Bariatric Surgery: Is It Right For Your Patient?

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The rising incidence of obesity has lead to an even greater increase in the number of weight loss operations performed. One can not avoid the advertisements for bariatric surgery centers nor patient inquires regarding these operations. As internists, problems of obesity are an increasing part of our practices. Managing obesity is of paramount importance being that it is the underlying cause of many of the conditions we treat as internists: Diabetes, hypertension, arthritis, hyperlipidemia etc. What do we know about the disease, its so-called epidemic and the efficacy of surgical treatment?

The obesity epidemic?

Is there really an epidemic of obesity? We are told of a rapidly rising incidence of obesity but is that true? Data from the CDC demonstrate that the prevalence obesity is increasing but at a slow, steady pace. The reasons are several-fold. The population is aging and as people get older, their weight increases. This is coupled with ready access to inexpensive highly caloric foods and decreased need or desire for physical activity.

Body weight is tightly correlated with hyperlipidemia, hypertension and diabetes. Does this translate to increased mortality? The question is important being that billions are spent on weight loss treatment, in part, because of the fear for the adverse effects on health of obesity. Recent publications have demonstrated that relatively minor degrees of weight loss substantially increase longevity (1). Control of diabetes and hypertension can also increase longevity independent of obesity (2). Taken together, these observations can explain why obesity is not as lethal as previously thought (3).

The lethality of obesity and its comorbid conditions is important to consider when evaluating bariatric surgery. Outcomes from these procedures have been intensively scrutinized because of their increasing popularity. Numerous systematic reviews of varying quality have been published in the past few years (1;4-14). All have reached similar conclusions: There is compelling evidence that bariatric surgery results in weight loss with equally compelling evidence that they cause complications and deaths. The data regarding comorbidity control is less well defined and there are no reliable studies demonstrating increased longevity from surgically induced weight loss. Furthermore, not all patients lose weight with these operations and predicting treatment failures is difficult. Who then should undergo these operations? That question can not be answered generally; rather the decision should be made between the patient and their primary health care provider, preferably a clinician with a longstanding relationship with the patient.

Obesity and Morbid Obesity-Overview

Obesity is an excess of adiposity. However, by convention, it is defined as a body mass index (BMI) greater than or equal to 30. The body mass index is calculated by dividing the weight in kilograms by the square of the height in meters. Alternatively one can multiply the weight in pounds by 705 and divide the product by the square of the height in inches. A BMI between 25 and 29.9 is overweight. Obesity has been further subdivided:

Stage I BMI 30-34.9
Stage II BMI 35-39.9
Stage III BMI 40 or greater

Surgeons will further classify patients with BMI of 50 or greater as superobese.

Health risks associated with obesity are numerous. It is an independent risk factor for heart disease, type 2 diabetes, hypertension, stroke and hyperlipidemia. Osteoarthritis and obstructive sleep apnea are also more common in the obese individual. There are increased risks for a variety of cancers, including breast cancer in postmenopausal women who gain weight. Finally, there is an increased risk of all cause mortality in the obese.

If obesity is responsible for a wide variety of ills, then weight loss should logically be a primary recommendation by treating physicians. Unfortunately despite a broad range of dietary programs, conventional therapy for weight loss is rarely successful. Only surgical intervention has resulted in sustained weight loss with associated control of comorbidities.

Current recommendations for weight loss offer a 3 step approach:

1. Diet and exercise
2. Adjunctive medication for BMI >27 with comorbidities or BMI >30
3. Bariatric surgery for BMI >35 with comorbidities or BMI >40

Bariatric surgery became accepted following a 1991 NIH consensus conference chaired by UTSW's Scott Grundy. They recommend management as noted above and defined the significant comorbidities as hypertension, hyperlipidemia, coronary artery disease, diabetes mellitus type 2, osteoarthritis, obstructive sleep apnea and gastroesophageal reflux disease. Additional illnesses that are considered when evaluating a patient include polycystic ovarian syndrome, pseudotumor cerebri, stress urinary incontinence and nonalcoholic steatohepatitis. Acceptable procedures for treating what was then termed morbid obesity were Roux-en-Y gastric bypass or vertical band gastroplasty, according to the panel. Despite numerous systematic reviews and consensus panels, these recommendations have changed little over the years.

Nonsurgical approaches to Weight Loss

All the consensus panels and literature examining obesity stress the importance of diet , exercise and possibly medication as essential to all weight loss programs. Unfortunately, there is little evidence to support the wide variety of available weight loss programs. Most patient enrolled in nonsurgical weight loss studies have stage I or II obesity and not stage III. Additionally, obesity is a chronic disease and the vast majority of studies were of relatively short duration.

Dansiger et al conducted a trial comparing Atkins, Ornish, Weight Watchers and the Zone Diets. Patients with BMI's ranging from 27 to 42 were instructed in their assigned diet, counseled every 2 weeks for two months, then advised to follow their diet to the best of their ability for the remainder of the year. Weight loss was greater in those who completed the full year study but did not differ between the 4 groups. (range 2.1-

3.3kg) The greatest loss was seen in those who reported the best dietary adherence. While improvement in some cardiac risk factors did reach statistical significance, only one patient discontinued a cholesterol lowering medication. 50% of patients dropped out of the Atkins and Ornish diets, 35% from the Zone and Weight Watchers groups. This study specifically addressed only the dietary aspect of the weight loss effort and did not encourage exercise or other lifestyle changes (15).

