Bariatric Surgery: A Review for the Primary Care Provider

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Background Information:
The incidence of overweight and obesity is increasing at an alarming rate, and in 2002 Surgeon General declared an obesity epidemic in the United States (1). Body Mass Index (BMI), which describes relative weight for height (kg/m^2), has been endorsed by the NIH as the standard for assessing overweight and obesity due to its significant correlation with total body fat content (2). Between 1988 to 2000, the estimated prevalence of individuals in the United States who were overweight (BMI $\geq$ 25 kg/m^2) increased from 55.9% to 64.5%, and the prevalence of obesity (BMI $\geq$ 30 kg/m^2) increased from 22.9% to 30.5% (3). Perhaps more shocking is that rate at which clinically severe obesity (BMI $\geq$40 kg/m^2) has risen. In a study done by Flegal and colleagues, between the years 1986-2000, the prevalence of severe obesity (BMI $\geq$ 40 kg/m^2) quadrupled (increasing from 1 in 200 Americans to 1 in 50), and individuals with a BMI $\geq$ 50 kg/m^2 (referred to as "super" obesity) quintupled (increasing from 1 in 2000 Americans to 1 in 400) (4). Another growing trend is the number of patients undergoing surgical interventions for obesity, increasing from 13,365 individuals in 1998 to 72,177 individuals in 2002 (5).

With the increasing trend of obesity and growing numbers of individuals undergoing bariatric surgery, are primary care doctors equipped to handle this special group of patients? In a cross sectional survey of primary care doctors 85% had reported treating a patient in the past year undergoing bariatric surgery, while 76% had reported referring patients to a bariatric surgeon. However, 35% of practitioners felt unprepared to provide good quality long-term medical follow-up, and only 45% felt competent to address the medical complications of bariatric surgery (6). Primary care providers must screen all patients for overweight and obesity and initiate appropriate treatments and/or referrals. With the growing trends of bariatric surgery, it is even more important for primary care physicians to understand the criteria for referral to a bariatric surgeon, be familiar with the appropriate pre-operative work-up, and also be prepared for the unique complications of caring for the post-operative bariatric patient during long term follow-up.

The Problem of Obesity:
Obese individuals are at risk for developing multiple medical problems, including type 2 diabetes mellitus, hypertension, stroke, hyperlipidemia, osteo-arthritis, obstructive sleep apnea, non-alcoholic steatohepatitis (NASH) and cancer (including endometrial, breast, prostate and colon). Obesity is also an independent risk factor for heart disease (7). In addition to medical problems, a significant minority of obese individuals also suffers from psychosocial complications, including depression, binge eating, trauma or other emotional problems (8). The pathophysiology of obesity is multi-factorial, not well understood, and includes genetic, behavioral, psychological and other factors (9). Multiple approaches exist for the treatment of obesity, including nutritional education, diet and exercise, counseling with behavioral strategies, medical therapy, and bariatric surgery. However, bariatric surgery is the most effective method for achieving sustained weight loss of a considerable degree in individuals with morbid obesity (10). Therefore, as more obese individuals are having little

success with conservative weight management strategies, they are turning to weight-loss surgery as a solution.

Referral to a Bariatric Surgeon:
In 1998, the National Heart, Lung, and Blood Institute's (NHLBI) Obesity Education Initiative released clinical guidelines for the identification, evaluation, and treatment of overweight and obese individuals. According to the NHLBI guidelines, the criteria for weight loss surgery include the following: 1) BMI $\geq$ 40 kg/m^{2}or those with a BMI $\geq$35 kg/m^2 with serious co-morbid conditions 2) Failure of non-operative weight loss efforts (e.g. diet, exercise, behavior modification and psychological support) 3) Well informed, compliant, and highly motivated individuals 4) Absence of contra-indications to surgery (2). There are relatively few absolute contra-indications to bariatric surgery, including mental or cognitive impairment, active cancer, advanced liver disease with portal hypertension, unstable coronary artery disease, uncontrolled severe obstructive sleep apnea with pulmonary hypertension (pulmonary systolic pressure >50) (11).

