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GASTROENTEROLOGY, CRITICAL CARE, AND LIFESTYLE MEDICINE (SA MCCLAVE, SECTION EDITOR)

Weight Regain After Bariatric Surgery: Prevalence, Etiology, and Treatment

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Abstract

Purpose of Review Obesity is a life-limiting disease that is associated with a number of co-morbidities. Bariatric surgery remains the most efficacious and durable weight loss method available to patients. However, a significant percentage of patients can regain weight resulting in frustration, depression, and return of obesity-related co-morbidities. The present review provides an overview of the most common therapeutic modalities available to combat weigh regain after weight loss surgery.

Recent Findings Given the high percentage of patients with weight regain after surgery, significant effort has been placed on developing treatment options in the last few years. Tremendous work has taken place in the realm of cognitive behavior therapy, appetite suppressants, and endoscopic procedures with the hope of reducing the need for revision surgery which can be associated with significant complications.

Summary Weight regain is unfortunately a common phenomenon associated with all weight loss modalities including bariatric surgery. We now have a number of treatment options that can reverse the weight loss trend.

Keywords Obesity · Weight regain · Bariatric surgery · TORe · Roux-en-Y gastric bypass · Sleeve gastrectomy

Introduction

Obesity is a life-limiting disease associated with a number of co-morbidities that is among the most common and chronic in the world. Currently, more than two thirds of Americans are overweight (BMI ≥ 25 kg/m^2) and over one third are obese (BMI ≥ 30 kg/m^2) while worldwide obesity affects an estimated 650 million adults. Prediction models suggest that the prevalence of adult obesity might be as high as 42% by the year 2030 [1•]. Although many approaches exist, allowing patients to lose weight in the short term, less than 20% of individuals who try to lose weight are able to achieve and maintain a 10% reduction over a year, with the majority gaining it back within 3–5 years [2–4]. With regain of weight, individuals experience relapse of weight-related medical co-morbidities thus contributing once more to socioeconomic and direct health care costs. This cycle of weight loss and regain is frustrating to individuals, and despite our understanding of the biological and behavioral defenses mounted by the body to maintain weight, there still exists a pragmatic gap for individuals who are directly affected.

Bariatric (or weight loss) surgery is currently the most effective way to lose weight and has the highest rates of weight maintenance in the long term. Owing to this favorable profile, an estimated 216,000 bariatric surgeries are performed per year [5]. The Swedish Obesity Study was an early reporter of bariatric surgery leading to sustainable weight loss and decreased overall mortality when compared to lifestyle intervention alone [6••]. Bariatric surgery can consist of purely restrictive procedures such as the laparoscopic adjustable gastric band (LAGB) and sleeve gastrectomy (SG), Roux-en-Y

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gastric bypass (RYGB) which is felt to be a combination of restriction and malabsorption, as well as the biliopancreatic diversion duodenal switch (BPD-DS) which is primarily a malabsorptive procedure. Weight loss can range from 20 to 50% of total body weight (TBW) with restrictive procedures producing less and malabsorptive procedures producing more weight loss [7•, 8•, 9].

However, not all patients who undergo bariatric surgery are able to maintain the weight they lose. In a recent prospective, long-term study of patients who had undergone RYGB, 93% of patients maintained at least a 10% weight loss from baseline, 70% maintained at least a 20% weight loss, and only 40% maintained at least a 30% weight loss after 12 years [10–12]. Weight regain after bariatric surgery can be devastating to the patient as many of the obesity related co-morbidities that resolved with weight loss can return [11]. Additionally, weight regain after bariatric surgery can have a devastating effect psychologically as patients feel that they have failed their last option leading to a great deal of frustration, anger, and even depression. The etiology of weight regain tends to be multifactorial with risk factors including pre-operative BMI, nutrition habits, mental health, and anatomical changes such as dilation of gastro-jejunal anastomosis and presence of gastro-gastric fistula [11, 13, 14]. Fortunately, a number of options are available ranging from behavior intervention, medications approved for weight loss, and endoscopic interventions as well as revision surgery that serve to counter some of the factors that have resulted in weight regain. The current review focuses on treatment options that are available for patients who have regained weight after bariatric surgery.