Millions of Americans enroll in commercial weight loss programs every year. Outcomes of these were recently reviewed. Only randomized trials lasting at least 12 weeks conducted in the United States with adult participants were considered. Only Weight Watchers demonstrated clinical efficacy in a large, randomized trial, with a loss of 5% of initial weight. Medically supervised programs such as Optifast and HMR can result in a 15-25% loss of initial weight with maintenance of 8-9% loss at one year, 7% at 3 years and 5% at 4 years. The morbidly obese enjoyed a larger initial loss and with intensive maintenance therapy were able to sustain a larger long term loss compared to those who were less obese. In general, weight loss was greatest among those who had regular counseling and kept diet and exercise records (16).

In one of the few nonsurgical trials of morbidly obese patients, Samaha et al randomized a cohort of morbidly obese VA patients to low carbohydrate vs low fat diet. With a high degree of follow up at 6 months, the low carbohydrate group had lost an average of 5.7 kilo compared to the low fat group's weight loss of 1.8 kg. The low carbohydrate diet group also had lower triglycerides, better control of diabetes and improved insulin sensitivity in the non diabetics (17). At one year, the difference in weight loss disappeared with the low fat group achieving that same degree as the low carbohydrate diet group. There was an advantage in terms of better control of metabolic parameters in the low carbohydrate group, but only following statistical correction of weight loss. Although successful, these patients all required extensive counseling that only resulted in modest amounts of weight loss (18).

Bariatric Surgery-what are the operations?

Bariatric surgery got a rough start. Sustained weight loss is rarely achieved in the morbidly obese. When malabsorption was surgically created by connecting the proximal to the distal small bowel dramatic weight loss occurred. Being the first successful treatment for morbid obesity, jejunoileal bypass operations were performed in large numbers prior to any clinical trials of the procedures safety and efficacy (19;20). With time many, lethal complications of the operation became evident (21-26). When an appropriately controlled trial was performed, gastric bypass was found to be equally effective in causing weight loss but with many fewer complications (27). History inevitably repeats itself. There are many operations being promoted for obesity treatment such as the biliopancreatic diversion, minigastric bypass, duodenal switch etc. that are equally untested yet claimed to be safe and effective by their proponents.

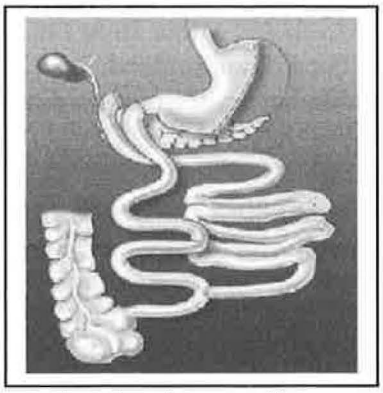
Roux-en-Y Gastric Bypass. The stomach is either divided or stapled closed. A limb of jejunum is brought to the resultant pouch. The length of this limb is usually about 75 cm, however, in the long-limb variation of this procedure the limb may be as long as 150 cm.

Creating malnutrition proved an unwieldy approach for obesity treatment. Attention was then directed at restricting food's ability to enter the stomach. A number of gastroplasty operations were devised in an attempt to reduce gastric storage capacity. Although these operations proved effective for some, weight loss was modest, many patients regained weight within a couple of years of the procedure and about 1/3 of patients required a revision operation for gastroplasty complications (28).

Weight loss procedures were being developed in the era of declining numbers of ulcer operations. Gastric resections caused a variety of eating disorders with many patients having trouble maintaining adequate body weight. These observations led to the development of the gastric bypass operation which was designed to mimic the effects of gastric resection procedures (29). When these procedures were compared to banded gastroplasty operations in a randomized controlled trial, their superiority became evident (30;31). Roux-en Y gastric bypass has become the gold-standard operation that all other weight loss operations are compared to.

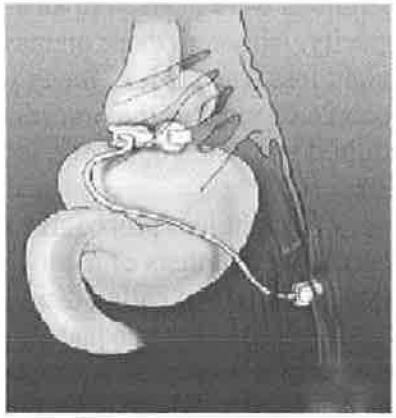
Malabsorption operations still have their advocates. Patients become morbidly obese because they ingest excessive calories. They do so knowing that these behaviors result in weight gain and ill health. This behavior fits the psychiatric definition for substance abuse, i.e. the use of a drug even when the use knows it will cause harm. As with substance abuse, amelioration of overeating habits in the morbidly obese is notoriously unsuccessful. Critics of the gastric bypass operation point out that some patients regain weight. Nutrient malabsorption will result in weight loss irrespective of eating habits. In an effort to create an operation that is not reliant on modification of patient's eating habits, jejunoileal bypass derivatives have been created that have fewer side effects.