Pre-Operative Work-up:
Candidates for bariatric surgery should have a thorough evaluation completed by a multi-disciplinary team consisting of a physician with a special interest in obesity, a nutritionist, a psychologist or psychiatrist, and a bariatric surgeon (11). The goals of the pre-operative evaluation include assessing indications and contraindications to operative treatment, performing comprehensive medical, psychological and dietary evaluations, treating and optimizing medical comorbidities, and educating patients regarding their options of treatment and risk, and setting realistic expectations (11). Preoperative medical evaluation involves a clinical assessment for conditions that commonly accompany obesity, including hypertension, diabetes, hyperlipidemia, coronary artery disease, sleep apnea, non-alcoholic steatohepatitis, pulmonary hypertension and musculoskeletal disorders. All patients should undergo a thorough history and physical examination. Routine laboratory testing for secondary causes of obesity (e.g. hypothyroidism, Cushing's, etc) are not recommended unless clinically suspected (11). All patients should receive an EKG and a chest X-ray (20). Patients should also undergo cardiac risk assessment following the American Heart Association Guidelines. However, full evaluation may be limited because of body habitus and weight limitations of diagnostic equipment (13). If pulmonary arterial hypertension is suspected, patients should have an echocardiogram performed (21). Due to the high incidence of obstructive sleep apnea (OSA) in obese patients, screening should be universal, although there is no widely accepted method to determine who should be formally tested with a sleep study. Increased incidence of OSA is associated with male gender, BMI $\geq$ 25 kg/m^2 , neck circumference >16 inches in females and >17 inches in males, habitual snoring and gasping noted by bed partner, excessive daytime somnolence, hypertension, high Mallampati score (19).

In the perioperative period treatment of co-morbidities should be optimized. For patients with a history of type 2 diabetes mellitus, strict glycemic control should be instituted to maintain a blood glucose level <150 or a hemoglobin A1c <7. (11). Patients with OSA should be using CPAP or BiPAP at least 4-6 weeks prior to surgery in an effort to decrease hypercarbia, hypoxemia and pulmonary artery vasoconstriction (19). Patients with NASH may benefit from calorie restriction for a several weeks preoperatively to reduce the size of the liver, making surgery easier (55). Beta blockers may decrease the risk of intra-operative

ischemia, infarction or dysrhythmia in patients with coronary artery disease (13), however its role has not been defined in bariatric surgery.

The nutritional and psychological evaluations are of equal or greater importance to the overall success to bariatric surgery. Individuals should undergo a complete nutritional evaluation to assess nutritional status, aid in patient education, and determine whether patients will be compliant with the post-operative diet (11). The nutritionists have an important role in helping to educate patients regarding lifelong changes of diet and exercise needed to lose weight and maintain a healthier weight. The psychiatric evaluation focuses on the patient's psychological wellbeing, ability to make informed decisions, and willingness to participate in postoperative treatment (8). As previously stated, individuals with severe obesity have an increased incidence of psychological problems, and some studies suggest that patients with an Axis I or II disorder (according to the *Diagnostics and Statistical Manual for Mental Disorders, fourth edition*) are likely to lose less weight after surgery than those without such disorders (40). Other psychological factors have been associated with suboptimal surgical outcome, including disturbed eating habits (e.g. binge eating), substance abuse, low socioeconomic status, and limited social support (41). Patients must also have realistic expectations regarding outcomes of surgery. In a meta-analysis of outcomes for various forms of bariatric surgery, the average amount of excess weight loss (total weight – ideal body weight) was 61.2% (16). In a survey of over 250 obese individuals, their "dream weight" was 89% ± 8% of excess body weight lost, whereas 67% ± 10% and 49% ± 14 % was "acceptable" and "disappointing", respectively (15).

Choosing a Bariatric Procedure:

Bariatric surgeries can be divided into two main categories: restrictive and malabsorptive. A combination of the two can also be performed (e.g. Roux-en-Y gastric bypass). Restrictive procedures induce weight loss by limiting intake. The most popular restrictive procedure is the laparoscopic adjustable gastric banding procedure (LAGB). In 2001 the LapBand ^{TM} was approved by the FDA and has become increasingly popular. The band consists of a silicone ring connected to an infusion port which is placed in the subcutaneous tissue and can be easily accessed with a syringe and needle. Injection of saline into the port leads to reduction in the band diameter, resulting in an increased degree of restriction (figure 1). A relatively new restrictive procedure is the sleeve gastrectomy. The sleeve gastrectomy is gaining popularity as a first stage procedure for super obese patients with multiple comorbidities and increased risk factors for surgery. The sleeve gastrectomy involves removing the majority of the greater curvature of the stomach, resulting in a tubular stomach (figure 2). This procedure is technically simple without complex anastomoses. After patients have a significant amount of weight loss and a reduction in comorbid conditions, a second stage procedure (e.g. Roux-en-Y gastric bypass, biliopancreatic diversion with duodenal switch) can be performed.

