Medical Approach to a Patient with Postoperative Weight Regain

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Chapter Objectives

1. Summarize the current literature regarding the weight loss efficacy of surgical weight loss procedures.
2. Review the contributing surgical, biopsychosocial, and behavioral factors associated with weight regain following bariatric surgery.
3. Present a proposed evaluation and treatment algorithm for the medical management of weight gain following bariatric surgery.

Introduction

Weight loss surgery is considered to be the most efficacious treatment for individuals with clinically severe class III obesity (body mass index [BMI] $\geq$ 40 kg/m^2) or with moderate class II obesity (BMI $\geq$ 35–39.9 kg/m^2) when accompanied by an obesity-related comorbidity. Weight loss at 2–3 years following a variety of surgical procedures varies from 20 % to 34 % of total weight depending on the procedure performed. In general, weight loss is greatest following malabsorptive procedures (biliopancreatic diversion [BPD] and biliopancreatic diversion with duodenal switch [BPDDS]) followed by restrictive-malabsorptive (Roux-en-Y gastric bypass [RYGB]) and restrictive procedures (laparoscopic adjustable gastric banding [LAGB] and laparoscopic gastric sleeve [LGS]). Similarly, significant improvement in multiple obesity-related comorbid conditions has been reported including type 2 diabetes mellitus (T2DM), hypertension, dyslipidemia, obstructive sleep apnea (OSA), and quality of life. However, long-term durability of weight loss and improvement in comorbid conditions are less certain, and weight regain has been observed. Although the causative factors of weight regain have not been well characterized, clinicians are being asked to evaluate an increasing number of patients postoperatively. This chapter will review the current information regarding weight gain following bariatric surgery and the factors associated with weight regain and will present a proposed evaluation and treatment algorithm.

Estimating the Occurrence of Weight Regain

Analyzing outcome data for bariatric surgery suffers from many limitations. In general, published data is reported from case studies and case series stemming from single surgeons or single institutions. Often, surgical techniques such as pouch size and limb length as well as the surgical procedure performed will vary over time within and between surgical centers. Furthermore, definitions used to define weight loss outcomes have not been standardized. Whereas some studies report outcomes as percent excess weight lost (%EWL), other authors use change in BMI units (kg/m^2) or loss of total body weight measured in kilograms or percentage. Body weights are also often self-reported instead of measured. Additionally, since follow-up and reporting of patient outcomes is often incomplete, selection bias may occur. Realizing these limitations, cross-sectional data estimates that significant weight regain occurs in 20–35 % of patients, depending upon the procedure performed and duration of time following surgery [1–4]. This number is likely to be an underrepresentation of actual incidence rates.

In addition to uncertain rates of weight regain, it is also unclear what how much weight (actual or percentage) is regained among post-bariatric surgical patients. The Swedish

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C. Still et al. (eds.), *The ASMBS Textbook of Bariatric Surgery: Volume 2: Integrated Health*,
DOI 10.1007/978-1-4939-1197-4_21,

Obese Subjects (SOS) study, the largest nonrandomized intervention trial comparing weight loss outcomes in a group of more than 4,000 surgical and nonsurgical subjects, has previously reported 10-year data [5]. Surgically treated subjects underwent fixed or variable banding, vertical banded gastroplasty (VBG, a procedure that is no longer performed), or RYGB. Total body weight change was maximal after 1 year in the three surgical subgroups (RYGB, −38 ± 7 %; VBG, −26 ± 10 %; and banding, −21 ± 10 %). Weight regain was reported by the second year of follow-up. For the RYGB and banding subgroups, 10-year weight change was −25 ± 11 % and −13.2 ± 13 %, respectively. Thus, at 10 years, subjects who underwent RYGB experienced a mean weight regain of 12 % total body weight and those who underwent fixed or variable banding regained 8 % total body weight. This translates into regaining 34 % (for RYGB) and 38 % (for banding) of the maximal lost weight at 1 year. Categorical weight regain was not reported.

Other published studies are of shorter duration and include smaller numbers of subjects. For example, Himpens et al. [6] determined the long-term efficacy of LGS among 30 consecutive patients from a single center. Whereas 3-year mean %EWL was 77.5 ± 19.8 %, 6-year mean %EWL was 53.3 ± 28.3 %. Thus, among this cohort, mean %EWL between years 3 and 6 decreased by 24.2 %, representing a regain of 31 % of lost EWL. In a retrospective study from Christou et al. [7] of 161 patients who underwent a RYGB and followed for more than 10 years, %EWL diminished from a mean of 89.5 % after 2.5 years to 68.1 % at 12.3 years. The mean 21.4 % change in %EWL represents a regain of one-fourth of total %EWL.

In another historical cohort study of 93 patients who underwent RYGB and completed 5 years of follow-up, mean %EWL decreased from 83.0 ± 21.7 % at 2 years to 74.3 ± 23.7 % at 5 years. The 8.7 % reduction in %EWL represents a 10 % regain of lost EWL [8]. However, the authors note that the variation in change of %EWL between 2 and 6 years follow-up ranged from a minimum of −88.0 % to a maximum of 29.1 %. Finally, Nguyen et al. [9] conducted a prospective randomized trial comparing RYGB ($n = 111$) to gastric banding ($n = 86$). At 2 years, data was available for 84.6 % of RYGB patients and 91.9 % of gastric banding patients. Follow-up rates at 4 years were available for 83.1 and 93.3 % for the two surgical procedures, respectively. In contrast to other studies, there was no significant change in mean %EWL for the two procedures between years 2 and 4. However, the standard deviations were large suggesting wide variation in outcomes.