Biliopancreatic diversion or duodenal switch. These operations add significant nutrient malabsorption to the gastric restrictive component typical of the gastric bypass. The biliopancreatic diversion operation is similar to the gastric bypass but the intestinal limb is very long. Approximately 100 to 150 cm of small bowel is in contact with both the biliopancreatic secretions as well as food. Consequently, these operations can cause substantial nutrient malabsorption. A common side effect of the operation is malodorous flatus. Vitamin deficiencies are common. The most problematic is profound hypocalcemia caused by diminished small bowel absorption of calcium as well as vitamin D deficiency. Deficiencies of all the fat soluble vitamins (A, D, K and E) are relatively common. The major advantage of these operations is that weight loss results irrespective of a patient's eating habits. The duodenal switch procedure is similar to the biliopancreatic diversion except that the duodenum is connected to the small bowel, bypassing most of it causing malabsorption. Rather than create a pouch as if the gastric bypass operation stomach is reduced in size by removing the portion of the greater curvature. This operation has the advantage of retaining the pylorus minimizing problems related to dumping syndrome



Amongst the first was the biliopancreatic diversion, an operation that combined moderate amounts of gastric restriction with less severe malabsorption than was created with the jejunoileal bypass (32). All gastric bypass operations cause dumping syndrome. Avoidance of this complication occurs when the pylorus is spared in the duodenal switch modification of the biliopancreatic diversion (33).

One of the most important developments has been the rapid expansion of laparoscopic banding operations. These operations have the distinct advantage of being relatively easy to perform, requiring much less technical skill on the part of the operating surgeon. Consequently, the complications attributable to these procedures are much less that that of gastric bypass procedures. When first introduced, they were predicted to fail just as had the banded gastroplasties (34). Admittedly, weight loss is slower than that for gastric bypass but within 5 years results of laparoscopically placed adjustable bands approximates that of gastric bypass (35).



Adjustable gastric banding procedure. An inflatable band is placed around the proximal stomach by a laparoscopic approach. A reservoir is placed in a subcutaneous location that enables the band to be inflated or deflated depending on what the patients requirements are. This operation has few complications and almost no mortality. Although safe, the weight loss effect is more gradual than from gastric bypass procedures. Ultimately, however, patients will lose the same amount of weight as from a gastric bypass.

Minigastric bypass is mentioned only to condemn it. This operation has been heavily advertised by its creator. The procedure has been the subject of a front page Wall Street Journal article yet there have been a paucity of journal reports regarding is efficacy (36). This procedure entails creating a relatively large gastric pouch along with a loop rather than Roux-en Y gastrojejunostomy. Persistent exposure of the pouch and esophagus to bile is a major theoretical concern and there is no follow-up data in the literature regarding the safety profile for this operation.

Do these operations cause sustained weight loss?

Roux-en Y gastric bypass causes sustained weight loss for most patients. Evidence for this comes not from any randomized controlled trials but rather from the preponderance of evidence of collected series. There has not been a randomized controlled trial comparing gastric bypass to medical therapy. However, because medical treatment for morbid obesity is usually ineffective, most believe that such a trial is not necessary. Most series of weight loss operations suffer from lack of complete follow-up of patients being studied. They very best studies have follow-up of 80% and it is assumed that those not being followed have had poor outcomes. There is a trial underway funded by the NIH to determine the long terms outcomes from bariatric surgery (LABS) but it will be several years before any results are published.

On average patients can expect to lose 65% of their excess body weight with Roux-en-Y gastric bypass. Excess body weight is defined as the amount of weight that is in excess of ideal body weight as defined by the Metropolitan height-weight charts. This

translates to a weight loss of about 100-120 pounds for most patients. Patients undergoing these procedures generally start with BMI>40 kg/m^2 and will achieve a final BMI of about 35 kg/m^2-still obese.

Laparoscopic banding procedures will result in weight loss but much more slowly than with gastric bypass. Lap-band patients require much more counseling than those with gastric bypass but can achieve approximately the same degree of weight loss at 5 years that a gastric bypass patient experiences in 1 year.

How well are the comorbid conditions of obesity controlled with weight loss operations?

Outcomes of LAP-BAND System: % excess weight loss (Fielding Surg Clin North Am 85:129-40, 2005)

Study	N	1 year	2 years	3 years	4 years	5 years	6 years	7 years
Dargent 1999	500	56	65	64				
Fielding 1999	335	52						
Allen 2001	60			65				
O'Brien 2002	709	47	52	53	52	54	57	
Vertruyen 2002	543	38	61	62	58	53		52
Rubenstein 2002	63	39	46.6	53.6				
Ren 2002	115	41.6						
Belachew 2002	763	40	50	50–60				

Data supporting comorbidity control following bariatric procedures is imperfect. Most studies have been retrospective case series that have incomplete follow-up. A major prospective cohort study that is underway is the Swedish Obesity Study (SOS). Two groups of obese Swedes have been prospectively followed. One group consists of individuals who desired bariatric surgery. The control group consists of a matched group that did not desire this intervention (37). Not being randomized, there is an inherent bias with this study being that those undergoing surgery are more concerned about and motivated to address their obesity than the control group. Most of the operations in the surgical arm have been banded gastroplasties, operations that are felt to be ineffective. Thus, the SOS is not a definitive study and because the spectrum of operations differs from those commonly performed in the United States; its results may not apply to U.S. patients.