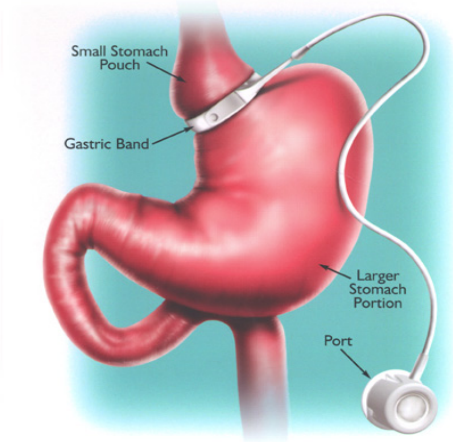

Fig 1. LabBand [TM]

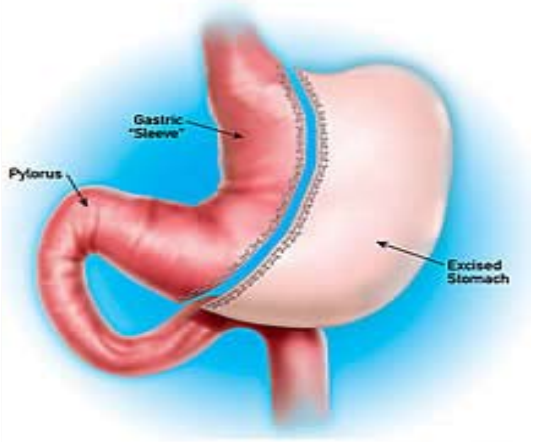

Fig 2. Sleeve gastrectomy

Malabsorptive procedures produce a controlled state of malabsorption by reducing contact of digested food with secretions of the liver, pancreas, and small bowel, or a combination of these. The most common malabsorptive procedure is the Biliopancreatic Diversion (BPD) with Duodenal Switch (DS). The surgery begins with the creation of a gastric sleeve which can hold 200-500 ml, followed by transection of the duodenum a few centimeters distal to the pylorus, and transection of the ileum approximately 250cm proximal to the iliocecal valve. The distal portion of the ileum is then connected to the proximal duodenum via gastroduodenostomy to form the alimentary limb. The portion of small bowel which was bypassed is anastomosed approximately 100cm proximal to the iliocecal valve via ilioiliostomy, and forms the biliopancreatic limb. The surgery results in a common channel that is approximately 100cm (figure 3). Due to increased incidence of protein calorie malnutrition and other vitamin deficiencies, BPD with DS is not a very common procedure.

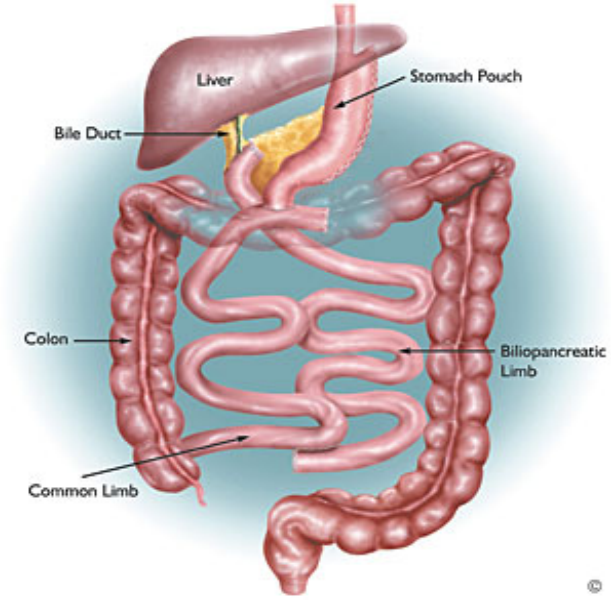

Fig. 3 Biliopancreatic diversion with duodenal switch

The most commonly performed bariatric surgery is the Roux-en-Y gastric bypass (RYGB), which accounts for roughly 80% of weight loss surgeries in the United States. It is a combination restrictive and malabsorptive procedure. It involves the creation of a small gastric pouch (approximately 15-50ml) followed by transection of the jejunum approximately 75 cm below the ligament of Treitz. The distal portion of the gastric pouch is anastomosed to the distal segment of jejunum (the Roux loop). The bypassed portion of the small bowel is then attached to the Roux loop via jejunojejunostomy to form the common channel (figure 4).

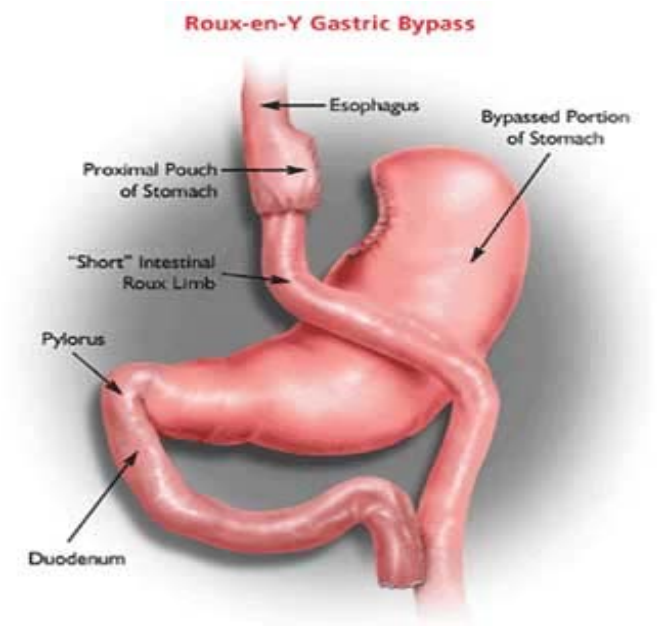

Fig. 4 Roux-en-Y gastric bypass

Surgical Complications:

