Y limb of intestine (RYGBP). The RYGBP is the most commonly performed bariatric procedure in the U.S.

In its early development, the procedure was performed as a loop bypass having a much larger stomach. However, bile reflux was problematic with the loop configuration, so the procedure was modified to the present configuration with a limb of intestine connected to a small stomach pouch, preventing the bile from entering the upper stomach and esophagus. The remainder of the stomach and initial segment of the small intestine are bypassed. In the standard RYGP, the amount of bypassed intestine is not great enough to create malabsorption of protein or other large nutrient molecules. However this portion of the intestine is where most of the body's calcium absorption and iron intake occur, making anemia and osteoporosis the most common long-term effects of this procedure. These complications make lifelong supplementation necessary.

Other notable deficiencies of clinical importance include Vitamin B1 (thiamine) and Vitamin B 12. To prevent nutritional complications, daily multivitamins are strongly encouraged and lifetime follow-up with a bariatric practitioner is necessary.

The RYGBP results in sustained weight loss and an improvement in weight related medical complications. Half of the expected weight loss very often occurs in the first six post surgical months, and usually peaks between 18 and 24 months. The medical conditions that are often benefited by the procedure include Type II diabetes, high blood pressure, hypercholesterolemia, arthritis, venous stasis disease, bladder incontinence, liver disease, headaches, GERD, and sleep apnea.

Normally the RYGBP procedure involves little to no malabsorption, however; the RYGBP procedure can be modified to provide malabsorption to enhance and accelerate weight loss in special situations. When modified in this manner the RYGBP is called a distal gastric bypass. The distal gastric bypass results in intensified nutritional compromise over the proximal RYGBP. Whether the long-term weight loss is superior over the proximal RYGBP or the malabsorptive complications are worth the improved weight loss is not well founded. The

distal RYGBP is reserved by most surgeons for very specific circumstances.

The way in which the RYGBP works is quite complicated. Marked changes in behavior are often noticed following surgery. Most patients report a decreased appetite and that they feel fuller sooner after eating and that they lack feelings of deprivation. Patients also relate that they enjoy healthy eating and lose cravings for unhealthy foods. The behavioral changes are in part due to hormonal alterations (ghrelin, GIP, GLP, PYY) and neurological signals from the GI tract that relay impulses to the hunger centers of the brain. Dumping syndrome is another mechanism of the RYGBP procedure that is related to weight loss. Dumping syndrome produces symptoms such as lightheadedness, flushing, heart palpitations, diarrhea, and other symptoms within 30 minutes of consuming sweets or high sugar foods. Some patients continue to remain sensitive to these foods while most lose their sensitivity over time.

The morbidity risk in the first month following the RYGBP procedure is approximately 0.2-0.5% in expert centers. The risk of death and complications is greater in centers with low experience in bariatric procedures.

#### **Advantages of RYGBP:**

60% of excess weight lost in year 1

Maintains a weight loss of 50% for 25 years

Rapid resolution of metabolic syndrome

Improvement in obesity-related complications

Better weight loss than after purely restrictive procedures

Low incidence of protein-calorie malnutrition and diarrhea

Rapid improvement or resolution of weight-related comorbidities

Appetite reduction

#### **Complications of RYGBP:**

##### **Early:**

Anastomotic Leak

Pulmonary embolism

Wound infection

Gastrointestinal hemorrhage

Respiratory insufficiency

Mortality

##### **Late:**

Incisional hernia

Bowel obstruction

Internal hernia  
Stomal stenosis  
Micronutrient deficiencies  
Marginal ulcer

## Restrictive Procedures

### **Gastroplasty**

Designed in the early 1970's to be a safer option to the RYGBP and the JIB, the gastroplasty was made possible by the invention of mechanical staplers. The first purely restrictive procedure for the management of obesity, the horizontal gastroplasty involved the stapling of the stomach into a small partition. A small opening was left for food to pass from the upper stomach into the lower one. The resulting weight loss results were very poor long term and despite modifications to the procedure, it was eventually forsaken in favor of procedures with better long-term results.