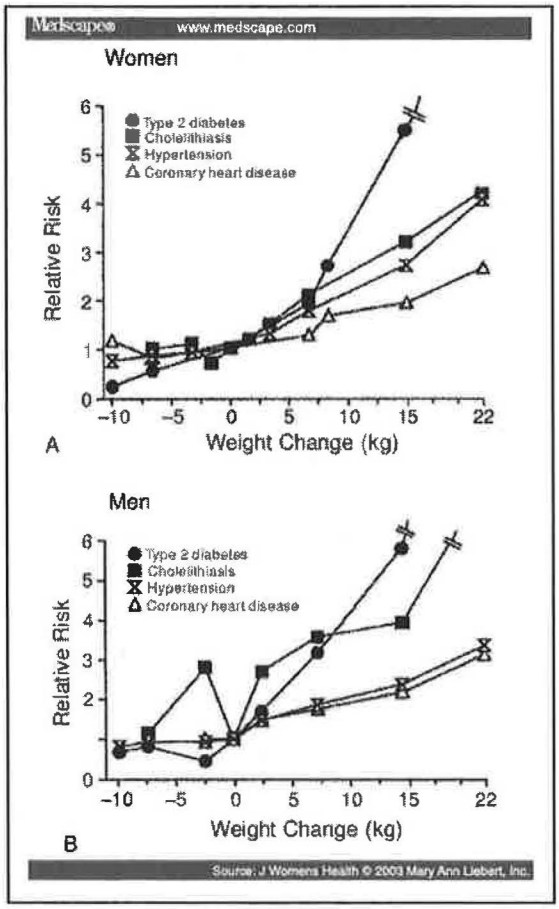
Type 2 Diabetes

Some of the strongest evidence in favor of surgery shows the dramatic improvement in diabetes after surgically induced weight loss. It is well known that

obesity worsens the metabolic abnormalities found with type 2 DM including hyperinsulinemia, hyperglycemia, hypertension and hyperlpidemia. There is a 60-80 fold increased risk of developing diabetes in those with a BMI >30. Several studies have demonstrated marked improvement in diabetic control after surgery (38). A meta-analysis by Buchwald showed 76.8% resolution and 86% resolution or improvement in diabetes after surgery (39). The SOS study again showed remarkable improvement in diabetes at 2 years (72%) but only 36% at 10 years, likely due to significant weight regain (40;41). This still represented a significant difference when compared to the control group with only 13% resolution. Maggard et al found 21 case series that looked at diabetes (present in 11% of patients preoperatively) and reported resolution or improvement in 64%-100% (42).

Hypertension

The relationship between rising BMI and the incidence of hypertension is well known. Weight loss in the overweight patient by any means is integral to management of hypertension. Good evidence supports the role of surgery in treatment of hypertension. The SOS study showed dramatic improvement in both systolic and diastolic blood pressures at 2 years which then diminished at 8 and 10 years. The relapse in body weight gain was associated with the rise in blood pressure. Most patients enrolled in the SOS underwent gastroplasy operations. They tended to regain weight and hypertension returned with the increase in weight. Of those who underwent RYGB, they generally lost more and maintained their weight loss also maintained the lowered blood pressure (40;41). Maggard et al reviewed 19 case series that reported hypertension results. Of these there was a median 89% improvement in blood pressure (42). Buchwald's meta-analysis of 136 studies also showed resolution of hypertension in 61.7% of affected patients (39).



Dyslipidemia

Dyslipidemia is closely associated with obesity. Consequently, weight loss is generally accompanied by improvement in the lipid profile. All the systemic reviews of bariatric surgery found good evidence that lipid profiles improved with surgically induced weight loss. Maggard's RAND/AHRQ study found 11 bariatric surgery-dyslipidemia studies. 60%-100% improvement or resolution was reported

postoperatively (42). Buchwald's JAMA review found that the best results were obtained from the BPD, DS and RYGB. (58.9% AGB, 73.6% VBG, 96.9% RYGB and 99.1% BPD/DS). Low HDL improved more with the restrictive procedures according to the same analysis (39). The SOS study reported improvements in triglycerides, HDL, and total cholesterol at 10 years (40;41).

Obstructive Sleep Apnea

OSA has effects beyond those of the respiratory system. Evidence exists that there are metabolic consequences of OSA that may be improved with treatment. CPAP treatment of OSA improves glycemic control. Morbidly obese patients with diabetes were found to have reduced their HbA1c from 9.2 to 8.6% following initiation of CPAP treatment. Given that surgically induced weight loss has proven benefits in both OSA and DM, morbidly obese individuals with OSA and DM may benefit more by bariatric surgery than treatment of these complications individually (43).

