# Re-emergence of Comorbidities After Bariatric Surgery

22

Tejal Bipin Lathia and Vishakha Jain

*There is nothing permanent except change.*

*—Heraclitus*

## 22.1 Introduction

The advent of bariatric surgery (BS) has changed the way obesity is managed. Rapid advances in the field of bariatric surgery have opened up newer avenues with better surgical modalities, lesser complications, and better outcomes in people with obesity. Judicious selection of patient and procedure are of paramount importance. This determines both short-term as well as long-term outcomes post-surgery. There is no doubt that bariatric surgery results in significant weight loss. However, we cannot equate the trajectory of weight loss with that of the accompanying comorbidities. The remission as well as re-emergence of comorbidities are impacted by factors other than weight loss alone.

Recent meta-analyses on outcomes in patients who undergo sleeve gastrectomy (SG) and Roux-en-Y-gastric bypass (RYGB) surgeries, the commonest surgeries performed now, demonstrate primarily a loss of excess body weight and amelioration or remission of diabetes mellitus. Other comorbidities like dyslipidemia, metabolic syndrome (MetS), cardiovascular disease (CVD), polycystic ovarian syndrome (PCOS), obstructive sleep apnea (OSA) syndrome, non-alcoholic steatohepatitis (NASH) all show improvement to a great extent. But many pre-existing

T. B. Lathia (✉)
Department of Endocrinology, Apollo and Fortis Hospitals, Navi Mumbai, India

V. Jain
All India Institute of Medical Sciences, Bibinagar, Hyderabad, India



A. G. Bhasker et al. (eds.), *Management of Nutritional and Metabolic Complications of Bariatric Surgery*,
https://doi.org/10.1007/978-981-33-4702-1_22

comorbidities like hypertension, chronic kidney disease, non-alcoholic fatty liver disease (NAFLD), and osteoarthritis do not resolve but may show some improvement.

Discussing the re-emergence of comorbidities after bariatric surgery is a daunting task as there are limited studies with inadequate long-term follow-up of patients. Most of the evidence looks at either uncontrolled case series or cohorts with variable follow-ups. Furthermore, follow-up rates decline from year 1 to year 5 post-surgery and only 4% of studies report more than 80% follow-up rates. Hence comorbidities re-emerging after surgery may be missed or inadequately reported.

With the limited data available to us, the earliest co-morbidity probably to re-emerge is mental health issues while the major late comorbidity to re-emerge is diabetes mellitus. Post-bariatric surgery follow-ups are vital—support group meetings, behavioral intervention, and ongoing psychological support are key to prevent re-emergence of comorbidities. Further research is needed to document the late re-emergence of comorbidities.

In this chapter, we will discuss the resolution and re-emergence of comorbidities for which data is available namely mental health disorders and diabetes mellitus. We briefly describe comorbidities that remit to varying degrees after surgery but in whom data on re-emergence is lacking and is needed. We further discuss the factors that impact the re-emergence of comorbidities and medical interventions that may prevent weight regain which is the chief factor modifying their evolution. We also recommend strategies that may help to prevent the re-emergence of comorbidities.

## 22.2 Mental Health Disorders

Mental health evaluation and diagnosis of pre-existing psychological and psychiatric comorbidities are mandatory prior to performing any bariatric surgery, many of which are ameliorated by the surgery. Depression improves after surgery [1] and may lead to lasting improvements in cognition [2].

Anecdotal evidence exists that alcohol and substance abuse disorders increase after bariatric surgery. King et al. [3] conducted the first prospective multicentre cohort study on the prevalence of these disorders before and after bariatric surgery. In this cohort, the prevalence of alcohol use disorder (AUD) was greater in the second postoperative year (9.6%) than the year prior to surgery (7.6%) or in the first postoperative year (7.3%). It was associated with male sex, younger age, smoking, regular alcohol consumption, recreational drug use, and lower interpersonal support, and undergoing RYGB versus laparoscopic adjustable gastric banding (LAGB) (AOR, 2.07). The authors hypothesized that this increase in AUD was due to an increase in alcohol sensitivity following RYGB combined with the resumption of higher levels of alcohol consumption in the second postoperative year. However, they did not find a significant association between preoperative mental health, depressive symptoms, binge eating, or past-year treatment for psychiatric or emotional problems, poor weight loss or weight regain, and postoperative AUD.

