Bariatric Surgery and Long-term Control of Morbid Obesity

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OBESITY, DEFINED AS 20% OR more than the ideal weight or body mass index (BMI, calculated as weight in kilograms divided by the square of height in meters) of 30 or more, has reached epidemic levels in the United States, affecting more than 30% of adults.[1] Annual direct costs for treating obesity-related medical illnesses have been estimated at nearly $51.6 billion; the annual US expenditure on weight reduction exceeds $30 billion.[2,3] It was recently estimated that the prevalence of obesity in US adults increased by 8% during the past decade. In the 21st century, obesity may be the number 1 US public health problem (http://www.surgeongeneral.gov/topics/obesity/).

Morbid or severe obesity was traditionally defined as a weight of 45 kg or more or 100% over ideal body weight defined by standard life insurance tables. More recent classification systems define morbid obesity as a BMI of 40 or more or a BMI of 35 or more in the presence of comorbidities.[4] The prevalence of severe obesity based on US 1999-2000 population data was estimated to be 3.1% in men and 6.7% in women.[1]

In a published report[5] of mortality rates in patients who were morbidly obese, mortality was 12 times higher in men aged 25 to 34 years and 6 times higher in men aged 35 to 44 years vs men with healthy weight of the same age. Because even modest weight loss (10%-15% of initial weight) usually results in improvement or resolution of multiple medical comorbidities, surgical treatment of severe obesity appears to be cost-effective by eliminating use of medications and absenteeism from work in patients who were previously morbidly obese.[6,7]

See also Patient Page.

Gastric Restrictive Operations

There are 3 types of gastric restrictive operations: stapled gastroplasty, gastric banding, and conventional Roux-en-Y gastric bypass. In stapled gastroplasty, the stomach is partitioned close to the gastroesophageal junction creating a small-capacity upper gastric pouch with a small calibrated outlet leading from the upper pouch to the remainder of the digestive tract (FIGURE, A). Early weight loss results after banded gastroplasty have been acceptable with a mean excess weight (difference between preoperative and ideal weight) loss reported in the range of 60% (or approximately 30% of initial preoperative weight lost).[8] The early morbidity rate (within the first 30 days) for banded gastroplasty is less than 10% and the perioperative mortality rate is less than 1.0%. However, many patients regain a substantial portion of their lost weight between 3 and 5 years, postoperatively. Vertical-banded gastroplasty has been shown to adversely alter postoperative eating behavior toward sweets and ice cream, which, in part, explain inferior weight loss results in comparison with Roux-en-Y gastric bypass[9]; a nearly 80% failure rate has been reported 10 years following vertical-banded gastroplasty.[10] Gastroplasty has recently fallen into disfavor due to poor weight loss maintenance and a 15% to 20% rate of reoperation for either stomal outlet stenosis or severe gastroesophageal reflux.

Gastric banding uses a premeasured prosthetic device to restrict oral intake (Figure, B). The circumference of the band is generally in the range of 5.0 cm, similar to the measurement used for gastroplasty. Kuzmak[11] introduced an inflatable band in which the diameter of the band can be adjusted by infusion of saline through a subcutaneous reservoir. Complication rates with the early techniques of gastric banding were relatively high due to stenosis, erosion, or both of the band, frequently requiring reoperation. Weight loss results and complication rates with the inflatable bands are better than those observed after the earlier banding techniques. Although erosion of the inflatable bands is relatively uncommon, usability of the subcutaneous reservoir deteriorates over time. Weight loss with gastric banding has been less consistent than weight loss reported after banded gastroplasty and gastric bypass.[12]

Gastric bypass combines gastric restriction with a small amount of subclinical malabsorption. Although absorption of iron and vitamin B_{12} is decreased after gastric bypass, malabsorption of protein, carbohydrate, and fat has not been reported after gastric bypass performed with short Roux limb lengths. In gastric bypass, the upper stomach is completely closed off, thereby excluding more than 95% of the stomach, all of the duodenum, and 15 to 20 cm of proximal jejunum from digestive continuity. The Roux-en-Y technique (Figure, C) is currently the preferred method of gastric bypass. Weight loss results with the Roux-en-Y technique have been superior to those observed after other gastric restrictive operations in multiple clinical comparisons. Mean excess weight loss in gastric bypass patients typically ranges from 65% to 75%, which corresponds to loss of approximately 35% of initial weight.[13,14] However, there is some degree of recidivism between 3 and 5