Behavioral Interventions

Successful weight loss and prevention of weight regain requires behavioral change in conjunction with lifestyle modification. In the multisite Longitudinal Assessment of Bariatric Surgery 2 (LABS-2) study, participants who continued graze eating, eating beyond feeling full, and who did not engage in self-weighing before or after surgery lost significantly less weight at 3 years post-surgery compared to participants who made those healthy behavior changes (24.6% vs. 38.8%) [15••]. Graze eating, lack of physical activity, uncontrolled psychological disorders, and life stressors have also been suggested as factors related to regain [16]. Behavioral drift (the slow movement away from a behavior or skill) is common for any skill that receives less attention over time (e.g., speaking a second language, playing a sport) and is also common among patients experiencing post-surgical weight regain [17].

Given the role that behavior change can play in post-bariatric surgical outcome, it should be a foundation component of any effort to address weight regain following surgery. Behavioral intervention for weight regain after bariatric surgery is based on the large non-surgical lifestyle intervention literature, the emerging studies focused specifically on intervention for patients experiencing post-surgical regain, and evidence regarding psychological and behavioral factors that can contribute to such regain [15••, 18, 19]. Studies have examined the application of traditional behavioral weight management programs for bariatric patients with weight regain [18], to those that are tailored to the experience of regain after surgery [17, 20, 21]. Many patients struggling with regain are lost to follow-up; therefore, an open, non-judgmental approach that begins with affirming what patients are doing well is an essential component to engage patients in treatment. From that starting point, it can be helpful to offer behavioral intervention specific to this subgroup for any patient experiencing clinically significant weight regain (e.g., ≥ 10% weight lost), as their interventional and educational needs are likely different than patients in the early post-operative phase, or those not currently struggling with regain. Curricula for this program might include non-judgmental reflection on factors that played a role in regain, reducing behavioral drift, education about emerging weight loss medications or post-surgical endoscopic procedures, emotion regulation strategies, and self-monitoring techniques (a cornerstone of behavioral intervention for weight loss) [17, 22]. Additional work is being done examining the inclusion of acceptance-based strategies and different modes of intervention delivery (online, phone) in hopes of augmenting outcomes and reaching more patients [20, 21].

Pharmacological Intervention

Prior to 2012, the only FDA-approved weight loss drugs on the market were orlistat, a lipase inhibitor with modest efficacy and significant side effects [23] and phentermine, a sympathomimetic appetite suppressant approved for short-term use. Since 2012, there have been four other medications approved for the primary indication of weight loss: lorcaserin hydrochloride, phentermine-topiramate, bupropion hydrochloride-naltrexone hydrochloride, and liraglutide. These medications are centrally acting appetite suppressants with the exception of liraglutide, which also has peripheral actions in the gastrointestinal tract and inhibits gastric emptying. These medications were approved based on data from randomized controlled trials in participants who did not undergo bariatric surgery [24–27].

At present, there are no randomized prospective trials analyzing the efficacy or safety of these medications in patients who have previously undergone weight loss surgery. However, there are several small prospective trials utilizing appetite suppressants in patients who have either experienced weight regain following surgery or are at a premature weight plateau. When phentermine (in combination with fenfluramine) was utilized in individuals with weight regain 18 months following gastric bypass surgery or a

biliopancreatic diversion, participants experienced 8 to 65% of excess weight loss over 12 weeks [28]. Another small study in patients with binge eating disorder showed that the use of topiramate for 3 months following adjustable gastric banding increased excess weight loss without the need for band readjustment [29].

Larger retrospective studies have concluded that weight loss medications used as an adjunct to bariatric surgery can help patients with inadequate weight loss or weight regain. In a multi-center retrospective study in patients who previously underwent Roux-en-Y gastric bypass or sleeve gastrectomy, approximately 45% of patients experience at least 10% weight loss with the addition of a medication [30]. This is in contrast to results expected by patients who have not undergone bariatric surgery, where the average weight loss is typically between 6 to 10% [31]. Topiramate was the most commonly prescribed medication and also was associated with a higher likelihood of achieving at least 10% weight loss when compared to other medications. However, the authors note that due to the retrospective nature of this study, several confounders including the primary indication for a particular medication was not always clear. Additionally, there was no standardization of lifestyle intervention, which could have clearly affected results.

