Bariatric Surgery for Severe Obesity: The Role of Patient Behavior

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In the United States, 34% of adults were obese (BMI ≥ 30 kg/m^2) in 2005-2006.[1] Of particular concern is the rapid increase within the most extreme weight categories, resulting in the heaviest individuals becoming heavier.[1,2] The prevalence of severe obesity, defined as BMI ≥ 40 or approximately ≥ 100 lbs. overweight, increased by 50% from 2000 to 2005, with 1 in 20 Americans now severely obese.[2] Severely obese individuals, compared to those who are less overweight, have higher rates of obesity-related comorbidities and higher health care expenditures, compared to those who are less overweight.

Bariatric Surgery as a Treatment for Severe Obesity

The increasing prevalence of severe obesity coupled with its lack of responsiveness to conventional weight control approaches has intensified the demand for bariatric surgery. In 1991, when the National Institutes of Health established guidelines for surgical treatment of severe obesity, fewer than 5,000 bariatric operations were performed in the US.[3] According to the American Society for Metabolic and Bariatric Surgery, 210,000 procedures were performed in 2007.[4]

The spike in patient interest in bariatric surgery can also be attributed to the advancement of laparoscopic (minimally invasive) techniques, which have replaced open surgery as the preferred surgical approach because they reduce complications, discomfort and duration of hospital stay.

Bariatric surgery procedures

Bariatric surgery encompasses several different procedures (Figure) that produce weight loss primarily through gastric restriction and/or intestinal malabsorption. **Roux-en-Y gastric bypass (RYGB)**, which utilizes both mechanisms, is the most commonly performed procedure in the US today. The operation creates a one to two tablespoon sized stomach pouch that restricts oral intake. This pouch connects to an intestinal limb that reroutes food so that fewer calories are absorbed by the body. The majority of RYGB patients experience rapid weight loss, losing approximately two-thirds of their excess weight, defined as body weight in excess of ideal body weight, within the first 1-2 years postoperatively.[4]

Laparoscopic adjustable gastric banding (LAGB), long popular outside the US, has quickly risen in popularity in this country since its approval by the **Food and Drug Administration (FDA)** in 2001. This restrictive operation places a synthetic band around the upper stomach. The band can be adjusted via a subcutaneous port to limit oral intake. To date, only one randomized controlled trial has compared outcomes following LAGB and RYGB, showing greater **percent excess weight loss (EWL%)** among RYGB patients (66.6%) than LAGB patients (47.5%) at 5 years postoperatively.[5]

In addition to RYGB and LAGB, newer procedures such as **laparoscopic sleeve gastrectomy (LSG)** are increasingly used for super-super-obese patients (BMI ≥ 60) and those patients with severe comorbidities who are at greater risk for perioperative morbidity and mortality.[6] LSG is a less technically demanding operation, thereby limiting duration of general anesthesia. It involves removing 80% of the stomach and creating a narrow tube-like conduit along the lesser curvature, thereby restricting food intake. LSG is shown to produce weight loss that is comparable to LAGB at 1 year.[7] For some high-risk patients, a two-staged operation may be performed in which the safer LSG procedure is conducted first to promote initial weight loss and reduce difficulty and risk inherent to a second surgery that is performed, either RYGB or **bilio-pancreatic duodenal switch (BPDS)**. The BPDS procedure involves bypassing the sleeve stomach to the distal portion of the small intestine to limit nutrient absorption.

Bariatric surgery outcomes

Overall, bariatric surgeries represent the most effective and durable weight loss option for severely obese individuals.[8] Depending on the procedure, patients typically lose between 20 and 50 kg within the first 1-2 postoperative years, and maintain the bulk of this weight loss for up to 10 years and longer.[4,8] Along with effective weight control, bariatric surgery procedures result in complete or partial resolution of several obesity-related comorbidities, most notably type 2 diabetes.[8-10] Successful surgical weight loss and maintenance are also associated with substantial long-term improvements in **health-related quality of life (HRQoL)**.[11] Finally, recent long-term data provide evidence that bariatric surgery contributes to significantly reduced risk of overall and disease-specific mortality.[12,13]

Suboptimal bariatric surgery outcomes

While bariatric surgery reliably produces rapid and large weight losses, up to 25% of patients fail to achieve adequate weight loss, typically defined as ≥ 50% excess weight lost and maintained for at least 5 years after surgery. Other patients regain substantial amounts of weight, even within the first 1-2 years after surgery.[14] These less successful patients will see less improvement in HRQoL and reduced reversal of medical comorbidities. In addition, these patients may seek conversion to another procedure, increasing technical-related surgical demands and decreasing cost-effectiveness.

The role of patient behavior in bariatric surgery outcomes

The variability in surgical weight loss outcomes may largely be attributed to patient behavior. Many patients have difficulty complying with postoperative recommendations regarding eating and activity. A rapidly growing body of research devoted to behavioral aspects of bariatric surgery suggests that failure to change problem eating behaviors and patterns of inactivity can undermine weight loss outcomes.