Using a different methodical design, Kofman et al. [10] conducted an Internet survey among individuals who had undergone RYGB surgery between 3 and 10 years prior to participation in the study. Weight regain, assessed using a series of self-report questions, was defined as the difference in pounds from the lowest postsurgical weight to present weight. Of the 497 individuals who responded, 25.6 % underwent surgery 3–4 years previously, 46.1 % between 4 and 5 years, and 16.9 % between 5 and 6 years before the survey. Mean maximum EWL of 81 % was achieved at 17.9 months after surgery. Eighty-seven percent of respondents reported gaining weight from their lowest postoperative weight; 33 % gained between 10 % and <20 % and 14 % gained 20 % or more of EWL. In summary, weight regain occurs following a variety of bariatric surgery procedure. However, current studies do not allow an accurate estimation of incidence rates.

Surgical, Biopsychosocial, and Behavioral Determinants of Weight Regain

It is reasonable to presume that weight regain following bariatric surgery may result from numerous causes, due to a combination of anatomical, physiological, behavioral, and psychological factors (Table 21.1). Thus, it is useful to classify the etiology of weight regain into distinct categorizes. Although not all of the factors are amenable to treatment when the patient presents with weight regain, this functional grouping provides an appreciation of the potential causative factors.

Table 21.1 Etiological factors for weight regain following bariatric surgery

Anatomical
LAGB malfunction or mismanagement
Band or port breakage, band too lose
RYGB
Pouch enlargement
Gastrojejunal anastomosis dilation
Gastro-gastric fistula
Physiological
Hormonal adaptation
Pregnancy
Menopause
Weight-gaining medications
Smoking cessation
Endocrine disorder: Cushing's disease, severe hypothyroidism
Behavioral
Dietary
Unhealthy eating patterns, grazing, nibbling, mindless eating
Consumption of high energy foods and beverages
Loss of dumping syndrome symptoms
Loss of control over urges, binges
Reduced vigilance
Excessive alcohol intake
Physical activity
Reduced leisure time activity
Increased sedentary behaviors
Insufficient moderate- and vigorous-intensity exercise
Development of physical limitations to exercise

Surgical Procedure Failure

Each type of bariatric procedure has its own potential mechanism of surgical failure that can lead to weight gain. In restrictive procedures such as LAGB, weight loss is based on the reduction of gastric volume due to the gastric band. Dilation of the band or insufficient tightening may result in a feeling of reduced restraint, leading to the ability to consume larger volumes of food and calorie-containing beverages as compared to the first months after surgery. This is supported by observations that suggest that restrictive procedures fail if the pouch and stoma are too large. In patients who have undergone RYGB, weight regain may occur as a result of breakdown of the surgical staple line and development of a gastro-gastric fistula, or enlargement of the gastric pouch or stoma outlet. A retrospective review from a bariatric center of excellence identified patients who underwent laparoscopic revisional surgery between 2001 and 2008. Of 384 secondary bariatric operations, 151 reoperative procedures were performed for complications such as pouch enlargements, strictures, and gastro-gastric fistulas with the major morbidity (13.2 %) related to leaks [11]. Similarly, another retrospective analysis identifies the major reasons for requiring surgical revision as weight regain (40.3 %), type-specific issues (27.8 %), dysphagia/reflux (25 %), and gastro-gastric fistula (6.9 %) [12]. Patients who experience these complications are generally appropriate candidates for a surgical revision procedure.

Biological

Hormonal Adaptations

The hormonal causes of weight regain after surgically induced weight loss are not fully understood. However, investigational data from nonsurgical weight loss suggest that there is a strong selection bias in favor of regulatory systems that vigorously defend against deficits in body weight. The regulatory changes with weight loss include significant reductions in levels of leptin and the gastrointestinal hormones peptide YY, cholecystokinin, and amylin and increase in the levels of ghrelin—a hormonal change that is associated with increased hunger and urges to eat. Ghrelin, an orexigenic or "hunger" hormone, is secreted by the stomach and is known to increase before meals and then fall after meals in humans. Multiple studies have shown that ghrelin levels are reduced following RYGB, though other clinical studies are conflicting [13]. The discrepancy in these findings may be due to the complexity of the ghrelin system or to the poor sensitivity of the techniques used to assess ghrelin levels [13]. PYY is an anorexigenic signal that suppresses appetite and is secreted after food intake. Glucagon-like protein-1 (GLP-1) is released into the circulation post meal by L cells in the small intestine to stimulate insulin secretion, inhibit glucagon release, and delay gastric emptying. Both anorexigenic hormones have been shown to increase after RYGB and LSG.