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**Contempo Updates Section Editor:** Janet M. Torpy, MD, Contributing Editor.

years after the Roux-en-Y technique. The incidence of perioperative complications observed with current modifications of the Roux-en-Y technique has improved substantially during the past decade with morbidity and mortality rates reported in the range of 10% and 1.0% or less, respectively. Early complications of gastric bypass include deep venous thrombosis or pulmonary embolism (1%-2%), anastomotic leaks (1%-2%), and wound infection (1%-5%).[13,14] Iron and vitamin B_{12} deficiency occur in more than 30% of patients and half of the patients with iron deficiency develop a microcytic anemia.[15]

Gastric bypass may produce symptoms of the dumping syndrome (nausea, bloating, diarrhea, and colic), which results from rapid emptying of the gastric pouch directly into the jejunum. Late-dumping symptoms include lightheadedness, palpitations, and sweating and typically occur 1½ to 2 hours after

Figure. Bariatric Surgery Techniques
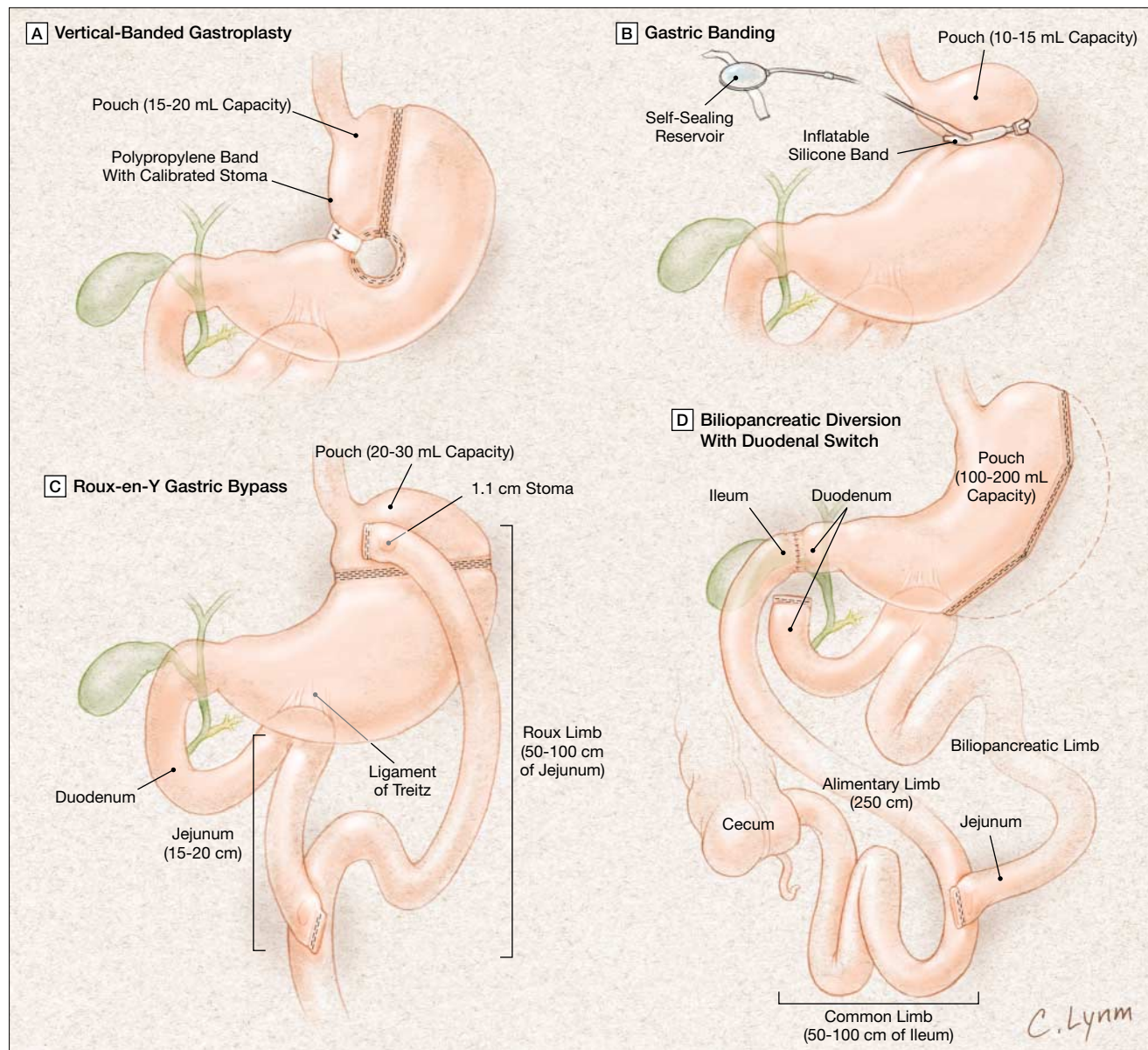
A, Vertical-banded gastroplasty. A 15 to 20 mL upper gastric pouch empties into the remainder of the stomach through a calibrated stoma. C, Roux-en-Y gastric bypass. A stapler fired across the cardia of the stomach creates a 20 to 30 mL pouch. The jejunum is divided distal to the ligament of Treitz with the distal end anastomosed to the upper stomach. D, Biliopancreatic diversion with duodenal switch. A sleeve resection of the greater curvature of the stomach is performed. The first portion of the duodenum is divided and the proximal duodenum and approximately half of the length of the small intestine (biliopancreatic limb) is excluded from digestive continuity. The small bowel is divided approximately 300 cm above the ileocecal junction, and the distal end is anastomosed to the first portion of the duodenum (alimentary limb). The distal end of the biliopancreatic limb is anastomosed to the ileum 50 to 100 cm proximal to the ileocecal junction.