60% of those with significant obesity have OSA. Obesity is, in fact, the most common predisposing factor for OSA. BMI alone is a poor predictor so all patients with symptoms should have a polysomnography study. Rasheid et al evaluated 100 patients with sleep symptoms. 13% had no OSA, 58% had moderate to severe OSA and received preoperative CPAP. All were reevaluated a median of 6 months postoperatively. BMI decreased from 54 to 38 and the Epworth Sleepiness Scale dropped from 12 to 6. 11 patients also completed a postoperative sleep study which showed significant improvement. (RDI 56 to 23 and REM latency in minutes 261 to 118). The primary flaw in this study, acknowledged by the authors, was the small number of postoperative sleep studies. Although recommended to all patients many declined as insurance would not cover the cost or their symptoms had sufficiently improved and they felt it unnecessary. Thus, limited, but compelling clinical evidence suggests that gastric bypass is a good treatment option for OSA (44).

Although surgical risk is high, it likely that weight loss operations are an appropriate treatment for obesity hypoventilation syndrome. This entity is characterized by chronic daytime hypoventilation leading to an elevated pCO2. It is seen primarily in the severely obese (45;46).

Gastroesophageal Reflux Disease

GERD is clearly associated with overweight and obesity. It is one of the defining comorbidities named in the 1991 NIH consensus statement. A meta-analysis by Hampel et al looked at BMI, GERD and its complications (erosive esophagitis, adenocarcinoma of the esophagus and gastric cardia). They found the effect of BMI on GERD to be independent of dietary intake. The data concerning hiatal hernia were conflicting (47). Some smaller studies have shown improvement in symptoms following bariatric surgery. Patterson et al. compared lap Nissen fundoplication to lap RYGB. This study had only 6 patients in each group but demonstrated equal efficacy in symptom resolution and lowering esophageal acid exposure (48). In another study, a series of 500 patients were treated in a private hospital and 163 of them were followed for at least 18 months. Spivak et al. reported resolution (72.9%) or improvement (14.6%) in symptoms in the 48 with GERD (49).

Given the improvement in other comorbidities with bariatric procedures, it can and has been argued that this, rather than fundoplication, should be the procedure of choice for morbidly obese patients with GERD.

Degenerative Joint Disease

Although this is one of the 1991 qualifying criteria for surgery (50), there are only a few case series reporting improvement in symptoms. Despite the lack of firm evidence, many orthopedic surgeons recommend that patients undergo weight loss surgery prior to joint replacement.

Polycystic Ovarian Syndrome

Long associated with obesity, PCOS also manifests many of the metabolic abnormality and diseases associated with metabolic syndrome. 30% of PCOS patients are obese, 30-40% have impaired glucose tolerance and up to 10% have type 2 diabetes by the 4th decade of life. Hypertension and decreased vascular compliance have been noted in these patients as has a predisposition to microvascular disease and thrombosis. They also tend to have an atherogenic lipid profile with high TG, VLDL and LDL and lower HDL. Sleep apnea is more prevalent, even after controlling for obesity. Weight reduction is a mainstay of treatment for the overweight PCOS patient. Trials have shown no greater benefit of one type of diet over another. There is no information specifically addressing surgery as the means for weight loss in this population.

Pseudotumor Cerebri

A much less common comorbidity, this is one of the few diagnoses mandating relative urgency for surgery. Sugerman et al. performed RYGB on 23 and ALB on 1 patient with pseudotumor cerebri. They report a decrease in BMI from 47 to 30 at the end of one year. All but one patient had resolution of headache within 4 months. Recurrence of headache occurred only in those who regained weight. Although an earlier study from the same group documented a decrease in ICP postoperatively, this study only provided the presurgical pressures (51).

Mortality following bariatric surgery

Great controversy exists regarding the safety of bariatric operations. In general, laparoscopic banding procedures have very low complication and mortality rates. There is a greater body of literature regarding outcomes for gastric bypass. The definitive study of bariatric surgery mortality emanates from California where a state-wide database of hospital discharges was collected for several years. Based on patient identifiers, records were linked for discharges from any California hospital and death records. Thus, a comprehensive assessment of mortality could be obtained. One year mortality was 0.9%, a figure that should serve as the standard for death rates for gastric bypass (52). Single institution studies of high risk patients report mortality of about 1.5% (53-55). Reports of higher mortality either are from relatively small samples collected over a very long period of time (56) or evaluated select groups of very high risk patients (57). Thus, on average, it is safe to conclude that gastric bypass mortality ranges from 05-1.5% dependent on the patients risk. Risk factors associated with higher mortality include male

gender, superobesity, age >60 years (58-60), hypertension and factors predictive for pulmonary embolus (54;55).

Perioperative Complications of Bariatric Surgery

1. Stricture of gastrojejunostomy: Gastrojejunostomy stricture occurs in 1% to 10% of patients after Roux-en-y gastric bypass. The complication occurs more frequently following the laparoscopic than the open gastric bypass. Anastomotic stricture presents with dysphagia, vomiting, and/or food intolerance. This problem is generally easily addressed by endoscopic balloon dilation. Follow-up dilations may be required, but surgical revision is rarely required. Most surgeons are comfortable performing this procedure approximately 2-3 weeks after surgery and this complication rarely develops before that time.