Although surgical revision of the gastrointestinal tract leads to alteration of gut hormones and the resultant changes in appetite and metabolism, it is unclear whether metabolic adaptation reoccurs to defend body weight. Surgically induced changes in ghrelin, PYY, and incretin hormone levels may diminish over time. Rodent studies have demonstrated that postsurgical weight regain is associated with failure to sustain elevated plasma PYY concentrations. The use of animal models for bariatric surgery should provide further clues into the mechanisms involving the hormonal causes of postsurgical weight regain.

Pregnancy

Weight gain associated with pregnancy is dependent upon many determinants, including physiological, psychological, and behavioral factors. Observational and cohort studies have shown that excessive gestational weight gain substantially increases the risk of weight retention at 1 year and future long-term weight gain at 15–21 years postpartum [14–16]. Weight retention is particularly more evident for women who are obese prior to pregnancy. Based on the existing literature, the Institute of Medicine published revised recommendations on appropriate weight gain during pregnancy. For underweight women, the recommended total weight gain is 12.5–18 kg; for normal weight women, 11.5–16 kg; for overweight women, 7–11.5 kg; and for obese women, 5–9 kg.

Among patients who have undergone bariatric surgery, counseling about pregnancy is important as almost half of all bariatric procedures are performed on women of reproductive age. Bariatric surgery is thought to improve fertility based on normalization of sex hormones, menstrual irregularities, and improvement in polycystic ovarian syndrome. Most authorities urge patients to delay conception for at least 1 year post-bariatric surgery to minimize complications from nutritional deficiencies and optimize weight loss. Maternal weight gain after bariatric surgery has not been well studied. In one prospective study of 79 consecutive first pregnancies following LAGB, mean maternal weight gain was 9.6 ± 9.0 kg compared to 15.5 ± 9.0 kg among 79 obese subjects matched for parity and maternal age [17]. The incidence of postpartum weight retention was not reported. Neonatal outcomes such as incidence of stillbirths, preterm deliveries, and birth weight have been shown to be consistent with community values [17, 18]. In one retrospective study, patients who conceived during the first postoperative year ($n = 104$) had comparable short-term perinatal outcomes compared with patients who conceived after the first postoperative year ($n = 385$) [18]. No significant differences were noted regarding hypertensive disorders, diabetes mellitus, or bariatric complications.

Menopause

The years surrounding menopause are associated with weight gain. Wing and colleagues [19] were among the first to observe this pattern in the Healthy Women's Study, a longitudinal investigation of biobehavioral factors during menopause in a cohort of 541 healthy and initially premenopausal women. Data published after the first 3 years of this study showed that the women gained on average 2.25 kg and about 20 % of subjects gained 4.5 kg [19]. Body composition studies demonstrate an increase in total body fat and visceral adipose tissue [20]. Change in weight and body fat is primarily due to decreased energy expenditure and physical activity along with loss of estrogen. Menopausal weight gain is associated with development of hyperlipidemia, hypertension, and insulin resistance. Literature on menopausal weight gain in patients who have undergone bariatric procedures is limited. However, it can be postulated that the same factors that contribute to weight gain in a nonsurgical menopausal woman can also affect a postsurgical menopausal patient.

Weight-Gaining Medications

It is well documented that many types of medications are associated with weight gain; these include antipsychotics, mood stabilizers, antidepressants, antidiabetics, and glucocorticoids. The degree of medication-induced weight gain varies by medication. Prescribed psychotropics may cause 2–17 kg of weight gain over the course of clinical treatment. In an analysis of four prospective trials of glucocorticoids in rheumatoid arthritis, the use of 5–10 mg/day of prednisone over 2 years was associated with an increase of mean body weight of 4–8 % [21]. Medication-induced weight gain can occur in individuals who have undergone bariatric procedures. However, currently there are no studies that have identified the effects of weight-gaining medications in this population.

Smoking Cessation

Tobacco use is a noteworthy health behavior to assess in bariatric candidates. One study found that 67 % of bariatric surgery candidates have a lifetime history of smoking and 27 % are current smokers [22]. Since current guidelines recommend smoking cessation at least 8 weeks prior to bariatric surgery, the effect of cigarette smoking on body weight may be an important factor. Longitudinal cohort data of 1,885 smokers from national surveys showed that mean weight gain after cessation of smoking was 2.8 kg in men and 3.8 kg in women; 9.8 % of men and 13.4 % of women gained more than 13 kg [23]. In the Lung Health Study of 5,887 smokers followed over 5 years, 33 % of sustained quitters gained ≥10 kg [24]. The etiology of weight gain is thought to be attributed to a reduction in energy expenditure and increased caloric intake. Smoking and smoking cessations rates have not been well characterized in the post-bariatric surgical population.

Medical Problems

As with any patient, individuals who have undergone bariatric procedures can develop medical conditions that are associated with weight gain. Although uncommon, medical causes of weight gain include Cushing's syndrome, acquired hypothalamic obesity syndromes, and myxedema from hypothyroidism. In a single-center study of 783 consecutive patients who were evaluated for endocrine disorders before bariatric surgery, Cushing's syndrome was diagnosed in six patients and ACTH-dependent hypercortisolism in an additional five [25]. A thorough clinical examination and biochemical work-up along with a heightened suspicion is necessary for diagnosis. Diagnosis of Cushing's syndrome can be challenging since obesity and hypercortisolism share many clinical features: central obesity, facial plethora, dorsocervical hump, and violaceous stria.