ingestion of a carbohydrate-laden meal. The incidence of dumping symptoms after gastric bypass is surprisingly low.[13]

Malabsorptive Operations

Biliopancreatic bypass (BPB) combines a modest amount of gastric restriction with intestinal malabsorption (Figure, D). This procedure and other anatomical variants including the distal Roux-en-Y technique and the duodenal switch are becoming increasingly popular. In a BPB procedure, the entire jejunum is excluded from digestive continuity and is anastomosed end-to-side to a common channel of ileum at a point between 50 and 100 cm proximal to the ileocecal junction. Scopinaro et al[16] have modified the original operation to further reduce gastric capacity to 200 mL or less in super obese patients (BMI ≥50 or ≥90 kg overweight). Other surgeons have lengthened the common channel in less obese patients (BMI 40-50) to reduce the incidence of malabsorption-related sequelae.[17] The duodenal switch operation is so named because the functional portion of the duodenum is excluded from digestive continuity and has been adopted for treatment of morbid obesity.[18,19]

Weight loss results with BPB have been good. Most authors report a mean loss of 75% to 80% of the excess weight with excellent weight maintenance after stabilization.[16,18] The incidence of early complications has been in the range of 10% to 15% with a 1.0% mortality rate.[16] However, metabolic complications within the first postoperative year include a 30% incidence of anemia, a 30% to 50% incidence of fat-soluble vitamin deficiencies, and a 3% to 5% incidence of hospitalization for treatment of protein-calorie malnutrition.[16] Because malabsorption contributes to both weight loss and weight maintenance, diarrhea and foul-smelling stools commonly occur after BPB.

Most of the current bariatric operations are now performed using laparoscopic techniques, which are technically difficult to perform and are associated with a steep learning curve. However, the laparoscopic approach confers reduced length of hospitaliza-

tion, earlier return to full activity, fewer wound infections, and a marked reduction in postoperative incisional hernias (the most common late complication of open bariatric procedures).[20]

Outcome Measures

Outcome of obesity operations should be assessed in terms of both absolute weight loss and improvement of obesity-related medical disorders. Many reports of outcome following bariatric operations have used loss of at least 50% of excess weight as the minimum criterion for success.[21,22] However, use of excess weight loss is less applicable to super obese patients. Although super obese patients typically lose more weight than patients who are lighter, a considerably lower percentage of super obese patients stabilize near their ideal weight. Body mass index is probably the purest measurement for reporting weight loss results because it is directly related to ideal body weight in both sexes and is not influenced by either frame size or the magnitude of the body weight. Although there are no absolute criteria that define weight loss success in terms of BMI, it is generally conceded that a final BMI of 35 or more is a less than desirable result. Although only a few bariatric surgical patients will achieve ideal weight at the time of stabilization, the heaviest patients must lose more weight to achieve a level that would represent a valid reduction in their actuarial mortality risk.

