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Chapter

Long Term Success and Follow-Up after Bariatric Surgery

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Abstract

Obesity is a multifactorial, chronic, and progressive disease whose pathogenesis is tied to a strong genetic component as well as a multitude of hormonal, metabolic, psychological, cultural and behavioral factors. Understanding the role these factors play, screening for them, and managing them appropriately, is important for effective weight loss. Psychology and behavior have profound implications on a patient's willingness and ability to engage in treatment and to follow up after bariatric surgery. Dietary education, presence of clear expectations, patient adherence to recommendations, and follow-up, directly impact bariatric surgery outcomes. Understanding postsurgical outcome success and failure and identifying best clinical practices for optimizing and maintaining results after bariatric surgery continues to be a work in process.

Keywords: obesity, behavioral modification, dietary adherence, long-term follow-up, long-term success

1. Introduction

Obesity perception and management has undergone a paradigm shift in the last few decades. Our understanding of the complex factors and etiologies of obesity as a chronic illness, improvements in medical and surgical treatment options, and access to care have all made this possible. There are tremendous implications of obesity on individuals and society, including health systems and financial costs. Obesity alone accounts for nearly half of the $3.3 trillion spent annually on medical care for chronic conditions. Obesity prevalence continues to increase globally. According to the Centers for Disease Control and Prevention (CDC), the prevalence in the United States was 42.4% in 2017–2018 [1]. Worldwide, 39% of adults were overweight in 2016, and 13% were obese [2]. Notably, the worldwide obesity rate has tripled over the last 40 years. Obesity disproportionately affects different ethnic groups; nearly 50% of African American adults are obese.

2. Defining obesity as a chronic illness

Obesity is recognized as a complex, chronic and progressive disease by the World Health Organization (WHO) as well as multiple international medical and scientific
societies, requiring lifelong treatment, monitoring, and control [3]. The CDC defines chronic disease as conditions lasting greater than one year that require ongoing medical attention or limit activities of daily living, or both. Obesity is associated with three of leading chronic diseases - heart disease, cancer, and type 2 diabetes. There are widespread consequences of obesity compared to normal or healthy weight for many serious health conditions, including all causes of death, hypertension, diabetes mellitus, coronary heart disease, stroke, and many cancers. Chronic diseases need to be treated and monitored for an individual’s lifetime. While patients’ chronic diseases may improve with management, relapse can and does happen.

Obesity affects not only individual physiology but also individual psychology. Pre-existing psychological conditions, as well as post-operative conditions that can be created or exacerbated after bariatric surgery, need to be understood, treated, and followed. Recognizing the interaction and impact of obesity on psychopathology, as well as how to identify and treat related psychological disorders, continues to be a work in progress for the obesity medicine field.

3. Obesity is a complex and multi-factorial disease

Obesity is a multifactorial, chronic, and progressive disease whose pathogenesis is tied to a strong genetic component as well as a multitude of hormonal, metabolic, psychological, cultural and behavioral factors.

Physiologically, the path to weight gain is defined by a positive energy balance which occurs when consumed calories (energy intake) exceeds used calories (energy expenditure) in the performance of basic biological functions, daily activities, and exercise [3]. A positive energy balance can be caused by overeating or by not getting enough physical activity. In addition, there are other conditions that affect energy balance and fat accumulation which do not involve excessive eating or sedentary behavior. These include:

- Chronic sleep loss.
- Chronic stress and psychological distress.
- Consumption of foods that, independent of caloric content, cause metabolic/hormonal changes that can increase body fat – foods high in sugar or high fructose corn syrup, processed grains and meats, and fats.
- Low intake of fat-fighting foods such as fruits, vegetables, legumes, nuts, seeds, quality protein.
- Various medications – such as steroids and anti-depressants.
- Various pollutants.