Musculoskeletal Disability

Obesity is associated with many health concerns, including impairments in physical function and mobility. Arthritis is the leading cause of disability among older adults in the United States owing to the increasing rates of obesity. Decreased physical activity related to arthritis is common, as evidenced by the 2007–2009 National Health Interview Survey in which 42.4 % of respondents reported activity limitations caused by arthritis [26]. The three most frequently found functional limitations among people with arthritis are bending or stooping, standing, and walking. These limitations can lead to decreased activities of daily living, which increase the risk of a sedentary lifestyle and weight gain. There is currently limited literature evaluating the role that bariatric surgery has on hip and knee osteoarthritis. No randomized controlled trials have been conducted assessing the impact that weight loss surgery has on hip and knee osteoarthritis. However, from the limited studies available, the general trend is that significant weight loss following bariatric surgery improves pain and function [27].

It is well established that participating in regular physical activity improves weight loss outcomes and is required to maximize postoperative results. When advising increased physical activity, real and perceived barriers to exercise should be individually evaluated and addressed. Staying mindful of possible orthopedic limitations, initial physical activity goals must be within the patient's tolerance.

Psychosocial

Several psychosocial characteristics have been proposed as risk factors for weight regain after bariatric surgery; these include depression, increased stress from changing life events, and disordered eating patterns. The presence of such factors may hamper long-term success.

Depression

Multiple studies have identified the relationship between obesity and depression as complex; raising the question of whether the causal pathway is bidirectional or reciprocal. The 10-year follow-up of the SOS study showed high rates of depression in both the surgically treated and conventionally treated groups and found that greater weight loss was associated with a greater reduction of depressive symptoms [28]. Other studies have shown an inverse relationship between the Beck Depression Inventory (BDI) score, a validated metric of depression, and the management of surgically mediated weight loss [29, 30]. Currently, no randomized controlled trials have been conducted on the long-term effects of bariatric surgery and depression. Therefore, the association between depression and weight changes following bariatric surgery is not completely understood.

Coping response to stressful life events can affect weight loss outcomes. A review of the literature by Elfhag et al. reveals factors associated with weight regain. These include poor coping strategies, psychosocial stressors, and eating in response to negative emotions and stress [31]. Personal crises such as bereavement, major illnesses, or even busy schedules can often lead to unhealthy coping mechanisms such as emotional eating. This habit can lead to the use of eating to regulate mood [31].

Disordered Eating

Two abnormal eating patterns have been described in obese patients: binge eating disorder (BED) and night eating syndrome (NES). Binge eating disorder was designated as an eating disorder in the fifth edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and is defined as the consumption of large quantities of food during a short amount of time (within any two-hour period) without being in control of this behavior. BED involves regular episodes of excessive, uncontrolled overeating and is strongly associated with psychological distress. Night eating syndrome is characterized by a circadian delay in the pattern of eating, defined by the main criteria of evening hyperphagia (i.e., the consumption of ≥25 % of the total daily caloric intake after the evening meal) and/or ≥2 nocturnal ingestions per week.

The prevalence rates at which bariatric candidates are affected by binge eating vary widely in the current literature. For example, de Zwaan et al. [32] used the Eating Disorder Examination Questionnaire, an instrument based on a structured interview widely considered the reference standard for the assessment of eating pathology. The authors found that 15 % of RYGB candidates met the diagnostic criteria for BED and 24 % reported features of the disorder but did not meet the full diagnostic criteria. In another study, Allison et al. [33] observed that <5 % of patients met the full diagnostic criteria for BED. Binge eating may be related to smaller weight loss or weight regain within the first two postoperative years [30]. However, this finding has not been reported consistently.

It has been established that patients who engaged in night eating preoperatively may continue this behavior postoperatively. This habit may be attributable to stretching of the gastric pouch, allowing for increased energy intake over time. Latner et al. found that more frequent nocturnal eating postoperatively was associated with a greater body mass index (BMI) and less satisfaction with bariatric surgery [34]. Much like binge eating, the prevalence of NES among bariatric candidates varies within the available literature. Regardless of the conflicting prevalence reports, the act of night eating presents a challenge to patients' compliance with the recommended postoperative diet and behavioral recommendations.

Behavioral

Weight loss surgery is commonly described as a tool to help patients lose and maintain weight loss. The surgical intervention imposes changes in dietary behavior that result in reduced caloric intake. At the same time, patients are counseled to increase physical activity and engage in programmed and structured exercise. Continued adherence to these recommendations is necessary for success.

Diet

Dietary caloric intake is reduced immediately following surgery due to a smaller gastric capacity, diminished hunger, and increased satiety brought about by altered gut hormones (discussed previously). The presence of dumping syndrome may also lead patients to reduce their intake of concentrated sweets and fatty foods to avoid associated postprandial symptoms, such as abdominal cramping, nausea, diarrhea, light-headedness, sweating, and tachycardia. In fact, over 60 % of patients report avoiding sweets and nearly 30 % avoid fatty foods after gastric bypass surgery [35]. Other food intolerances may occur as well. As a result, patients who have had RYGB may consume fewer fatty foods and sweets. However, over time, caloric intake is less restrained. In the SOS study, mean daily intakes of 2,900, 1,500, 1,700, 1,800, 1,900, and 2,000 kcal/day, respectively, were reported at baseline and 6 months, 12 months, 2 years, 3 years, and 4–10 years after surgery. These increases in caloric intake

likely contribute to weight regain, which often begins in the second postoperative year [5]. These data suggest that some bariatric surgical patients have difficulties adhering to the postoperative diet.