The Longitudinal Assessment of Bariatric Surgery-2 (LABS) was an observational cohort study [4] which conducted assessments pre-surgery, 6 months

post-surgery, and annually post-surgery for up to 7 years. Prevalence of opioid use decreased after surgery from 14.7% (95% CI: 13.3–16.2) at baseline to 12.9% (95% CI: 11.5–14.4) at month 6 but then increased to 20.3%, above baseline levels, as time progressed (95% CI: 18.2–22.5) at year 7.

After bariatric surgery, the prevalence of prescribed opioid analgesic use initially decreased but then increased to surpass baseline prevalence. Studies have shown that drugs, alcohol, and food trigger similar reward responses in the brain, and binge eating can be construed as an "addiction." Alcohol and drugs could substitute for overeating following bariatric surgery.

Several studies have demonstrated that a subgroup of patients after weight loss surgery will develop or redevelop subjective binge or "loss of control" eating, and rarely even self-induced vomiting for weight and shape reasons. deZwaan et al. [5] interviewed a sample of 59 patients in-person who had undergone RYGB about a range of eating behaviors, including binge eating, chewing, and spitting out food, picking at and nibbling food, and nocturnal eating and compensatory behaviors such as vomiting and laxative and diuretic misuse. Subjective bulimic episodes were reported by 25% and vomiting for weight and shape reasons by 12% of the participants, on average, 2 years after surgery. Subjective bulimic episodes were significantly associated with a preoperative binge eating disorder, with more eating-related and general psychopathology after surgery, and with less weight loss. The authors concluded that a substantial subgroup of patients with a preoperative eating disorder will develop binge eating after surgery that might be associated with less weight loss. A subsample will start vomiting for weight and shape reasons after bariatric surgery. This is the classic example of re-emergence of a comorbidity after surgery mainly due to weight loss less than anticipated.

A study [6] examined the clinical significance of the loss of control over eating (LOC) in bariatric surgery over 24 months of prospective multi-wave follow-ups. 361 gastric bypass surgery patients completed a battery of assessments before surgery and at 6, 12, and 24 months following surgery. Prior to surgery, 61% of patients reported LOC; post-surgery, 31% reported LOC at 6-month follow-up, 36% reported LOC at 12-month follow-up, and 39% reported LOC at 24-month follow-up. Postoperative LOC is a prospective predictor of significantly poorer post-surgical weight and psychosocial outcomes at 12- and 24-month following surgery. Thus, after an initial reduction in LOC at 6 months, the behavior worsened by end of 2 year follow-up.

Another study [7] indicated that over 60% of patients who met criteria for binge eating disorder before surgery developed graze eating (i.e., eating small/modest amounts of food continuously throughout the day) after surgery. Graze eating is particularly problematic because the postoperative stomach does not preclude it, and it can contribute to weight regain. Graze eating seems to be an emergent comorbidity to substitute for previous binge eating which is not possible post-surgery.

A systematic review and meta-analysis by Adams et al. [8] suggested that mortality by suicide was significant after bariatric surgery while analyzing all-cause and cause-specific mortality in post-bariatric surgery patients. Backman et al. [9] examined the prevalence of diagnosis and treatment for alcohol and substance use

disorders, depression, and suicide attempts before and after RYGB in a nationwide cohort study in Sweden, compared with that in a large unselected population cohort (who had not undergone bariatric surgery) using several national databases.

Patients who underwent RYGB also had an increased risk of attempted suicide after surgery compared with before. There was no such increase in the reference cohort. The increase in suicides was previously studied by Tindle et al. [10]. Medical data following bariatric operations performed on Pennsylvania residents between 1995 and 2004. About 30% of suicides occurred within the first 2 years following surgery, with almost 70% occurring within 3 years. For every age category except the youngest, suicide rates were higher among men versus women.

Increase in alcohol and substance use, LOC eating, graze eating as well as increase in suicides are early remerging comorbidities within the first 1–2 years post-surgery. Addiction transfer, change in the pharmacokinetics of alcohol post-RYGB, failure to achieve expected weight gain, failure of comorbidities, or quality of life to improve are some of the reasons for these mental health problems.