Bariatric surgeries can all be performed laparoscopically which has resulted in less perioperative pain, reduced complication rates, and shorter hospital stays (10). A meta-analysis performed by Maggard and colleagues demonstrated the differences in complication rates between open and laparoscopic procedures. Overall, surgical complications were higher in open procedures at 31.1% compared to 26.1% of laparoscopic procedures. There were lower rates of respiratory complications (including pneumonia, atelectasis, and respiratory insufficiency) in laparoscopic procedures at 1.9% versus 3% of open procedures. There was also a significant difference in wound infections, occurring in 0.0% of laparoscopic procedures compared to 13.1% of open procedures. In addition, incisional hernias were much less common in laparoscopic procedures at a rate of 0.0% versus 8.2% for open procedures. However, there were higher rates of internal hernias in laparoscopic procedures, 1.3% vs. 0.0% of open procedures. Based on the significantly lower complication rates occurring in laparoscopic procedures, this approach is preferred in virtually all patients undergoing bariatric surgery (55).

Patients undergoing bariatric surgery are at increased risk for venous thromo-embolism (VTE), and pulmonary embolism is one of the leading causes of early mortality following obesity surgery (26). The incidence of VTE is approximately 0.2-3.5% (24, 25). Although

there is some controversy regarding standards of care for deep vein thrombosis (DVT) prophylaxis amongst obese patients, it is generally accepted that patients should use sequential compression devices and either subcutaneous heparin or low molecular-weight heparin (26). The treatment period for DVT prophylaxis is variable, with discontinuation either at the time the patient becomes ambulatory or at the time of discharge, based on surgeon preference. In particularly high risk patients, some surgeons may opt to continue DVT prophylaxis after discharge (55). There are no guidelines on the use of prophylactic vena caval filters, however their use has been suggested for bariatric patients at high risk for post operative pulmonary embolus (e.g. venous stasis disease, BMI $\geq$ 60, prior VTE, known hypercoaguable state) (11).

Another common complication of patients undergoing obesity surgery is cholelithiasis secondary to rapid weight loss and bile stasis, resulting in gallbladder sludge and the creation of cholesterol stones (26). There are several different approaches to gallbladder disease in patients undergoing bariatric surgery, and there is no consensus as to which is best. Some surgeons elect to screen all patients pre-operatively for gallstones with abdominal ultrasound, and if present, perform cholecystectomy at time of bariatric surgery (55). Others opt to perform routine cholecystectmy on all patients at the time of surgery (26). If cholecystectomy is not performed, treatment with ursodiol 600mg daily for six months post procedure is recommended to decrease the incidence of new stone formation (29).

There are many complications unique to the laparoscopic adjustable gastric band (LAGB), and approximately 13-15% of patients will require reoperation (30). Acute stomal obstruction occurs in a approximately 2% of patients and is caused by either inclusion of excess tissue (perigastric fat) within the band or significant tissue edema surrounding the band (31). Patients present with persistent nausea, vomiting and inability to tolerate oral intake. Acute stomal obstruction can be treated conservatively via decompression with a naso-gastric tube, but if obstruction persists, surgical revision or removal of the band is necessary. Gastric band erosion may occur in up to 3% of patients, and is usually caused by either gastric wall ischemia from an excessively tight band or mechanical trauma related to the band buckle (32). Patients may experience fever, pain, nausea, vomiting, or port site infection. Band erosion is treated through endoscopic or laparoscopic removal. Band slippage or prolapse was seen in up to 24% of patients in the initial FDA trial, but more recent studies show a lower incidence of 2-14%, secondary to changes in technique (31,33). With band slippage, patients may present with food intolerance, epigastric pain and gastric reflux, and surgery is required to repair, reposition, replace or remove the band. Tubing or port malfunction (including tube disconnection, leakage within the system, port migration, etc) has an incidence of 0.4-7% (31, 34). Port malfunction can present with inability to access the port, titrate the volume of saline, maintain band volume, or patients may gain weight unexpectedly. All malfunctions of the tubing or port require surgical repair. Pouch and esophageal dilatation is a common complication, occurring in up to 10% of individuals (35). It can be associated with an excessively inflated band, binge eating, or excessive food intake. Treatment is deflation of the band. If symptoms persist, repositioning the band may be necessary. Other complications include esophagitis or gastro-esophageal reflux, which usually improves with deflation of the band and acid suppression.