Grazing, defined as the consumption of smaller amounts of food over extended periods of time, has been identified as a common high-risk eating pattern after bariatric surgery. Studies have shown that both preoperative and postoperative grazing behaviors independently predict poorer postsurgical weight loss [36]. In addition, dietary noncompliance, meaning the selection of high-calorie foods and beverages, can also add to higher calorie intake and weight regain. A recent postoperative behavioral survey identified a positive correlation of the magnitude of weight regain with dietary noncompliance which included consuming large quantities of food in the evening or night, eating large quantities of high-fat foods, and eating out more frequently [37]. These studies confirm the importance of diet quality and calorie control in any therapy for obesity.

Alcohol Use

Limited studies have looked at alcohol use disorder (AUD) before and after bariatric surgery. Suzuki et al. found that individuals undergoing bariatric surgery were found to have a prevalence of AUD comparable to the general population but that those with a lifetime history of AUD may be at an increased risk for elapsing after surgery, specifically after the RYGB [38]. No associations were found between weight loss following surgery and the development of AUD [38]. In another study, King et al. found a significantly higher prevalence of AUD in the second postoperative year overall and, specifically after RYGB, compared with the years immediately before and following surgery [39]. Future studies are needed to clarify if and how postoperative weight loss is related to alcohol use.

Physical Activity

Numerous studies suggest that self-reported levels of physical activity increase significantly after bariatric surgery [40, 41]. However, there is little objective data regarding changes in physical activity levels in the postoperative period. In one study, patients reported a large increase in moderate- to vigorous-intensity activity after surgery, but accelerometer data suggested that such an increase did not actually occur in most individuals [42]. In fact, data suggest that only 10–24 % of post-bariatric surgery patients meet national guidelines regarding minimal physical activity levels for general health promotion (i.e., ≥150 min/week or moderate-to-vigorous physical activity in bouts of 10 min or more) [43]. Data from the National Weight Control Registry indicate that patients who have lost weight through bariatric surgery tend to be less physically active than individuals who have lost similar amounts of weight through nonsurgical approaches [42].

In addition to hormonal changes, energy expenditure with weight loss is disproportionately reduced, largely attributable to increased skeletal muscle work efficiency and reduced physical activity. Due to these underlying adaptive physiological factors and the behavioral challenges of balancing caloric intake and expenditure, weight loss maintenance is difficult.

Support/Follow-Up

Obesity is a chronic, progressive disease that requires continual follow-up. The need for regular follow-up was demonstrated in the Weight Loss Maintenance Trial. In this randomized controlled trial of subjects who lost >4 kg in the initial weight loss phase, individuals were randomized to 1 of 3 interventions: (1) self-directed control group, (2) personal contact intervention that provided brief monthly or face-to-face contact, and (3) interactive technology intervention. All three groups were able to maintain some of the weight they lost, however, those who received personalized contact maintained significantly greater weight loss compared with the other two treatment groups at 24 and 30 months [44].

Despite the significant weight loss achieved through bariatric surgery, close follow-up is also recommended postoperatively to promote continued weight loss and/or maintenance. According to the AACE/TOS/ASMBS guidelines (2009), follow-up visits are recommended within 2 weeks after surgery, at 6 months, at 12 months postoperatively, and then annually. These postoperative visits are used to monitor patient's weight loss as well as counsel patients on issues related to dietary and exercise adherence. Even though regular postoperative follow-up is advised, clinical reports have suggested that follow-up is often suboptimal and can negatively affect weight loss. A recent study showed only 40 % of patients returned for each of their first 4 annual follow-up visits with the surgeon. Those who returned for all of their annual follow-up visits lost significantly more weight than did those who did not return [45]. This data suggests that lack of follow-up may be a determinant of weight regain after bariatric surgery.

Clinical Approach to Evaluating and Managing Postoperative Weight Regain

As discussed in the preceding section, the etiology of weight regain may have multiple determinants. Thus, patients should undergo a comprehensive evaluation to assess all potential causative factors. A proposed evaluation algorithm for assessment and treatment of postoperative weight gain is shown in Fig. 21.1. Several predictors of weight regain have been identified in selective studies. However, due to differences in methodology, patient populations studied, and