## 22.3 Type 2 Diabetes Mellitus

A systematic review and meta-analysis published in 2013 by Gloy et al. [11] that included 11 randomized controlled trials (RCTs) ($n$ = 796) in patients with Body Mass Index (BMI) between 30 and 52 kg/m$^2$ found that surgeries including RYGB, LAGB, SG, and Biliopancreatic diversion (BPD) result in greater remission of type 2 diabetes mellitus (T2DM) [Relative Risk (RR) of T2DM remission: 22.1; 95% CI: 3.2–154.3] compared to a variety of non-surgical treatment options.

## 22.4 Diabetes Relapse

Observational studies show that the sustainability of the metabolic effects of BS on type 2 diabetes is highly variable.

Using retrospective electronic chart analyses of 4434 patients, Arterburn et al. [12] showed that type 2 diabetes remission occurred in 68% of subjects within 5 years of the surgery. Of these, 35% relapsed within 5 years of initial remission, with a median time to relapse after surgery of 8.3 years. Factors associated with relapse included preoperative HbA1c levels above 6.5%, prior insulin use, and longer duration of type 2 diabetes. Preoperative BMIs did not predict type 2 diabetes remission or relapse and, interestingly, weight regain after RYGB was not a predictor of relapse.

Mingrone et al. [13] studied the durability of the effects of BPD, RYGB, and conventional medical therapy (MT) in 60 patients randomized to one of the three interventions. At 5 years, type 2 diabetes remitted in 37% of patients after RYGB, in 63% after BPD, and in none of the medically treated patients. About 44% of the surgical patients who remitted after 2 years relapsed by year 5. However, despite the relapse, 80% of the surgical patients were able to maintain HbA1c levels below

7.0% through diet or metformin alone, suggesting good type 2 diabetes control with minimal therapy. In this study, weight changes did not predict type 2 diabetes remission or relapse after surgery.

In the STAMPEDE trial [14], 90% completed the 5-year follow-up. At baseline, HbA1c was 9.2 ± 1.5%, and the mean BMI was 37 ± 3.5. Patients who underwent surgical procedures had a greater mean percentage reduction from baseline in HbA1c level than did patients who received MT alone (2.1% vs. 0.3%, $P = 0.003$). At 5 years, changes from baseline observed in the RYGB and SG groups were superior to the changes seen in the MT group with respect to body weight (−23%, −19%, and −5% in the RYGB, SG, and MT groups, respectively), triglyceride level (−40%, −29%, and −8%), high-density lipoprotein cholesterol level (+32%, 30%, and 7%), use of insulin (−35%, −34%, and −13%) ($P < 0.05$ for all comparisons).

In the 7 year outcome of the LABS (Longitudinal study of Bariatric Surgery) study [15], of 2348 participants, 1738 underwent RYGB (74%) and 610 underwent LAGB (26%). Among those with diabetes at baseline (RYGB [28%]; LAGB [29%]), the proportion in remission at 1, 3, 5, and 7 years were 70%, 70%, 65% and 60%, respectively, for RYGB and 31%, 30%, 30%, and 20% for LAGB. The incidence of diabetes at all follow-up assessments was less than 1.5% for RYGB. After both procedures, greater post-surgical weight loss was associated with remission. However, even after controlling for differences in the amount of weight lost, relative diabetes remission rates remained nearly twofold higher after RYGB than LAGB.

Overall, these studies show a high rate of type 2 diabetes remission after BPD and RYGB as compared with SG. Relapse usually occurs in 5 years or later. The risk factors for relapse of type 2 diabetes after BS are indicators of low beta-cell function: longer duration of type 2 diabetes, insulin use, poor diabetes control, and higher preoperative A1C levels. In addition, less weight loss after surgery and/or greater weight regain have been associated with diabetes relapse in some but not all studies.

Given the progressive nature of type 2 diabetes and its increased rate with aging, it is not entirely surprising that diabetes relapse occurs after BS. By inducing sustained weight loss, these procedures significantly improve diabetes control and appear to alter the trajectory of the disease without resulting in a permanent cure. Type 2 diabetes after BS seems to return in a less severe form, and patients require less insulin and fewer oral medications to achieve control.

## 22.5 Comorbidities That Remit After Bariatric Surgery

Obesity is an established risk factor for various cardiovascular disease and bariatric surgery not only leads to substantial weight loss but also the remission of cardiovascular disease (CVD) risk factors like diabetes mellitus, dyslipidaemia, and hypertension. It seems almost intuitive that bariatric surgery not only reduces overall CV mortality by almost 50% but reduces the incidence of myocardial infarction and stroke by 30% [16].