2. Gastrointestinal bleeding: Gastrointestinal bleeding occurs in approximately 1% to 2% of patients after Roux-en-y gastric bypass, and usually occurs from one of the various staple lines. The gastric pouch and anastomotic staple lines are easily identified with upper endoscopy. The jejunojejunostomy may be as far as 150 cm distal to the gastrojejunostomy making this anastomosis less accessible by endoscopy unless a very long enteroscope is used. As with most gastrointestinal bleeding, endoscopic therapy is the preferred method of management and should be performed with the knowledge of the operating surgeon. Bleeding can also occur from the gastric remnant staple line, which is usually not accessible through normal endoscopy. If this occurs in the acute setting, surgical intervention is often required. If this complication occurs remote from the original operation, it can be managed by angiography and potentially by creating a gastrostomy to the gastric remnant, performing endoscopy through this access. Under these circumstances, the patient should be referred to a center with experienced bariatric surgeons.

3. Marginal ulcer: Ulcers may occur, usually on the gastric side of the gastrojejunostomy. These ulcers are usually thought to be ischemic in nature; however, in most cases, the gastric pouch looks otherwise well perfused. Almost all of these patients will heal with a course of proton-pump inhibition. Follow-up endoscopy should be performed to document resolution. When refractory to medical treatment, the anastomosis might require revision. Marginal ulcer bleeding can be severe but usually responds to endoscopic intervention. Patients with perforated marginal ulcers can occasionally be managed nonoperatively if they are not septic.

4. Bowel obstruction: As with any operation, adhesive bowel obstructions may occur as a result of gastric bypass. Laparoscopic gastric bypasses have a relatively high rate of internal hernias resulting in bowel obstructions. As with any obstruction, the presenting symptoms are vomiting, abdominal distension and pain. Internal hernias can present more insidiously with intermittent symptoms such as cramping and abdominal pain that resolves spontaneously. A high index of suspicion is needed to make the diagnosis. Contrast x-rays or CT scan may suggest the diagnosis of internal hernia but often surgical exploration based on a high index of suspicion confirms the diagnosis of internal hernia. Fortunately, most partial bowl obstructions resulting from adhesions resolve with bowel rest alone. Complete bowel obstructions require emergent surgery.

5. Complications of the *LapBand* : Although this procedure is associated with fewer acute perioperative complications, it has its own set of potential problems. As with any prosthesis, there can be migration of the band caudal or cephalad, as well as *into* the esophagus or stomach. Patients may also present with severe food intolerance. A certain degree of such intolerance is necessary, however, in order for the action of the band to allow for weight loss. There have been reports of significant esophageal dilation and promotion of gastroesophageal reflux but these are seen less frequently than was the case for banded gastroplasties. In most cases, deflating the band will correct these problems if the patient has not lost the desired weight; conversion to a Roux-en-y gastric bypass may be required.

Long term Complications of Bariatric Surgery

In addition to the more immediate postoperative complications, there are significant potential long term nutritional and metabolic complications. These are of particular concern for the internist as patients can present years after surgery and the potential connection might be overlooked.

Starvation

There are 3 types of starvation injury observed follow bariatric surgery: protein malnutrition (kwashiorkor), refeeding syndrome and Wernicke-Korsakoff syndrome. While patients can store energy in the form of fat or glycogen, protein cannot be stored and its depletion in the overweight patient is easily overlooked. Persistent vomiting postoperatively should signal that the patient is at risk for inadequate protein intake. The best measure for protein depletion is the serum albumin.

Replenishment of the significantly malnourished patient should proceed with caution to avoid the refeeding syndrome. With initial full calorie parenteral hyperalimentation serum phospourus is rapidly depleted. It is postulated that the low phosphorus interferes with the formation of the high energy phosphate bonds required to maintain the biconcave shape of red blood cells. These resultant spherical cells are more rigid and break more easily, causing a hemolytic anemia. The decrease in 2,3-diphosphoglycerate in the rbc also causes a shift in the oxygen dissociation curve, limiting oxygen release to tissues. This could explain in part the multiorgan system failure seen with refeeding syndrome.

The Wernicke-Korsakoff syndrome manifests as peripheral and central nervous system damage. Symptoms generally appear 1-4 months after the onset of vomiting. Although rare, it must be recognized and treated rapidly to avoid permanent damage. Findings include lateral nystagmus, loss of deep tendon reflexes, ataxia and numbness of the extremities. Thiamine replacement is the appropriate treatment: however a large glucose load can deplete the limited thiamine in cells so the replacement should be administered early in the course of concomitant rehydration. (Mason, 1998) Peripheral neuropathy has been found in up to 16% of patients.

Another possible cause of vomiting related to malnutrition is that of mechanical obstruction due to localized edema at the operative site. With improvement in serum albumin the edema often decreases, permitting resumption of a regular diet.