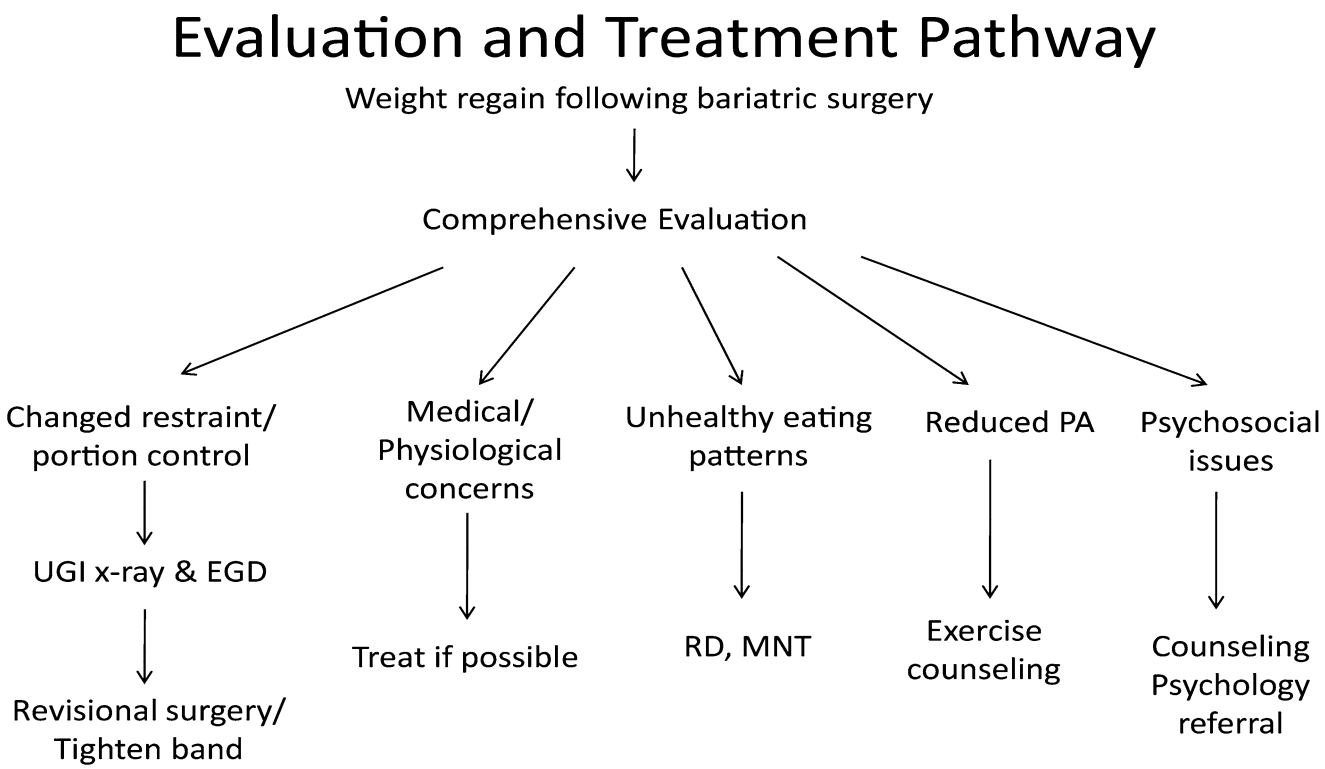

Fig. 21.1 Evaluation and treatment pathway for weight regain following bariatric surgery. *RD* registered dietitian, *MNT* medical nutrition therapy, *PA* physical activity

length and completion of follow-up, the predictive variables differ among publications. For example, Odom et al. [29] surveyed 203 patients (24.8 % response rate) from a single center after a mean follow-up of 28.1 ± 18.9 months after RYGB. Seventy-nine percent of patients reported weight regain; 15 % regained ≥15 % of total weight lost, which they considered "significant weight regain." Independent predictors of significant weight regain were lack of control of food urges (odds ratio [OR] = 5.1), concerns over alcohol or drug use (OR = 12.74), lowest self-reported well-being scores (OR = 21.5), and no follow-up visits (OR = 2.60). In another survey of 497 patients who previously underwent RYGB after a mean of 4.2 years, participants who regained >10 % EWL reported significantly higher frequencies of binge eating, grazing, and loss of control [10]. Freire et al. [46] conducted a cross-sectional study among 100 patients who underwent open RYGB after a mean of 45.5 ± 32.6 months. The incidence of weight regain was 69.7 % and 84.7 % at 2 and 5 years postsurgery, respectively (weight regain calculated as the increase from the lowest weight reported at any time after surgery). Factors associated with weight regain were poor diet quality, lack of physical exercise, and poor nutritional counseling [46]. Although the studies reviewed provide an indication of factors that have been associated with weight regain following bariatric surgery, we believe that a more comprehensive approach is indicated.

Anatomical Factors

Patients presenting with loss of restraint or reduced restriction of food volume may require an evaluation of the surgical procedure. An upper GI X-ray is a reasonable first step to assess pouch enlargement, anastomotic dilation, or formation of a gastro-gastric fistula among patients who underwent RYGB and for inadequate band restriction for patients who had LAGB performed. Depending on initial results, an esophagogastroduodenoscopy (EGD) will provide a more accurate delineation of the anatomy and intraluminal measurements. Subject to other biopsychosocial factors discussed below, patients can be considered as candidates to undergo a surgical revisional procedure.