The vertical banded gastroplasty (VBG) is based on a pouch formed along the lesser curvature of the stomach with a Silastic ring or mesh band around the outlet of the stomach pouch. The VBG procedure offers a low mortality rate and virtually absent deficiencies in micronutrients. In addition, due to the lack of an anastomosis there is a lower risk of complications due to infection.

The VBG is being performed on a much less frequent basis due to studies showing significant rates of weight regain and exacerbation of severe heartburn. The RYGBP offers superior weight loss compared to the VBG. The results are similar for persons who have a strong preference for sweet foods with the RYGBP, presumably due to the connection between sweets and dumping syndrome.

### **GASTRIC BANDING**

Non-adjustable gastric banding is another example of a restrictive bariatric procedure. This procedure was first introduced in 1978 and involved the application of Marlex mesh around the upper part of the stomach, creating a small upper pouch separate from the rest of the stomach. However, the pouch eventually enlarged again which resulted in weight regain.



In 1980, the gastric segmentation procedure was introduced which utilized a Dacron vascular placed around the upper portion of the stomach. The pouch that was created was smaller than the previous attempts, but the Dacron band had to be abandoned in favor of Gortex as the Dacron caused the liver to adhere to the band.

In 1983, physicians began the use of the present day forerunner for gastric banding. They placed a 1 cm silicone band around the stomach to create a 30-50ml proximal gastric pouch. This band was later modified to produce adjustability of the diameter of the band using an inflatable balloon.

### **Advantages of gastric banding**

- Absence of anemia
- Absence of dumping
- Lack of malabsorption
- Short hospital stay
- Very low mortality rate

### **Complications of gastric banding**

- Gastric perforation
- Incisional hernia
- Stomal stenosis
- Band slippage
- Band erosion into stomach
- Need for reversal or revision

### **LAPAROSCOPIC ADJUSTABLE GASTRIC BANDING**

In 1986, physicians devised a silicone band, which contained an inflatable balloon in the center. The balloon was connected to a small reservoir that was placed just under the skin of the abdomen. The reservoir allows the size of the balloon to be adjusted. When the balloon is inflated to the maximum, maximal weight loss is achieved by decreasing the amount that the stomach may contain. Deflating the balloon decreases the amount and the rate of weight loss. The bands can be placed during a laproscopic procedure, decreasing the risk of complications for the patient.

There are currently several different brands of banding systems on the market. The Lap-Band system obtained FDA approval for USA use in 2001. Other brands include the Mid-Band and the Swedish Adjustable Band. No one brand has been proven to be clearly superior

The laproscopic adjustable banding procedure produces weight loss purely through the restriction of food intake. The best results are obtained if the patient is strictly compliant and

undergoes frequent follow up for band adjustments. The procedure is completely reversible and does not carry risks of nutritional complications of other bariatric procedures.

The LAGB is a safe procedure with a low rate of life-threatening complications. The mortality rate of the procedure is lower than that of the RYGBP at 0.1%. Excessive weight loss is lower than with gastric bypass or malabsorptive procedures. Improvement in weight related comorbidity-such as diabetes, asthma, sleep apnea, GERD, HTN, asthma, and Hyperlipidemia-is seen with the LAGB procedures but the improvement is somewhat less favorable than that of the gastric bypass procedures.

### **Advantages of LAGB**

Same as gastric banding  
Adjustability of the band  
Reversibility (by band removal)  
Laparoscopic placement

### **Surgical Advantages of Pure Gastric Restriction**

50% excess weight loss at 1 year

Minimal nutrition complications

Can be used in populations that are high risk for RYGB

### **Complications after LAGB**

#### **Intraoperative :**

Hemorrhage  
Injury to the spleen, stomach, or esophagus  
Conversion to open procedure

#### **Postoperative :**

Band slippage (stomach prolapse)  
Leakage of the balloon or tubing  
Port Infection  
Band infection  
Obstruction  
Nausea and vomiting

### **Late complications**

Band erosion into the stomach  
Esophageal dilatation

Failure to lose weight

### **Risk of Deficiencies**

Determined by the type of surgical intervention

Restrictive	Minimal risk
Malabsorptive	Moderate risk
Combination	High risk

Risk increases as:

the length of the common channel decreases, and  
the degree of malabsorption increases