Vitamin Deficiencies

Vitamin and mineral deficiencies are far more common in the post operative patients. All bypass procedures can cause deficiencies in iron, calcium and thiamine (vitamin B1) as these are primarily absorbed in the now bypassed duodenum. Vitamin D, as a fat soluble vitamin is also poorly absorbed, along with the other fat soluble vitamins A, D and E. The loss of vitamin D eventually leads to a calcium deficiency and secondary hyperparathyroidism. When severe, osteomalacia can also occur.

Vitamin B12 (cobalamin) is absorbed in the distal ileum but requires intrinsic factor. The excluded stomach and bypassed duodenum inhibit the binding of free B12 to intrinsic factor. B12 is not properly cleaved from its protein moiety because it is not exposed to pepsin or hydrochloric acid. Thus, B12 is malabsorbed , particularly in patients with RYGB or BPD.

Patients undergoing purely restrictive procedures have also been found to have vitamin deficiencies. Those with rapid weight loss were found to have significant folate and thiamine deficiencies and case reports have documented deficiencies in A, C, D, E, K, B2, and B6 as well (61).

All of the above can be avoided provided the patient commits to long term management and is carefully followed. Lifelong supplementation should include a multivitamin and 1000mg calcium with vitamin D (citrate is better absorbed than gluconate due to the altered GI physiology). Iron supplementation should be started and maintained if indicated. Vitamin B12, IM, intranasal or sublingual should be taken by patients with RYGB or BPD/DS. Thiamine and folate supplementation as provided by the MVI is usually sufficient.

Other Complications

All patients experiencing rapid weight loss, surgical or otherwise, are at risk for the development of gallstones. Studies have found an incidence between 3 and 30%. Ursodiol, 300mg, taken during the period of rapid weight loss, can decrease that risk to approximately 2% but can be expensive. Most surgeons do not remove the gallbladder during obesity procedures unless there is already known disease.

Dehydration is the other complication common to all operations. Patients need to be encouraged to drink small amounts of liquid throughout the day (except at meal times) and to be particularly cautious when initiating or increasing their exercise regimen. Fluid intake should be approximately 1ml/kcal of the estimated energy requirement.

Protein and calorie consumption must be adequate to maintain muscle mass and avoid the many complications detailed above. This had been estimated as 1-1.5gm

protein/kg of the ideal body weight. At this institution we utilize bioimpedance analysis to measure lean body mass and ask the patient to consume at least 1gm protein/kg lean body mass.

Selecting a Patient for Bariatric Surgery

Evaluation of the patient prior to surgery must incorporate not only surgical risk but also likelihood of successful weight loss for the individual patient. If the patient has an appropriate BMI and associated comorbidities as per the 1991 NIH criteria, he or she must then be assessed for both physical and psychological readiness.

Male gender, age greater than 60, weight greater than 400 pounds or BMI >50 kg/,m^2 each represent increased surgical risk. Age alone is not a contraindication for surgery as carefully selected patients have been shown to derive great benefits from surgical weight loss (62). Most surgeons remain reluctant to operate on patients older than 70. The superobese, in addition to being more technically challenging, are also at higher risk for cardiopulmonary complications, specifically pulmonary hypertension. The patient with pulmonary hypertension is at higher risk for postoperative ARDS. Cardiac function is usually evaluated with a stress echocardiogram if there is any question of ventricular dysfunction. Patients can often be asymptomatic due to lack of exertion or they attribute cardiac symptomatology to their weight alone. Polysomnography will identify patients with OSA who will benefit from perioperative CPAP treatment. The use of CPAP postoperatively is helpful particularly in patients requiring larger amounts of pain medication. The presence of pulmonary hypertension gives pause to proceeding with surgery. If reversible preoperatively, patients often demonstrate substantial physiological improvement following surgery. If irreversible, the risk of developing ARDS and renal failure is high with a consequent high probability of postoperative mortality. Both hypertension and diabetes need to be reasonably well controlled before bariatric operations.

Smoking also confers higher surgical risk (Livingston et al. NSQIP Analysis of Bariatric Surgery: Modifiable Risk Factors Contribute to Bariatric Surgical Adverse Outcomes, in press Journal of the American College of Surgeons). Most surgeons require that patients stop smoking for at least 3 months before surgery. This is useful not just for improving pulmonary risk but also as a test of a patient's willingness to comply with long term behavioral changes.

Nonalcoholic Steatohepatitis (NASH) has become one of the most common causes of cirrhosis. Consequently, an increasing number of patients being considered for bariatric surgery will have cirrhosis. In general, cirrhosis (or hepatitis C for that matter) are not contraindications for weight loss surgery. However, if portal hypertension exists surgery should not be performed (63).

Psychological issues are as important as the medical risks. There are no validated predictors or standardized psychological tests for the preoperative assessment of the

bariatric patient. Stable well controlled psychiatric illness is not a contraindication to surgery. Of greatest importance is that the patient understands of the role surgery plays in the weight loss process and a personal commitment to changing current eating habits. Because of the real morbidity and mortality of the operation, patients are considered candidates only after they have made real and sustained efforts to lose weight through more conventional means. Several insurance companies require patients to spend 6-12 months in a physician supervised weight loss program prior to granting authorization. While there is not evidence for the value of this requirement, monthly counseling and encouragement will help the physician to determine the patient's level of understanding, commitment to change and likelihood of long term compliance.