Medical and Physiological Considerations

Patients identified to have an endocrinologic disorder, such as Cushing's syndrome or hypothyroidism, should be medically treated. However, the most common treatable medical reason for weight gain is prescription of weight-gaining medications. Therefore, all patients should have a thorough medication history reviewed. If possible, weight-gaining medications should be substituted for either

Table 21.2 Drugs that produce weight gain and alternatives

Category	Drugs that cause weight gain	Possible alternatives
Neuroleptics	Thioridazine; olanzapine; quetiapine; risperidone; clozapine	Molindone; haloperidol; ziprasidone
Antidepressants		
Tricyclics	Amitriptyline; nortriptyline	Protriptyline
Monoamine oxidase	Imipramine; phenelzine	Bupropion; nefazodone
Inhibitors	Mirtazapine	
Selective serotonin	Paroxetine	Fluoxetine; sertraline
Reuptake inhibitors		
Anticonvulsants	Valproate; carbamazepine; gabapentin	Topiramate; lamotrigine; zonisamide
Antidiabetic drugs	Insulin	Acarbose
	Sulfonylureas	Miglitol; metformin; orlistat
	Thiazolidinediones	DPP-4 inhibitors; GLP-1 analogs; SGLT-2 inhibitors
Anti-serotonin	Pizotifen	
Antihistamines	Cyproheptadine	Inhalers; decongestants
β (beta) adrenergic blockers	Propranolol	ACE inhibitors; calcium channel blockers
α (alpha) adrenergic blockers	Terazosin	
Steroid hormones	Contraceptives	Barrier methods
	Glucocorticoids	Nonsteroidal antiinflammatory agents
	Progestational steroids	

weight-neutral or weight-losing medications. A list of medications by disease category and effect on body weight is shown in Table 21.2. Substitutions will often need to be coordinated with the patient's other healthcare providers, particularly for the psychotropic medications.

Behavioral Factors

Among all of the determinants of weight regain, recidivism of behavioral patterns or developments of new maladaptive patterns are the most common. All patients should undergo a comprehensive dietary, physical activity, and behavioral and psychological assessment. Depending on clinic staffing and patient needs, the evaluations can be performed by a physician, registered nurse, nurse practitioner, physician assistant, registered dietitian (RD), and a mental healthcare professional. Diet can be assessed by either a 24-h dietary recall or food frequency with particular attention to total caloric intake, meal and snack patterns, presence of grazing or nibbling, binging behavior, and consumption of high-calorie foods and beverages. Physical activity is assessed by time spent in daily activities, sedentary time, and frequency, intensity, and duration of any planned exercise. Mental health is assessed for presence of stressors, affective disorders, substance abuse, and coping response. Concerns identified in any of these categories should be directly treated.

Physical Activity

Physical activity has been a focus among multiple investigators. In epidemiologic studies of postoperative patients, increased self-reported physical activity has been repeatedly associated with improved weight loss, mood, and psychosocial functioning [40, 43]. Similarly, in a cross-sectional study, which used armband accelerometers to measure activity in patients who had undergone gastric bypass 2–5 years earlier, higher levels of moderate-to-vigorous physical activity were associated with greater postoperative weight loss [47]. However, data from intervention studies are lacking. In one small, nonrandomized, prospective study, participation in a postoperative exercise program (including 75 min of supervised aerobic exercise and resistance training 3 times a week) for 3 months did not significantly increase weight loss after RYGB surgery [48]. However, the intervention did prevent the observed decrease in dynamic muscle strength that was seen in postoperative patients who did not exercise, and it was also associated with an increase in functional and aerobic capacity. In a small, randomized, controlled trial, Shah and colleagues randomly assigned 33 obese (BMI $\geq$ 35.5 kg/m^2) postoperative patients to either high-volume exercise (with a goal of expending $\geq$ 2,000 kcal/week in moderate intensity aerobic exercise) or a usual activity control for 12 weeks [49]. Subjects assigned to the exercise intervention reported a greater than threefold increase in time spent in moderate physical activity and a nearly twofold increase in

recorded step counts. In this small study, intervention group subjects did not have greater weight loss or greater improvements in body composition; however, they did have significantly greater improvements in physical fitness. Additional data are needed to further characterize the benefits of exercise in postoperative bariatric surgery patients and to determine the optimal physical activity levels in this group.

Additional concerns regarding prescription of exercise in the bariatric surgery patient are physical and cognitive barriers. Before bariatric surgery, an individual's ability to exercise is often limited due to musculoskeletal pain. Walking capacity of severely obese patients is on average 55 % of normal values and is inversely related to BMI [50]. Cognitive barriers to physical activity include lack of time, social stigma, lack of motivation, reduced awareness of the health benefits of exercise, fear of injury, a lack of confidence in the ability to participate in physical activity, and self-consciousness or embarrassment. Treatment strategies that address these barriers may help patients become more physically active.

Psychological Counseling and Peer Support in the Postoperative Period

Data suggest that patients with postoperative depression experience poorer weight loss than those who are not depressed. Similarly, postoperative patients who exhibit disordered eating patterns, such as grazing and loss of control over eating, have poorer weight loss and greater weight regain [10, 36]. Patients who are found to have mood disorders, disordered eating behavior, or substance abuse after bariatric surgery should be offered professional psychological counseling and support. It is not known, however, whether such treatment improves weight loss or other outcomes.