Nevertheless, in the right patient, the use of an appetite suppressant in conjunction with efforts at lifestyle modification can result in further weight loss and amelioration of weight-related co-morbidities. Some groups have even suggested that the optimal timing for these medications should be at weight plateau and not after the patient has regained weight [32]. Of note, all of these appetite suppressants have been approved for chronic use, although given the relatively short time they have been on the market, there is limited clinical experience with efficacy and safety in the long term.

Endoscopic Intervention

As noted above, one of the most common anatomical changes with RYGB over time is the enlargement of gastro-jejunal (GJ) stoma size, contributing to weight regain through a number of mechanisms [33••]. A dilated GJ stoma can change the rate at which the gastric pouch empties its contents into the jejunum resulting in modulation of incretin production as well as reduction in satiety allowing the patient to increase the volume of food consumed in one meal. Abu-Dayyeh et al. retrospectively reviewed 165 patients who had a history of RYGB and underwent endoscopic evaluation and noted that 59% had significant weight regain (≥ 20% of maximal weight lost after RYGB) [11]. They noted that after 5 years, each 10-mm increase in the GJ stoma diameter was associated with an 8% increase in the percentage maximal weight lost after RYGB that was regained.

Dilated GJ stoma can be treated surgically; however, this revision requires a technically difficult dissection and has a significant risk of morbidity and complications. Recently, with advancements in endoscopic suturing devices, a novel approach to the reduction of the stoma diameter has emerged; Transoral Outlet Reduction Endoscopic (TORe). This procedure typically begins with cauterization of a portion of the stoma to expose the submucosa. A suturing system is then used to plicate the opening (Fig. 1). A recent retrospective analysis of prospectively collected data from three larger bariatric centers was conducted analyzing 130 subjects who underwent the TORe procedure [33••]. On average, they had regained 24.6 ± 16.6 kg and were 8.4 ± 4.9 years from RYGB. Their average pre-revision stoma was 28 ± 4.7 mm in diameter and this was reduced to 8.3 ± 1.42 mm resulting in weight loss of 9.31 ± 6.7 kg ($N = 84$), 7.75 ± 8.4 kg ($N = 70$), 8 ± 8.8 kg ($N = 46$) at 6, 12, and 18 months respectively. Nausea ($n = 18$)

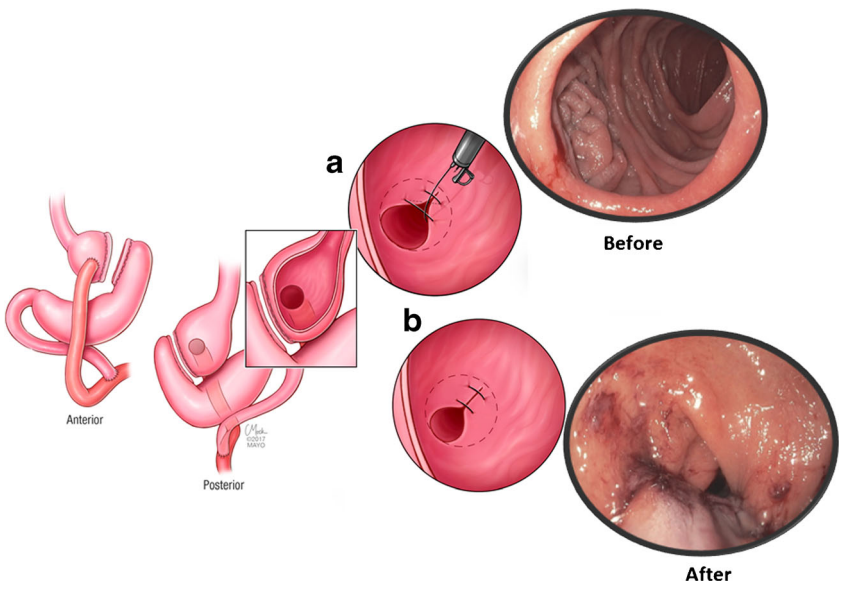

Fig. 1 Image depicting dilated gastro-jejunostomy (**a**) that has been plicated with suturing device (**b**). Used with permission of Mayo Foundation for Medical Education and Research; all rights reserved

and abdominal pain ($n = 23$) were the most commonly reported symptoms and could be managed with oral agents. Repeat endoscopy was required in 8% of cases and 4% underwent balloon dilation of a narrowed anastomosis. This group then performed a meta-analysis by combining their data with other published results and again noted similar weight losses of 9.5 kg (95% CI 7.9–11.1), 8.4 kg (95% CI 6.5–10.3), 8.4 kg (95% CI 5.9–10.9) at 6, 12, and 18–24 months in a total of 330 patients [33••].