Eating behaviors and surgical outcome

Pre-surgical binge eating, the uncontrollable consumption of a large amount of food in a discrete period of time accompanied by psychological distress, is prevalent among bariatric surgery patients and has been shown to be a negative indicator of post-surgical weight loss.[15,16] Furthermore, individuals who engage in binge eating prior to surgery tend to "graze" (frequently consuming small amounts of food over an extended period of time) following surgery, which is

associated with less post-surgical dietary restraint and poorer post-surgical weight loss.[17] Finally, post-operative loss of control while eating is associated with less weight loss, greater caloric intake, and greater percentage of calories from fat.[17] These studies suggest that effective treatment of bariatric surgery patients' maladaptive eating behaviors is imperative to promote optimal postoperative weight loss.

To date, only one intervention targeting maladaptive eating behavior has been conducted. Leahey and colleagues (in press) used cognitive-behavioral and mindfulness techniques to reduce binge eating and associated loss of control while eating in post-surgical bariatric surgery patients. The intervention consisted of ten consecutive weekly group sessions. During the sessions, participants were encouraged to use cognitive restructuring techniques to alter thoughts associated with maladaptive eating behavior, increase awareness of satiety and external eating cues, modify environmental cues to reduce overeating, and improve coping skills. The intervention was found to substantially reduce binge eating/loss of control while eating (d=1.47); from pre- to post-intervention, average number of weekly episodes were reduced from 2.25 to 0.10. Post-surgical weight loss also improved. Before the intervention, participants' average deviation from expected weight loss following bariatric surgery (per NIH guidelines) was +12.29-lbs. After treatment, participants' deviation from expected weight loss was reduced to +6.43-lbs. These results suggest that a behavioral intervention is effective at treating maladaptive eating behavior and improving weight loss in post-surgical bariatric surgery patients. Future studies ought to continue to investigate the effects of behavioral interventions on maladaptive eating behavior and examine the efficacy of these interventions using randomized controlled trials.

In addition, research is needed to better understand the impact of different bariatric surgery procedures on hunger and satiation. At the **Weight Control and Diabetes Center (WCDRC)**, The Miriam Hospital, researchers are measuring changes in hunger and satiation following RYGB and LAGB. Hunger is assessed using the relative-reinforcing value of food, a computerized behavioral-choice paradigm that assesses how motivated a person is to work for food versus a non-food alternative. This measure has been validated in both normal-weight and obese individuals with both groups showing greater motivation to work for food when hungry.[18] Satiation is assessed by measuring the rate at which physiological (i.e. salivary) responding declines or *habituates* to repeated presentations of a taste stimulus.[19] Theoretically, the quicker one habituates to the sensory properties of a food, the quicker that consumption of that food will be terminated or the eating episode will come to an end, providing an objective measure of satiation. Subsequent studies will examine whether changes in hunger and satiation using these measures predict rate and amount of postoperative weight loss.