Weight gain is self-perpetuating, which is a reason why obesity is considered a progressive disease. Weight gain causes hormonal, metabolic and molecular changes that increase the potential for even greater fat accumulation. Obesity-associated biological changes reduce the body’s ability to oxidize fat for energy, increase the conversion of glucose/carbohydrates to fat, and increase the body’s capacity to store fat. This means that more calories consumed will end up being stored as fat. To worsen matters, obesity affects appetite and hunger regulators in a way that can decrease satiety, increasing portion size and eating frequency. Weight gain, therefore, changes the biology of the body in a manner that favors further weight gain and obesity [3].
Dieting to reduce caloric intake is a primary treatment for obesity, but it can also contribute to obesity progression. Dietary weight-loss causes biological responses that can persist long-term and end up contributing to weight regain. Weight loss can lead to reduced energy expenditure and calorie conservation if the body ‘thinks’ it is starving. A reduction in energy expenditure with dietary weight-loss requires that, to maintain weight-loss, an individual eat even fewer calories compared with someone of equal body size who has never dieted before. Eating less can be especially difficult with dieting, since there can be associated long-term changes in appetite regulation which increase hunger and food consumed. Such diet-induced changes favor a positive energy balance and weight regain. Since the conditions responsible reduced energy expenditure and increased appetite can persist long-term, an individual often will not only regain their lost weight, but even more [3].

Changes in fat metabolism are another biological response that occurs with dieting. Dietary weight-loss can lead to reduced oxidation of dietary fat by approximately 50 percent [4]. This includes reduced fat burning during low-grade activity such as walking, house chores, or working on a computer. This reduction in fat oxidation following a dietary weight-loss increases the amount of fat available for storage. In fact, dieting increases the capacity for fat depots to store even more fat than before a diet. These changes lead to a progressive increase in fat accumulation even if the individual is not overeating.

As a heritable trait, obesity is influenced by the interplay of genetics, epigenetics, metagenomics and the environment. Genetic predisposition to obesity is well studied and described [5, 6]. An example of this is a classic study of obesity within Danish adopted individuals, which demonstrated a high degree of correlation of body mass index (BMI) between adoptees and their biological parents, instead of their adoptive parents [5]. Another study by the same authors demonstrated that twins raised separately had similar BMI with each other, regardless of the environment in which they were raised [7]. Epigenetic changes may be involved as mediators of environmental influences and provide future opportunities for intervention [8].

Obesity can be associated with several endocrine alterations due to changes in the hypothalamic–pituitary hormones axis. These include hypothyroidism, Cushing’s disease, hypogonadism, and growth hormone deficiency. Besides its role in energy storage, adipose tissue has several other important functions that can be mediated through hormones or substances synthesized and released by adipocytes, which include leptin and adiponectin. Additionally, obesity is also a common feature of polycystic ovarian syndrome with hyperinsulinemia being the primary etiological factor [9].

Metabolic syndrome is a condition characterized by a specific constellation of reversible major risk factors for cardiovascular disease and type 2 diabetes. The main diagnostic components are reduced HDL-cholesterol, raised triglycerides, blood pressure and fasting plasma glucose, all of which are related to weight gain, specifically intra-abdominal/ectopic fat accumulation and a large waist circumference. Metabolic syndrome is directly related to advancing age, affecting 30–40% of people by age 65. This seems to be driven mainly by progressive adult weight gain, and by a genetic or epigenetic predisposition to intra-abdominal/ectopic fat accumulation. Metabolic syndrome can also be associated with conversely, a lack of subcutaneous adipose tissue, low skeletal muscle mass and anti-retroviral drugs. Reducing weight even by only 5–10% substantially lowers all metabolic syndrome components, and the risk of type 2 diabetes and cardiovascular disease [10].
Culture also has a substantial association with BMI. This association is important for understanding the pattern of obesity across different cultures and countries. It is also important to recognize the importance of the association of culture and BMI in developing public health interventions to reduce obesity [11].

4. Psychology and behavior

Numerous studies support a strong link between obesity and mental health. This relationship is a two-way street; while mental health disorders increase the risk for obesity, having obesity also increases the risk of mental health disorders, especially in certain populations. Mental health disorders can increase the risk for obesity for various reasons. Medications used to treat psychiatric illnesses, such as anti-depressants, can themselves cause weight gain and insulin resistance. Additionally, mental illnesses are correlated with behaviors such as chronic sleep loss, poor eating behaviors, and sedentary behavior, which can contribute to obesity development.

Obesity increases the risk for depression. This is likely due to numerous complex factors, including poor self-esteem and depressed mood in response to weight bias and stigma, decreased activity and impaired mobility from joint and back pain associated with excess weight, and biological disruptions caused by adipocyte secretion of chemicals during obesity [12]. Obese patients overall have higher levels of stress, anxiety, depression, food craving, and emotional and behavioral disturbance [EBD] symptoms, with lower levels of self-esteem and quality of life compared with normal-weight individuals. Additionally, the severity of psychological disorders is directly related to the degree of obesity [12].