### **Other Nutrition Complications**

Refractory Hypoglycemia

Vitamin C Deficiency

Selenium deficiency

Copper deficiency

Severe Protein Calorie Malnutrition

Functional Pancreatic Insufficiency

Accelerated Weight Loss

Hepatic Failure

Dehydration

### **Other Post-surgical Complications**

Anastomotic leak or bleeding (1- 2%)

Strictures (10-15%)

Fistula formation

Severe diarrhea

Intusseption

Short Bowel Syndrome

Abdominal pain

Intestinal ischemia

Gastric erosions or ulceration

Hernias- Hiatal, Incisional

### **Non-Nutritional Psychosocial Complications**

Depression

Suicide

Alcoholism

Night Eating Syndrome

Binge Eating Syndrome

### **Suggested Monitoring**

Monitoring Guidelines

Frequent (no less than every 3 months)

Weight (more often in first 6 months)

CBC, Electrolytes, BUN, Cr, Ca, Mg, P

Glucose, Liver Tests, Albumin

Fat soluble vitamins-A,D,E and K

Vitamin B12, B1

Iron studies

Vitamin C, Selenium, Zinc, Copper

Pre-albumin (or Transferrin if renal disease)

### **Occasional (at least annually)**

Measured Height

Bone Mineral Density

PTH, 1,25-OH Vitamin D, Zinc, 24 hour urine calcium

### **Post Surgical Monitoring**

Weight loss progression\*

Goal: not more than 1-2 lbs/d in 1<sup>st</sup> mo

Adequate Protein Intake

Fluid status

### **Goal Nutrient Intake**

Protein (1-2 grams per kg of adjusted weight)

60 gram Gastric bypass

75 grams Duodenal Switch

**Fat**

25% total calories

**Carbohydrate**

15-30 grams per serving day in 4-6 servings

**Fluid**

64 ounces

**Potential Nutritional Limitations**

Meat and dairy intolerance

Nutrient malabsorption

Vomiting, especially with over-consumption

Constipation

Dehydration

**Post-surgical Supplementation**

Prenatal multivitamin or Flintstone chewable MVI with minerals (2/day)

Iron Polysaccharide 150 mg po BID for women

Calcium Carbonate 500 mg po TID

Vitamin D 400 IU po qD

Vitamin B12 500 mcg po qD

**Nutrient Deficiencies**

Preventable with supplementation

Require lifelong compliance with supplements

Minimized by regular and routine monitoring

**Nutrition Monitoring Challenges**

Few randomized protocols to address nutrition monitoring

How often and for how long patients are to be followed is debated due to costs

Timing of follow-up visits not clear

Routine vitamin replacement not covered by many carriers

### **Looking to the Future**

The future of bariatric medicine is an evolutionary process, many other procedures are being studied and developed. The implantable gastric stimulation device uses electrical stimulation to produce a feeling of fullness in the stomach. The intragastric balloon is also being revived as an endoscopic procedure. The balloon once implanted into the gastric space decreases the amount of food that the stomach can hold. However, neither of these procedures has achieved adequate long-term weight loss.

### **Step-wise Approaches**

Surgeons have also begun using inventive procedures in patients who would not otherwise be good surgical candidates. They begin by using less risky procedures to stabilize the patient and achieve an initial weight loss that will enable the patient to become a better surgical candidate for further operative procedures that will allow the patient to achieve final weight loss outcomes.

These less invasive steps have included the “sleeve gastrectomy,” the gastric balloon and the adjustable band as an interim step before a RYGBP or DS is performed.

### **SUMMARY**

Almost all bariatric procedures have resulted in consistent short-term weight loss. Unfortunately there is no perfect operation. The remarkable drive for the obese patient to regain weight cannot be eliminated in all patients. Furthermore, the history of bariatric surgery is replete with procedures that seemed initially to be very promising and safe in theory, but which were later found to be failures. As such, newer procedures should always be viewed with caution. The RYGBP, LAGB, DS and BPD have withstood appropriate scrutiny through the literature. Only through careful research and discussion with a qualified bariatric surgeon can patients decide which procedure may be the best for them.

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