With RYGB and BPD/DS, one of the most serious and life-threatening complications is peritonitis from an anastomotic leak. The incidence of anastomotic leak is about 1.2% in

open gastric bypass (27) and 3% in laparoscopic procedures, however with increased experience performing laparoscopic procedures, the rate of anastomotic leaks has decreased (28). The incidence of post-operative bleeding is 0.6-4% and most commonly occurs from an anastomotic site. Bleeding may be intra or extra-luminal, however intra-luminal bleeding is more common. There are other complications which are unique to RYBG. Stomal stenosis is one of the most common complications of RYGB, occurring in 6-20% of patients (36). The exact etiology is uncertain, although tissue ischemia or increased tension on the gastrojejunal anastomosis is believed to have a role. Patients present with nausea, vomiting, dysphagia, reflux and poor oral intake, and treatment consists of endoscopic balloon dilatation. Rarely the bypassed portion of the stomach develops massive gastric distension. The exact cause of the remnant distension is not well understood, and it is thought to be secondary to paralytic ileus, or distal, mechanical bowel obstruction (26). Patients complain of pain, hiccups, left upper quadrant pain, abdominal distension or shortness of breath. Treatment consists of rapid decompression of the gastric remnant, otherwise progressive distension can lead to rupture and spillage of gastric contents into the peritoneal cavity.

Metabolic and Nutritional Complications:
Patients undergoing LAGB and other restrictive procedures are at low risk of developing nutritional deficiencies, but they can occur, especially if patients are experiencing food intolerance or excessive vomiting. Patients undergoing malabsorptive or combination procedures have a high risk of nutritional deficiencies which requires routine monitoring and supplementation. After RYGB patients are at risk for iron, vitamin B12, folate, calcium, and vitamin D deficiency (39). Patients undergoing BPD with DS are at increased risk of protein calorie malnutrition, iron deficiency anemia, hypocalcemia and deficiencies of fat-soluble vitamins, especially Vitamins A, D and K (37, 38).

Nutritional and vitamin deficiencies in patients undergoing RYGB occur for a number of reasons, including poor absorption (secondary to bypassing the duodenum and proximal jejunum), food intolerance, achlorhydria and poor secretion of intrinsic factor. Serum iron deficiency occurs with rates as high as 52%, and anemia occurs in up to 74% of patients (43). Individuals generally benefit from iron supplementation with 320mg of iron twice daily, however high doses of oral iron may not prevent anemia in menstruating women (44). Vitamin B12 deficiency occurs in up to 64% of patients and can be corrected with 1000-2000 micrograms of oral B12, however a small percentage of patients will require intramuscular injection of B12 (45). Folate deficiency is seen in as many as 38% of individuals and can be supplemented with 800 mcg of oral folate daily (47). Of note, there have been reports of increased neural tube defects in infants of mothers after RYGB (48). Up to 50% of patients will be deficient in 25-OH vitamin D, and 10% will have low serum calcium (43). However, calcium deficiency is not always apparent because of release of calcium from bones, therefore it is important to check for markers of bone turnover (e.g. serum parathyroid hormone, N-telopeptide) and evidence of decreased bone mass (e.g. DEXA scanning) (49). The recommended supplementation is 1200-1500mg per day of calcium and 400 international units of vitamin D daily (46). Of note, calcium citrate is preferred over calcium carbonate because the latter requires acidification for absorption. Another common complication of the RYGB is dumping syndrome, occurring in up to 76% of patients (51). When simple sugars are ingested, it causes an osmotic shift in the small intestine, leading to movement of fluid from the circulation to the intestines. In addition rapid entry of food to the jejunum stimulates substantial release of peptide hormones. The following changes are

manifested as early satiety, nausea, cramps, diarrhea, sweating, flushing, dizziness, palpitations, and exaggerated insulin response leading to hypoglycemia. In order to avoid the dumping syndrome, patients should be instructed to avoid fruit juices and foods or drinks with added sugar. Patients should ingest frequent, small, dry meals which include dietary fiber and increased protein (especially fish and chicken), and have modest increase in dietary fat to delay gastric emptying (52).

In patients undergoing BPD/DS, one of the most significant complications is protein calorie malnutrition, occurring in as many as 11.9% of patients (26). Treatment involves hospitalization for 2-3 weeks for parenteral nutrition (55). Approximately 4% of patients will require reoperation which involves reversing the procedure altogether, or lengthening the common channel to improve absorption (38). Usually protein calorie malnutrition occurs in the first few months after surgery, but it can occur much later. Other common problems include hypocalcemia and iron deficiency anemia (especially in menstruating women) (55). There have also been case reports of thiamine deficiency leading to Wernicke's encephalopathy (54). Patients undergoing BPD/DS are at increased risk of fat soluble vitamin deficiences, especially vitamin A, D and K, and require lifelong supplementation (26). The serious nutritional complications associated with BPD/DS, in addition to the technical difficult of the operation likely contribute to the decreased popularity of the procedure (55).