It is important that patients with mental health disorders are monitored for weight disorders, and that obese individuals are screened for mental health disorders. Treatment of obesity is associated with a significant improvement of anxiety, depression, and general psychopathology, and a similar pattern of reduction of binge eating symptomatology. Pre-treatment emotional eating severity has been found to be a significant outcome modifier, supporting the importance of a pre-treatment careful psychological assessment to supervise the post-surgical outcome [13].

Evaluation for underlying eating disorders such as food addiction and binge eating can be important assessment criteria for patients looking to undergo bariatric surgery, as well as for ongoing assessment afterwards. There are multiple surveys, questionnaires, and assessment tools that can be used to evaluate psychopathology before and after bariatric surgery. Examples include the Yale Food Addiction Scale (YFAS), Emotional Eating Scale, Beck Depression Inventory-Second Edition (BDI-II), Hospital Anxiety and Depression Scale, and the Short-Form Health Survey-36 (SF-36). These disorders share overlapping and non-overlapping features; the presence of both may represent a more severe obesity subgroup among treatment-seeking samples. Loss-of-control (LOC) eating, a key marker of binge eating, is one of the few consistent predictors of suboptimal weight outcomes post-bariatric surgery [14].

The presence of food addiction without binge eating has mixed results in terms of impact on weight loss after bariatric surgery. While some studies do not appear to show an impact [15], others show a correlation between higher number of food addiction symptoms and less weight loss [16]. Patients with emotional eating diagnosed pre-operatively, such as in response to anger/frustration, anxiety, or depression, are
more likely to miss follow-up appointments and have poorer weight loss outcomes at 1-year post-op [16]. Evidence like this supports screening for these behaviors during the pre-surgical psychosocial evaluation, which would allow opportunities for psychotherapy and potential improvement in weight loss outcomes.

Psychiatric symptoms may not be related to weight loss outcomes [16]. Depressive disorders, as opposed to anxiety disorders, have been shown to decrease significantly after bariatric surgery. Importantly however, the presence of depressive disorders after bariatric surgery significantly predicts post-surgical outcomes and may signal a need for heightened clinical attention [17].

5. Behavior modification

Behavioral modification is an increasingly studied element of long-term obesity management. As a key component of obesity pathogenesis, behaviors before and after bariatric surgery are important but poorly documented or followed. Surgery, like medical therapy, is essentially an adjunct to what becomes a comprehensive, long-lasting management plan that addresses the multifactorial etiology of obesity.

Weekly self-weighing, eating cessation when feeling full, and not eating continuously during the day are three habits shown to improve post-operative weight loss by up to 14%, compared with individuals that do not engage in these behaviors [18]. Baseline cognitive restraint and strong adherence to the recommended postoperative diet are associated with an additional 4.5% weight loss after bariatric surgery [19]. Results like these suggest the importance of pre- and postoperative dietary counseling to improve postoperative outcomes. A significant minority of patients appear to experience suboptimal weight loss after bariatric surgery. The reasons for this are not well understood, but suboptimal weight loss is often attributed to preoperative psychosocial characteristics and/or eating behaviors, as well as poor adherence to a recommended postoperative diet.

Important components of long-term obesity management include assessing eating problems, weight control practices, and prior or current substance abuse such as the problematic use of alcohol, smoking, and illegal drugs. In addition to recognizing these detrimental factors, it is important to have a process in place to address problematic eating behaviors and eating patterns.