Many bariatric patients experience dramatic improvement in their medi-

cal comorbidities with only a modest amount of weight loss. It is inappropriate to consider a patient who weighs 225 kg and has lost more than 90 kg with complete resolution of sleep apnea, hypertension, and diabetes a failure due to loss of less than 50% of excess weight. Improvement of both medical problems and overall quality of life must be included in assessment of outcome of obesity operations.

Selection Criteria

Minimum weight limits for surgical treatment of severe obesity were traditionally established in the range of 45 kg or 100% above ideal weight as defined by standard life insurance tables. The 1991 National Institutes of Health Consensus Development Panel recommended that surgical treatment be considered for any patient with a BMI of 40 or more or those with BMI of more than 35 who have serious coexisting medical problems (Box).[4]

Amelioration of Medical Problems

Improvement of obesity-related medical problems is a primary goal of bariatric operations. Improvement or resolution of obesity-associated diabetes including a significant decrease in insulin resistance after weight reduction surgery has been reported.[23,24] In 1 study, after the Roux-en-Y technique, 139 of 141 patients with either overt diabetes or impaired glucose tolerance became euglycemic.[23] Fasting insulin and glycosylated hemoglobin were also reduced to

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Box. Criteria for Patient Selection[*]

Body weight
    Body weight ≥45 kg or 100% above ideal weight
    BMI ≥40
    BMI ≥35 with medical comorbidities
Failure of nonsurgical attempts at weight reduction
Absence of endocrine disorders that can cause morbid obesity
Psychological stability
    Absence of alcohol and drug abuse
    Understanding of how surgery causes weight loss
    Realization that surgery itself does not guarantee good results
    Preoperative psychological evaluation for selected patients

*BMI indicates body mass index, calculated as weight in kilograms divided by the square of height in meters.

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normal levels whereas insulin release, insulin resistance, and utilization of glucose were substantially improved.

Weight reduction surgery also has salutary effects on obesity-related hypertension and cardiovascular dysfunction. Weight loss resulting from bariatric surgery has been associated with significant improvement of left ventricular ejection fraction and lesser but measurable improvements in mean blood pressure, cardiac chamber size, and ventricular wall thickness.[25] The response of hypertension to weight loss following gastric bypass was recently reported by 2 groups of investigators.[26,27] Each group noted improvement or resolution of hypertension in approximately 70% of patients 4 years postoperatively. However, there were conflicting results regarding the relationship between blood pressure reduction and weight loss with 1 group showing a correlation between blood pressure improvement and the amount of weight loss[26] and the other reporting a significant correlation between improved blood pressure and proximity to ideal weight after stabilization.[27] The Swedish Obese Subjects study found no difference in blood pressure between surgically and medically treated patients with hypertension 8 years postoperatively.[28]

Investigators have independently reported significant decreases in both total cholesterol and triglyceride levels after gastric bariatric operations. Two groups have shown a favorable increase in the high-density lipoprotein/low-density lipoprotein ratio after gastric bypass; these lipid reductions generally persist for as long as weight loss is maintained.[29,30] Salutary changes in lipid profiles have been reported in patients who regained a substantial portion of their lost weight.[30] Marked improvement or resolution of obesity-hypoventilation syndrome and sleep apnea have been reported following surgically induced weight loss.[31,32]

In women, weight loss resulting from bariatric surgery has a salutary effect on sex hormone balance, menstrual irregularity, fertility, and urinary stress incontinence.[33,34] Women who had previously been infertile have become pregnant and delivered healthy infants following bariatric operations; nutritional status can be maintained for both mother and developing fetus.[35] Pregnancy is not recommended during the first postoperative year in which the majority of weight loss occurs.

Conclusion

The recent increase in both popularity and demand for bariatric surgery can be attributed to several factors. There are no new nonsurgical approaches that are effective in the long term for treating morbid obesity. The overall success of the Roux-en-Y bypass technique has resulted in greater acceptance of surgery as a treatment option. Finally, the rapid increase in the number of medical centers with bariatric surgery programs has resulted in increased awareness among prospective patients. Currently, bariatric surgery offers the best treatment to produce sustained weight loss in patients who are morbidly obese.

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