Patients need to understand that the changes in eating habits are lifelong. Resumption of old habits is the main cause of failure to lose or later regain weight after bariatric operations. Patients with eating disorders (e.g. bulimia) require psychiatric intervention preoperatively. There are many emotional issues associated with eating and obesity. Patients must be counseled aggressively so that they are prepared for the challenges they will encounter after surgery. Ongoing therapy with a psychologist or psychiatrist, particularly in patients with depression or other mood disorders, can be quite helpful.

Management of the Bariatric patient

Required behavioral changes include:

Not drinking liquids for 30 minutes before, during or 30 minutes after eating solid foods. This allows the patient to concentrate on solid food and not wash down larger volumes with liquids.

No carbonated beverages. The gas distends the pouch causing nausea and vomiting.

Eating small bites and chewing to pureed consistency. We have recommended using toddler silverware to help with this process initially. Baby food is not necessary.

Solid foods are eaten in order of nutritional importance: protein first, then fruits and vegetables and then starches, only if the patient still has room.

Exercise is a necessary and mandatory component of successful weight loss.

Birth control during the period of rapid weight loss to avoid nutritional deficiencies in the developing fetus.

Perioperative medication assessment

Small pills are usually not problematic

Larger pills can be crushed or taken in liquid form if available.

Extended release medication should be converted to a rapid release formulation for the first 1-2 months as the patient adjusts to the new diet.

Diabetes medication dosing will drop dramatically. Patients often are discharged on half or less of their usual medication schedule. Patients should be encouraged to check their sugars several times daily, keep a log and confer with their physician regularly for dose adjustments.

Hypertension medication will also need adjustment but the changes occur less rapidly.

Pyschiatric medications usually do not need dose adjustments due to weight loss.

Laboratory Evaluation

Preoperative consideration

- Stress echocardiogram
- Polysomnography, split study
- Hepatic ultrasound, further evaluation if suspicious for portal hypertension
- Pregnancy test

Postoperative follow-up

- Every 6 months x 2 then annually
  - CBC
  - Iron Studies
  - B12, Folate
  - B1 especially with ongoing vomiting
  - Ca++, VitD, PTH
- For persistent nausea and vomiting
  - Upper GI series and referral to surgery or gastroenterology as indicated.

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ADDITIONAL WEBSITES OF INTEREST

American Obesity Association www.obesity.org
Advocacy and educational information related to obesity.

Center for Science in the Public Interest www.cspinet.org
Consumer advocacy focusing on health and nutrition issues.

AMA Primer for Physicians, Nov 2003 www.ama-assn.org/ama/pub/category/10931.html
Comprehensive resources, tools, instructions and case studies. CME available

Obesity Online- NAASO www.obesityonline.org/site/index.cfm
Comprehensive resources include slide library and virtual meetings.

FDA Consumer www.fda.gov/fdac
FDA magazine with new and in-depth information on how to get/stay healthy.

American Dietetic Association www.eatright.org/Pulic/NutritionInformation/92.cfm
Reliable, objective food and nutrition information, fact sheets, readings lists.

Nutrition.gov www.nutrition.gov
Nutrition related materials from various US government agencies.
Includes link to MyPyramid.gov

USDA Food and Nutrition Information Center www.nal.usda.gov/fnic
Food composition data, research briefs, food service, food born illness resources

National Weight Control Registry www.lifespan.org/services/bmed/wt_loss/ncwr
Strategies, success stories, registration of long term weight loss without surgery.

American Society for Bariatric Surgery www.asbs.org
Official site for bariatric surgeons and allied health professionals

American Society of Bariatric Physicians www.asbp.org
Professional medical society with physician referral program, news, CME.

Association for Morbid Obesity Support www.obesityhelp.com
Peer support on obesity, surgery, dieting, resources for professionals

America on the Move www.americaonthemove.org/default.asp
Online support and tools for increasing activity

LEARN Program www.learneducation.com/index.asp
Comprehensive, sound, and effective weight management program

PACE www.paceproject.org
Tools to help counsel patients on diet, activity and lifestyle behaviors

ShapeUp! America www.shapeup.org/health.html
Variety of tools and information for patients and providers

Weight Control Information Network www.win.niddk.nih.gov/index/html
Patient information in Spanish and English from the NIDDK

Centers for Obesity Research and Education www.uchsc.edu/core
Guidance and training for healthcare providers on managing obesity.

International Association for the Study of Obesity www.iaso.org
Global professional organization provides conferences, journals, events

North American Association for the Study of Obesity www.naaso.org
Dedicated to the development and spread of knowledge in the field of obesity.

Healthy People 2010 www.healthypeople.gov
Includes links to 2005 Dietary Guidelines and Healthfinder program

Obesity Education Initiative www.nhlbi.nih.gov/about/oei/index/htm
Includes link to Aim for a Healthy Weight education kit, research activities, surgeon general's report, calorie/activity tool.