For unclear reasons, patients who exhibit disordered eating patterns may be more receptive to a behavioral intervention after surgery than before surgery. In one small nonrandomized prospective study, preoperative and postoperative bariatric surgical patients with binge eating or other disordered eating patterns were referred to a 10-week cognitive behavioral therapy program designed to address and improve the maladaptive eating patterns. Patients who were referred to the program postoperatively were much more likely to attend the initial session and to complete the program than patients referred preoperatively.

In epidemiologic studies, attendance at postoperative support groups is associated with improved weight loss outcomes [51, 52]. There is a lack of data regarding the effects of other types of postoperative psychological support, such as group or individual therapy, on weight loss and other outcomes.

Comprehensive Lifestyle Interventions After Bariatric Surgery

There is limited data regarding the benefits of comprehensive lifestyle interventions in the postoperative period. However, several pilot studies have been published over the past several years. In one small, randomized controlled trial, subjects who were assigned to a multifaceted lifestyle intervention after vertically banded gastroplasty reported improved dietary habits, increased physical activity levels, and reduced television viewing, as compared to subjects assigned to usual care [53]. Furthermore, subjects in the lifestyle intervention group lost significantly more weight at 1, 2, and 3 years after surgery than subjects in the usual care group.

Sarwer et al. [54] randomized 84 postoperative patients to either dietary counseling (brief: 15 min) every other week, in-person dietary counseling by a registered dietitian for the first 4 postoperative months, or standard care (no formal nutrition counseling sessions scheduled). Patients who received dietary counseling lost more total weight (20.7 ± 1.1 %) than those who received standard care (18.5 ± 1.1 %) at the end of 4 months. Total weight loss at 24 months was 32.4 ± 2.0 % versus 33.6 ± 2.5 %, respectively [54]. Although none of these weight loss differences reached statistical significance, the dietary counseling group reported greater improvements in eating behavior.

In a further study, Kalarchian and colleagues [55] reported the results of a small randomized, controlled study ($n = 36$) involving patients who had undergone bariatric surgery at least 3 years earlier but who had failed to lose 50 % or more of their excess weight. Participants were randomly assigned to a comprehensive lifestyle intervention, including 12 weekly group education sessions and five individual telephone coaching sessions over 6 months, or a waitlisted control group. Subjects randomized to the intervention group lost slightly more weight (3.3 ± 8.1 kg) than those in the control group (1.3 ± 6.8 kg), but the difference was not statistically significant [55]. Interestingly, in this study, the presence of depressive symptoms at the beginning of the study was associated with greater weight loss in the intervention group but not the control group, suggesting that the behavioral component of the intervention may have been helpful for patients with depression.

These few pilot studies suggest that currently designed lifestyle interventions are modestly effective in enhancing further weight loss among post-bariatric surgery patients. Multiple factors appear to influence outcome results, including patient selection, timing and intensity of the intervention, comprehensiveness of counseling provided, and selection of outcome measurements. Furthermore, the influence of other determinants of weight loss or weight regain (discussed earlier) may need to be addressed.

Pharmacotherapy

There are no published studies describing the use of adjunctive pharmacotherapy for management of weight regain following bariatric surgery. This is due, in part, to a paucity of anti-obesity medication available and the prevailing paradigm of not combining surgical and pharmacologic modalities for treatment. However, with the recent approval by the US Food and Drug Administration (FDA) of lorcaserin (Belviq™) and phentermine/topiramate (Qsymia™) for chronic weight management, the use of drug therapy can be anticipated.

Conclusion

The incidence of weight regain following bariatric surgery is not well defined. However, the current literature suggests that a significant percentage of patients will experience regain beginning several years following surgery. There are multiple determinants of weight regain that include biological, surgical, behavioral, social, and psychological factors. However, the extent and significance of these factors is currently uncertain. Patients who present with significant weight regain following bariatric surgery should undergo a comprehensive evaluation for determination of remedial factors. Additional clinical research is needed to further delineate this long-term postoperative problem.

Question and Answer Section

Questions

1. Cross-sectional data from the literature suggests that weight regain after bariatric surgery occurs in what percentage of patients?
   A. 5–15 %
   B. 15–30 %
   C. 20–35 %
   D. 50 %
2. A 45-year-old female who underwent Roux-en-Y gastric bypass (RYGB) 4 years previously presents with 27 lb. weight gain. Medical history includes depression and gastroesophageal reflux disease (GERD). She states she has been very busy recently due to job and family stressors. She has not had any time to exercise or prepare meals. She feels depressed and guilty secondary to the weight gain. Current medications include omeprazole/sodium bicarbonate, sertraline, and a multivitamin-mineral supplement. On exam, BP 122/80, pulse 70, weight 220 lb., and height 5′6″. Surgical preop weight was 275 lb. Which of the following management plans would be the most beneficial to this patient?
   A. Refer to a health psychologist for counseling and support. Discontinue sertraline and prescribe paroxetine to improve depressive symptoms.
   B. Refer to a health psychologist for counseling and support. Order a UGI X-ray and EGD to assess integrity of RYGB.
   C. Refer to a health psychologist for counseling and support and a registered dietitian for education on healthy eating patterns. Provide counseling during her visit to further assess causes of weight gain.

Answers

1. Answer **C**.
2. Answer **C**.

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