Mortality:
Based on two separate meta-analyses, the overall mortality of bariatric surgery is <1%, and the thirty day mortality rates differed significantly depending on which procedure was performed (16, 23). The thirty day mortality rate was 0.02-0.1% for purely restrictive procedures, 0.3-0.5% for gastric bypass and 0.9-1.1% for biliopancreatic diversion with duodenal switch (16,23). Other studies have elicited different risk factors which have been associated with increased mortality, including age, male gender, and decreased surgical experience (12, 17, 18). A study by Murr and colleagues reviewed outcomes on over 19,000 gastric bypass procedures between 1999 and 2003 and found that there were significantly higher mortality rates and increased complication rates for less experienced surgeons and for hospitals with lower patient volumes (12). In response to the decreased morbidity and mortality rates associated with increased surgical experience and increased hospital volumes, the American Society of Bariatric Surgeons (ASBS) formed a private compliance and research organization to accredit bariatric centers as "Centers of Excellence" (10). Centers of Excellence are comprised of an experienced surgical team (including bariatric surgical coordinators, anesthesiologists, nutritionists and mental health specialists), a well-structured multi-disciplinary program, a hospital capable of handing the morbidly obese (including appropriate consultative and critical care staff, experienced nursing staff, etc.), organized support groups and a clinic system for long term follow-up of patients (10).

Outcomes:
Average weight loss differed significantly depending on the procedure performed. Weight loss was more dramatic in malabsorptive procedures verses restrictive procedures. In two separate meta-analyses, the average total body weight loss was 34.8-39.7% for adjustable gastric banding, 41.5-43.6% for RYGB, and 46.4-53.1% for PBD/DS (16,23). Buchwald and colleagues also looked at the amount of excess weight lost, defined as total weight minus

ideal weight. They found the estimated average excess weight lost was 47.5% for LAGB, 61.6% for RYGB and 70.1% for BPD/DS (16).

Another outcome used to measure success of bariatric procedures is reduction in comorbidities, such as diabetes, hypertension, hyperlipidemia, obstructive sleep apnea, etc. In the meta-analysis performed by Buchwald and colleagues there were significant reductions in comorbidities two years after individuals underwent weight loss surgeries (23). The reduced comorbidities were most impressive in patients undergoing BPD/DS, followed by RYGB, and LAGB was associated with the least resolution of chronic medical problems. See Table 1 for more details.

% Reduction in Co-Morbidities After Weight Loss Surgery

	DM	**HTN**	**HLD**	**HCL**	**HTG**	**OSA**
Overall	76.8%	61.7%	79.3%	71.3%	82.4%	85.7%
LAGB	47.9%	43.2%	58.9%	78%	77%	95%
RYGB	83.7%	67.5%	96.9%	94.9%	91.2%	80.4%
BPD/DS	96.9%	83.4%	99.1%	87.2%	100%	91.9%

Table 1. Adapted from Buchwald, et. al. (DM=diabetes mellitus, HTN=hypertension, HLD=hyperlipidemia, HCL=hypercholesterolemia, HTG=hypertryglyceridemia, OSA=obstructive sleep apnea)

The Swedish Obesity Subjects Survey (SOS) looked at short and long term outcomes of patient's undergoing obesity surgery. The SOS was a prospective non-randomized controlled study which compared weight loss and comorbidities amongst surgically treated individuals (either RYGB, vertical gastric banding, LAGB) and a control group at 2 and 10 years post procedure (58). The study concluded that surgically treated individuals had a significant decrease in BMI and reduction in comorbidities compared with the control group. At 2 years out, the BMI of the control group increased by 0.1%, and the BMI of the surgical group decreased by 23.4%; at 10 years out, the control group's BMI increased by 1.6 %, where as the surgical group's BMI decreased by 16.1% of their starting weight. The SOS also looked at resolution of comorbidities amongst patients treated surgically and the control group. Of all the indices reviewed, patients undergoing surgery had a significant improvement in comorbidities compared with patients not undergoing surgery, with the exception of hypercholesterolemia. See Figures 5 and 6 for details.