Surgical Revision

Revision of a previous bariatric surgical procedure can be carried out due to a number of reasons including the development of intractable marginal ulcer, gastro-gastric fistula, severe gastroesophageal reflux, and malnutrition [34]. However, recently an increasing indication has been weight regain after previous bariatric surgery [34]. Depending on the registry evaluated and the country of origin, revision rates for bariatric surgery can vary between 3 and 20% [35]. Prior to surgical revision, it is important to identify the current anatomy through endoscopic evaluation and/or upper GI series in order to assess whether surgical revision is feasible and which procedure would be best indicated. In the setting of previous LAGB or vertical banded gastroplasty, most often a conversion to another bariatric surgery is indicated, although some centers have reported replacement of LAGB. For patients with previous RYGB and GJ stoma dilation, in addition to TORe discussed above, gastric plication to reduce the size of the stomach or revision of the GJ junction are possibilities. If the gastric pouch is not enlarged or the GJ stoma is not dilated, shortening of the common channel may be undertaken but can be associated with increased macro- and micro-nutrient deficiencies requiring the patient to be followed very closely.

Ferraz et al. recently published their outcome data in 29 patients who presented for weight regain approximately 5 years after undergoing RYGB [36]. They reported four approaches to revision surgery: group 1: increase of the Roux limb to 200 cm in those who had no significant anatomical alteration of the gastric pouch in order to increase malabsorption; group 2: increase in the Roux limb to 200 cm and placement of silicon ring in patients who did not have ring placed previously; group 3: increase in Roux limb to 200 cm and plication of the gastric pouch in those who have dilation of the gastric pouch despite previous ring placement; and group 4: plication of gastric pouch and placement of silicon ring in those who had a ruptured previous ring and dilation of gastric pouch. They noted that patients who underwent ring placement had weight loss of 20.6% at 9 months of follow-up and those that did not undergo ring placement had 11.6% weight loss at 13 months of follow-up.

It is important to note that revision surgery after bariatric surgery is not a benign procedure and can be associated with significant complications including the need for re-operations. In a recent systematic review, the need for re-operation after secondary bariatric surgery was noted to be 19.4% with 8.8% undergoing a third procedure and 9.6% undergoing re-operation due to complications [35]. They noted that with LAGB, re-banding had a much higher rate of revision than conversion to other bariatric procedures such as SG and RYGB. Conversion to RYGB was associated with long-term complications in 22% of cases. In terms of revision of RYGB, shortening of the common channel was associated with short-term complications in 48% of patients including deep vein thrombosis and surgical site infection. Long-term complications including bowel obstruction, hernias, and malnutrition were noted in 55% of patients.

Conclusion

Bariatric surgery remains the most efficacious and durable weight loss method available to patients with obesity who have weight-related co-morbidities. There are several mechanisms by which bariatric surgery effectively modulates appetite which is thought to be a major factor in its success. However, a proportion of patients will experience clinically significant weight regain following bariatric surgery and the reasons for this are multifactorial. In this situation, a multidisciplinary approach consisting of behavioral modification, along with a secondary intervention such as use of an appetite suppressant, endoscopic plication or revision surgery may be utilized to give the patient the best chance of losing weight. The best practice perhaps therefore should be that patients seeking bariatric surgery are counseled on the likelihood of weight regain as well as informed of possible options should it occur.

Author Contributions Manpreet Mundi and Ryan Hurt formulated an outline of the manuscript. Saketh Velapati created the first draft. Manpreet Mundi, Meera Shah, Aravind Kuchkuntla, Karen Grothe, Barham Abu-Dayyeh, and Ryan Hurt critically revised the manuscript. All authors agree to be responsible for its content.

Compliance with Ethical Standards

Conflict of Interest Saketh R. Velapati declares that he has no conflict of interest.

Meera Shah declares that she has no conflict of interest.

Aravind R. Kuchkuntla declares that he has no conflict of interest.

Barham Abu-dayyeh has received research support from Apollo Endosurgery.

Karen Grothe declares that she has no conflict of interest.

Ryan T. Hurt has served as a consultant for Nestlé.

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- •• Of major importance

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