Preconditioning is an element of preparation for bariatric surgery that sets expectations, lays the groundwork for behavioral modification, and helps get candidates ready for a lifestyle change. It involves coursework and counseling by a multidisciplinary team on a one-on-one basis or in a group setting. This provides multiple perspectives and education by a dietitian, occupational and/or physical therapist, psychologist, and surgeon. Variations of preconditioning include the amount of coursework and didactics required, the need to pass exams, and objective clearance parameters by the multidisciplinary team. Nutritional education is a large part of preconditioning, since evaluating a candidate's relationship with food, triggers for eating, and implementation of management techniques for healthy eating is such a large part of long-term success with weight loss. Additionally, cognitive behavioral therapy courses can also be included. Intensive preconditioning in addition to close multidisciplinary follow-up postoperatively, has been shown to improve weight loss outcomes after bariatric surgery [20].
6. Predictors of weight loss

Predictors of weight loss outcomes after bariatric surgery fall can be categorized as: 1) presurgical factors, 2) postsurgical psychosocial variables (e.g., support group attendance), 3) postsurgical eating patterns, 4) postsurgical physical activity, and 5) follow-up at postsurgical clinic. There is varying evidence regarding these predictors and how well they correlate with success after bariatric surgery. However, the only factor which has been subjected to meta-analysis, and which shows a positive association with postoperative weight loss is preoperative weight loss. Other preoperatively identifiable factors associated with improved outcomes include Caucasian ethnicity or female gender [21], higher educational status, non-shiftwork working patterns, and divorced or single marital status [22].

Increased levels of preoperative physical activity and an absence of binge eating behavior also been linked with favorable results. Interestingly, increased age, smoking, a history of sexual abuse, or psychiatric illness have not been shown to have a significant impact. Conversely, diabetes mellitus seems to have a slight negative correlation with postoperative weight loss [22].

Other specific behavioral predictors associated with successful outcomes (e.g., $\geq 50\%$ excess weight loss) are postoperative dietary adherence and support group attendance. Successful weight loss has been reported highest (92.6%) among patients reporting dietary adherence of $\geq 3$ on a 9-point scale who graze no more than once-per-day. Post-operative patients with dietary adherence $< 3$ but who graze daily or less have more than double the success rate of achieving $>50\%$ excess weight loss when their highest lifetime BMI is $< 53$. Success rates also double for participants with low to moderate dietary adherence (3 or less) that attend support groups (either in-person or online) [23, 24]. While it is unclear which specific components of these support groups are beneficial, or what constitutes optimal attendance frequency, it is possible that patients with low to moderate dietary adherence particularly benefit from the social support, accountability, and sharing of informational “tips” that promote adherence (i.e., cooking tips) [23, 24].

Alternatively, predictors of significant postoperative weight regain after bariatric surgery include indicators of baseline increased food urges, decreased well-being, and concerns over addictive behaviors. Postoperative self-monitoring behaviors are strongly associated with decreased weight regain. Data suggests that weight regain can be anticipated, in part, during the preoperative evaluation and potentially reduced with self-monitoring strategies after bariatric surgery [25]. Frequent self-weighing, at the very least, seems to be a good predictor of moderate weight loss, less weight regains, and avoidance of initial weight gain after surgery [26].

Given the chronic nature of obesity, patients after bariatric surgery should arguably be seeing a weight loss specialist for the remainder of their life. Especially after receiving a hypo absorptive operation, those patients should follow up with someone who is familiar with the specificities of their operation as well as pertinent side effects, nutritional deficiencies, etc. Long-term follow-up for patients after bariatric surgery is notoriously hard to achieve. There are multiple explanations of this, some of which are issues with the process, and others with the nature of the disease of chronic obesity. Weight loss programs sometimes do not set expectations for long term follow up in the beginning when patients start or reinforce this later. Resources can be present to get patients screened and set up for surgery but can be lacking post-operatively to keep patients engaged long-term. At some point, patients are often expected to continue follow up with their primary care physicians, who may or may
not be familiar with the nuances of the type of bariatric procedure that the patient received or have the resources themselves to assist patients in staying on track or helping struggling patients with weight regain. Individual motivation can falter when it comes to follow up, or long-term adherence to nutritional and lifestyle changes that are important for maintaining weight loss.

Very few bariatric surgery studies report long-term results with sufficient patient follow-up to minimize biased results [27]. One study of a national bariatric surgery database in France showed that the percentage of patients with one or more visits to a surgeon dropped from 87.1% to 29.6% between year 1 and 6 after surgery. Predictors of poor 5-year follow-up include male sex, younger age, absence of type 2 diabetes and poor 1-year follow-up [28].