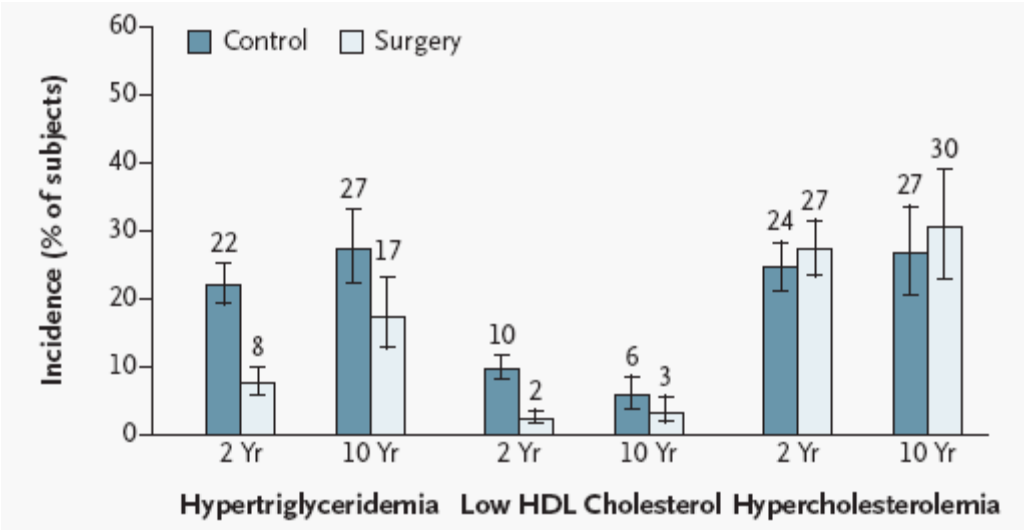

Figure 5. Taken from NEJM 351;26. Comparison of comorbid conditions in the surgical group and the control group at 2 and 10 yrs after weight loss surgery.

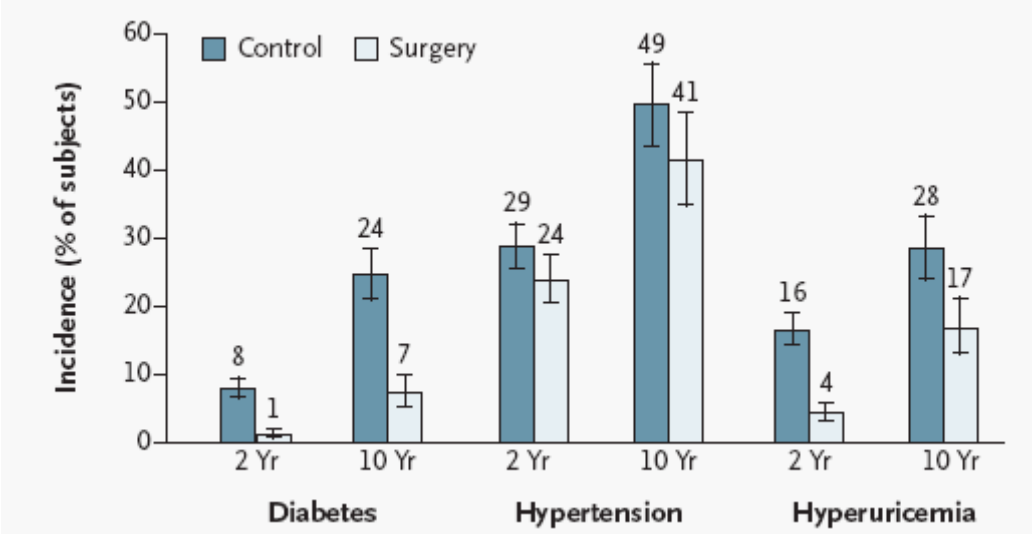

Fig. 6 Taken from NEJM 351;26. Comparison of comorbid conditions in the surgical group and the control group at 2 and 10 yrs after weight loss surgery.

Although there is still significant change in BMI between the two groups, it is interesting to note that there was significant weight regain in the surgery group. The decrease in BMI was 23.4% at two years and 16.1 % at ten years. Even though the rates of hypetension, diabetes, hypertryglyceridemia, and hyperuricemia are all statistically significant between the treated and untreated groups, between the two and ten year follow- up, the rates of resolution amongst the surgical group actually declined (58). Based on this study it can be inferred that the benefit of weight loss surgery on reduction in comorbidities is significant, however the benefits of surgery may be reduced in the long term due to weight regain.

Does the weight loss and comorbidity reduction associated with bariatric surgery translate into long term improvement in mortality? The SOS showed an 80% decrease in the annual

mortality of diabetic individuals after surgery in comparison to the control group (9% mortality at 9 years versus 28% mortality in a control group) (58). Other studies have shown benefits overall, not just in the diabetic population. Christou and colleagues performed an observational cohort study, comparing obese individuals undergoing bariatric surgery with a control group followed over a period of five years (57). Not only was there significant risk reductions for the development of cardiovascular, oncological, endocrinological, infectious, psychiatric and mental disorders compared with the control group, weight loss surgery reduced the relative risk of mortality by 89% five years later. A retrospective study by Flum and Dillenger looked at the long term impact of gastric bypass on survival and compared patients undergoing bariatric surgery were a cohort of similar patients (53). They found that patients who survived the first post-operative year, had a 33% less risk of dying than those not undergoing surgery. At a 15 year follow up, 16.3% of the non-operative cohort group died, compared to 11.8% of patients undergoing bariatric surgery. Overall, this study found that there was only a modest mortality benefit 15 years after surgery.