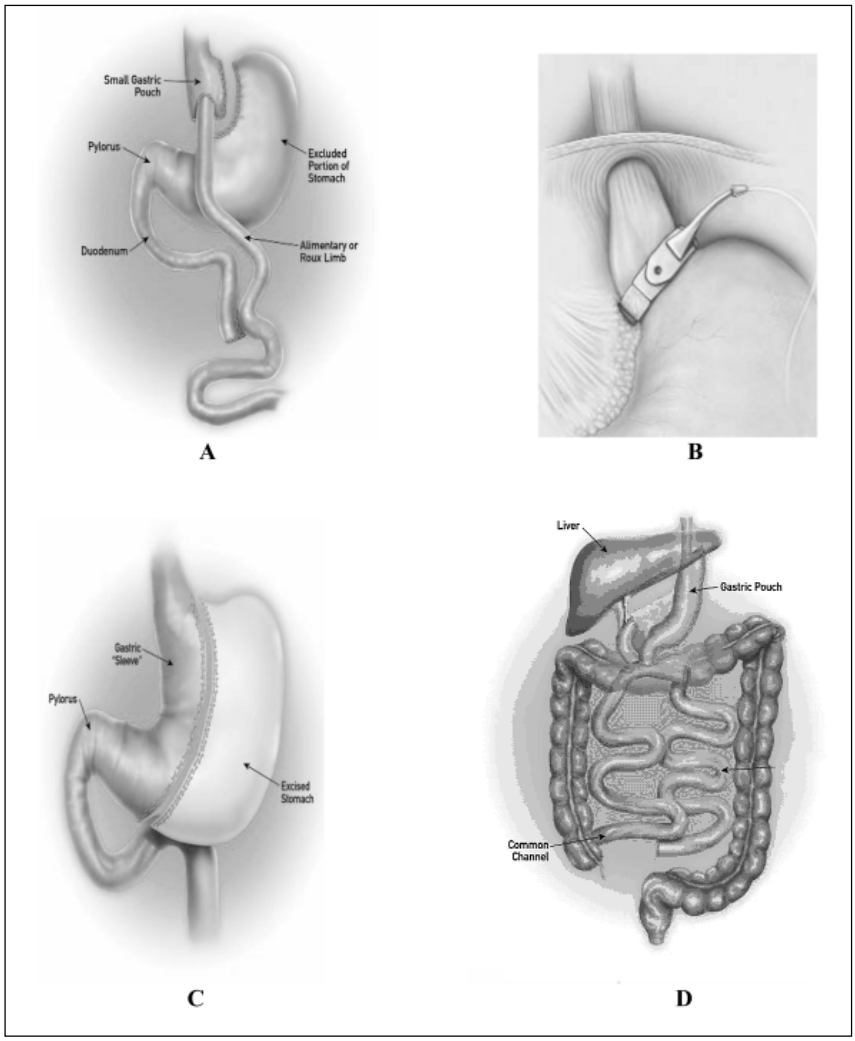

FIGURE. A. Roux-en-Y gastric bypass; B. Laparoscopic adjustable gastric banding; C. Laparoscopic sleeve gastrectomy; D. Biliopancreatic duodenal switch
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Physical Activity (PA) and Surgical Outcomes

PA can be defined as any bodily movement that results in **energy expenditure (EE)**. Total energy expenditure encompasses posture, spontaneous and voluntary physical activity, resting metabolic rate, and energy needed for digestion and absorption of food. The largest and most variable component of EE is PA. An increasing number of studies suggest that the amount of energy that bariatric surgery patients expend through PA can influence weight loss outcomes.[20-22] A recent cross-sectional study showed that patient-reported engagement in < 150 minutes per week of moderate to vigorous intensity PA was associated with poorer weight loss at 6-months and 1-year after RYGB after adjusting for differences in age and preoperative BMI.[20] In addition, recent prospective studies suggest that pre- to postoperative changes in PA may influence amount of weight loss attained.[21,22] In one study, smaller reported pre to postoperative increases in leisure-time PA were associated with smaller weight losses at 1 year after LAGB.[21] In another

study, RYGB patients who reported being inactive (< 200 min/wk) preoperatively and progressed to being physically active (= 200 min/wk) postoperatively achieved weight losses that were greater than those experienced by patients who remained inactive and comparable to those attained by patients who continued being active.[22] These studies suggest that the magnitude of pre- to postoperative increase in PA may be important for augmenting the amount of weight loss attained during the first postoperative year.

Despite consistency in findings across these studies, the accuracy and clinical implications of the findings are unclear given limitations inherent to self-report instruments, most notably recall bias. To improve upon these studies, researchers at the WCDRC are using accelerometers and other objective monitoring devices to assess and quantify postoperative PA changes among patients undergoing RYGB and LAGB. Accelerometers are small, motion sensing devices worn on the hip that can detect acceleration and deceleration in one or more directions of movement. The minute-by-minute data obtained from these devices allows for assessment of intensity and duration of PA throughout the day and provides an objective measure of caloric expenditure that is shown to correlate with more intensive and expensive measures such as doubly-labeled water.

Behavioral interventions to increase PA, although shown to be effective in a variety of populations, have not yet been applied to bariatric surgery patients. Moreover, it is not clear which is the best approach to increase PA in this population. Promoting regular walking is a typical approach used to increase PA among inactive individuals. Walking interventions, particularly those that incorporate pedometers and additional behavioral strategies (e.g., self-monitoring step counts, goal setting, etc.), produce significant increases in time spent being active. These increases are also shown to result in health benefits and modest weight losses.[23] However, while most bariatric surgery patients are physically able to walk, their engagement in such activity for any extended duration or at higher intensities may be limited by discomfort and fatigue due to high biomechanical loads and greater cardiorespiratory and energy demands. Consequently, interventions to promote walking and other planned PA among surgery patients may need to account for these limitations—e.g., prescribing walking in multiple short bouts versus a single continuous bout and encouraging patients to walk slower on a flat surface.[24,25]

Another approach to increasing PA that could prove easier for bariatric surgery patients to adopt is reducing sedentary behaviors (e.g., TV watching). Obese individuals allocate a larger proportion of their time to being sedentary compared with lesser weight individuals.[26] Consequently, reducing sedentary behaviors could result in more frequent opportunities for bariatric surgery patients to engage in both lifestyle and planned PA. No study, however, has tested the impact of reducing sedentary behaviors on PA among bariatric surgery patients.

Conclusion

With the exception of bariatric surgery, severely obese individuals have few effective weight control options. Bariatric surgery produces large weight losses which are shown to be maintained for 10 years and longer, although some patients do not achieve adequate weight loss and others experience considerable weight regain. These outcomes are increasingly attributed to variability in patient compliance with pre- and postoperative behavioral recommendations, particularly those related to eating and activity habits. Observational research suggests that both problematic eating and low PA are associated with poorer weight loss. Administering behavioral interventions to target such behaviors within the context of a comprehensive surgical program may improve surgical outcomes.

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Disclosure of Financial Interests

The authors have no financial interests to disclose.

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