7. Other reasons for long-term follow-up

Many important long-term outcomes of bariatric surgery are still poorly understood, such as neurological and psychological complications, bone health, etc. Poor nutritional habits of obese people can result in baseline deficiency of several vitamins, minerals, and trace elements essential for body metabolism and normal physiological processes. Current bariatric surgical procedures such as sleeve gastrectomy, adjustable gastric banding, Roux-en-Y gastric bypass, and biliopancreatic diversion/duodenal switch can cause or exacerbate nutritional deficiencies and malnutrition, with different health implications unique to each surgery.

Purely restrictive operations such as adjustable gastric banding and sleeve gastrectomy affect the absorption of iron, selenium, and vitamin B12, while hypo absorptive operations such as gastric bypass and biliopancreatic diversion/duodenal switch have a more profound impact on the absorption of essential vitamins such as fat-soluble vitamins, minerals, and trace elements. Nutritional deficiencies in vitamins, minerals, and trace elements after bariatric surgery can result in clinical manifestations and diseases, such as anemia, ataxia, hair loss, and Wernicke encephalopathy [29].

Preoperative nutritional assessment and correction of vitamin and micronutrient deficiencies, as well as long-term postoperative nutritional follow-up, are important. Patient awareness, education and counseling start preoperatively, and continues after surgery. Dietetic counseling should continue frequently during the first year and be extended optionally afterwards, depending on individual and surgery specific factors. Vitamin supplementation should be discussed before surgery, with emphasis on specific needs required after surgery, and followed up on. Routine, relevant bloodwork should be obtained at appropriate intervals, with decrease in frequency as needed, but checks at least annually long term. Deviations from anticipated clinical course should prompt immediate reevaluation of nutritional levels. Planned and structured physical exercise should be systematically promoted to build and maintain muscle mass and improve bone health [30].

Weight loss programs utilizing bariatric surgery must implement robust, consistent, and evidence-based strategies to improve weight loss reduce weight regain. Long term follow up is an important factor in reinforcing behavioral modification necessary for long term weight loss, and monitoring for side effects possible after bariatric surgery. As adherence to long-term follow-up has been shown to decrease over time, it is important to identify measures that improve follow-up rates to get the maximum benefit from bariatric surgery, while minimizing long-term adverse effects and complications [31].
8. Conclusion

Obesity can be successfully treated, especially if approached in a comprehensive, multi-disciplinary, long-term fashion, as befits a complex and chronic disease. Important components of successful surgical management include careful patient selection, setting expectations, pre-conditioning, behavioral modification, and long-term postoperative follow-up. This requires screening and management of clinically impactful psychosocial diagnoses, comprehensive education and dietary counseling, access to support groups, and the resources to ensure follow-up postoperatively.

Various bariatric surgical procedures, especially those with a hypo-absorptive component, are at risk for several nutrient deficiencies that need to be monitored long-term. There remains a significant level of uncertainty regarding the best clinical practices for optimizing and maintaining weight loss after bariatric surgery. Standardization of bariatric surgical processes and guidelines by professional organizations such as the American Society for Metabolic and Bariatric Surgeons (ASMBS) is an important start. However, more effort is needed to screen and improve psychological care, behavior management, and provide therapeutic patient education after surgery.

Understanding post-bariatric surgery outcome failure is important in addressing and helping the significant minority of patients (20–30%) who do not have expected weight loss, and subsequently regain weight previously lost. Screening for the multitude of risk factors related to bariatric surgery outcomes post-operatively can provide clinically relevant and useful information. For example, asking postsurgical patients to rate their level of adherence to dietary recommendations, and the frequency of grazing identifies high risk patients and the need for intervention. Additional measures based on patient’s responses might include additional dietary assistance, referral for behavior therapy, and encouraged attendance at bariatric support groups. If return of appetite after surgery is an identified impediment with dietary adherence, evaluation for anti-obesity medications (AOMs) may be useful.

Additional investigation is needed into specific psychosocial, behavioral, and dietary adherence components that affect postsurgical weight loss outcome. Future research should determine how eating disorders such as food addiction affect long-term postoperative outcomes and mood stability, and examine which interventions are successful at improving problematic eating behaviors. It is also important to better understand patient motivational characteristics in relation to treatment compliance such as follow-up, support group participation and other aftercare recommendations. Results of this research will ultimately lead to better understanding of postsurgical outcome success and failure, and lead to better tailored yet standardized interventions accordingly.

Conflict of interest

The authors declare no conflict of interest.
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