All of these studies reflect the positive impact bariatric surgery has on weight loss and comorbidity reduction. In the short term, the results of surgery have been astounding whereas the long term benefits are less impressive. Most of the information available relies on meta-analysis and retrospective or prospective case reviews. It would be beneficial to have a randomized control trial to assess morbidity, mortality, and risk factor reduction in both the short and long term. However, given the overall benefits of the surgery, it may not be ethical to randomly select patients to conservative therapy. Therefore future studies could focus on large, multi-center, non-randomized control trials to better elicit long term mortality rates and comorbidity reductions in patients undergoing bariatric surgery.

Follow-up in the Post-Operative period:
After gastric banding, patients initially resume their usual diet because the band is deflated. Band tightening occurs periodically every 4-6 weeks, with a goal weight loss rate of 1-2kg per week (55). If the band is tightened aggressively, it may lead to frequent vomiting and maladaptive eating patterns of consuming high calorie liquids or soft foods instead of healthy solids. Although nutritional deficiencies are considerably less common in patients undergoing gastric banding, they should still take a daily multi-vitamin (containing iron, B12, B complex with thiamine, vitamin C and calcium) (56).

After hospital discharge patients undergoing RYGB should have their blood pressure and weight monitored every 4-6 weeks until rapid weight loss diminishes, at which time the visits can be spaced out to every six or twelve months (55). During these visits patients adherence with dietary changes and nutritional supplementation should be discussed, and patients should have routine blood work done to assess for nutritional deficiencies (11). Medication management is also important as many patients have resolution of diabetes and hypertension after surgery. Diabetic patients need close monitoring of blood glucose because there is a decreased need for insulin after surgery (55). Patients on oral sulfonylureas or thiazolidinediones are at increased risk for hypoglycemia, therefore metformin is the safest oral medication in the post operative period. Discontinuation of all diabetic medications can be considered after the patient's blood glucose normalizes, and the patient is tolerating a regular diet. Patients also have significant decrease in hypertension post operatively. Keep in mind, hypotension may be related to poor oral intake or persist vomiting after surgery. Patients should have their medications adjusted or discontinued as needed.

Follow-up with a nutritionist should be continued in order to educate individuals regarding post operative dietary changes, and to help avoid unhealthy eating patterns. For patients undergoing RYGB, the diet changes considerably throughout the first six weeks of follow-up. In the first twenty-four hours, patients are only allowed water and sugar-free liquids, followed by a high protein liquid diet in which patients consume 30-60ml every two hours (55). Two to four weeks post-operatively patients are allowed a mechanical soft diet, and the transition diet begins four to six weeks postoperatively (55). During the transitioning, it is important for patients to learn how to chew their food slowly, not drink liquids during meals, and stop eating when they have a sense of fullness. If patients do not chew their food well, it may result in food impaction and vomiting (56). Patients also may experience food intolerances, including red meats, corn, rice, bread, fruits with seeds, and high fat foods (39).

Patients should also be closely monitored by a psychiatrist or psychologist in the post-operative period. Patients who have a history of eating disorders are more likely to have difficulty adjusting to changes in eating patterns (8). Also, patients who are on anti-depressants prior to surgery should continue their medications because individuals often experience emotional lability with the dramatic weight loss. In the short term patients experience enhanced self esteem and improved mood, however these changes appear to deteriorate over time (8). Unfortunately bariatric surgery has not proven to be a cure-all for the psycho-social problems affecting patients preoperatively.

Conclusion and Recommendations:

As the problem of obesity continues to increase, so does the number of individuals undergoing bariatric surgery. Thus far bariatric surgery remains the best treatment for weight loss and co-morbidity reduction in obese individuals. It is important for primary care physicians to screen all individuals for overweight and obesity, and when indicated, refer patients to bariatric specialists for obesity surgery. Individuals undertaking surgical measures for weight loss must undergo a complete medical, surgical, nutritional and psychological evaluation, preferably at a bariatric Center of Excellence. Patients must understand the risks associated with surgery, potential complications of the procedures, and have appropriate expectations regarding weight loss. Post-operatively patients should be monitored carefully for surgical complications, nutritional deficiencies, and resolution or improvement of comorbid conditions. It is extremely important for patients to continue to follow up with a nutritionist and psychiatrist or psychologist in the post-operative period. Weight reduction and improvement in comorbidities are significant, however more studies need to be done to better understand the long-term implications of bariatric surgery.

Sources:

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