It does not mean there will be no cardiovascular events or deaths after bariatric surgery. There is a persistent residual risk of heart disease and death in spite of weight loss. This is probably because cardiovascular disease is a multifactorial in nature and some of these factors are non-modifiable like gender and heredity while some factors like smoking may have residual effect in spite of discontinuation. It is thus not possible to classify CV disease as re-emergent or persistent.

In the recent GATEWAY trial [17], 100 patients with obesity and hypertension (the majority of whom did not have diabetes mellitus) were randomized to gastric bypass or medical therapy alone. Patients randomized to gastric bypass were six times more likely to reduce ≥30% of the total number of antihypertensive medications while maintaining controlled blood pressure levels. In addition, 51% of the patients submitted to gastric bypass showed remission of hypertension in post-hoc analysis. However, there is no data available on the re-emergence of hypertension once it has remitted post-surgery.

The type of surgery was the strongest independent predictor for all lipid level improvements or remissions in a study by Spivak et al. [18] Normal total cholesterol (TC) levels of below 200 mg/dL and low density lipoproteins (LDL) were achieved by 76% post-RYGB patients compared with 43.5% post-SG patients (odds ratio [OR] = 6.24, 95% confidence interval [CI]: 3.69–10.53) and 25.6% post-LABG patients (OR = 9.66, 95% CI: 4.11–22.67; $P < 0.01$).The levels of high-density-lipoprotein cholesterol (HDL) were most improved post-SG, reaching normal levels in 58.1% of SG male patients versus 39.5% of RYGB male patients (OR = 1.56, $P = 0.02$). The lowering of triglyceride levels by approximately 75% was comparable after SG and RYGB procedures. There is no data on the re-emergence of dyslipidaemia and the need for restarting statin therapy after bariatric surgery in those who have remitted post-surgery.

In a study [19] reporting the resolution of metabolic syndrome (MetS) post-RYGB in 3795 patients, MetS was diagnosed in 60% of the predominantly (80%) female patients. At baseline, 28% of patients had impaired glucose metabolism, 40% hypertension, and 30% dyslipidaemia.

Postoperative follow-up rate after 5 years was 70%. The authors found that 86% had resolution of MetS. After 5–9 years, complete remission of type 2 diabetes was achieved in 78%, hypertension in 51%, and dyslipidaemia in 89%. Elevated uric acid levels also reduce by 50% after surgery [20]. There is no data that addresses the re-emergence of metabolic syndrome per se after remission.

Obstructive sleep apnea (OSA) is a highly prevalent disorder in obese patients and has strong association with increase in cardiovascular mortality and other metabolic abnormalities. In a prospective multicentre study [21], the prevalence of OSA decreased from 71% at baseline to 44% at 12 months after surgery ($P < 0.001$). OSA was cured in 45% and cured or improved in 78% of the patients. But moderate or severe OSA still persisted in 20% of the patients after the operation, probably as factors other than weight alone play a role in the development of OSA.

However, de novo OSA occurred in 8% of the patients at the end of 12 months which may actually signal an early re-emergence of this comorbidity.

In severely obese patients submitted to bariatric surgery, obesity-associated gonadal dysfunction was very prevalent: polycystic ovarian disease (PCOS) was present in 36% of women and male-obesity secondary hypogonadism (MOSH) was present in 64% of men. After bariatric surgery, there was resolution of PCOS in 96% of affected women and the resolution of MOSH occurred in 87% of affected men [22]. No long-term data about re-emergence of PCOS or MOSH in the long term after surgery is available.

Until recently, most of the literature [23] suggested a protective effect of bariatric surgery on cancer incidence and mortality, till the study by Derogar et al. [24]which suggested increase incidence of colorectal cancer after bariatric surgery (RYGB). If this finding is validated in other studies, this would signal an emerging co-morbidity as a result of bariatric surgery. However, in a review of literature of all studies till date, Maestro et al. [25] conceded that the overall cancer risk was reduced after bariatric surgery especially in women, but more appropriately designed studies would be necessary since the existing studies do not reach the highest levels of evidence.

To summarize, there is meaningful reduction, resolution, or prevention of several comorbidities associated with obesity after bariatric surgery but very scarce data on re-emergence of these comorbidities.

## 22.6 Factors That Affect the Re-emergence of Comorbidities

1. Type of surgery
2. Weight regain
3. Delayed surgery
4. Mental health
5. Patient factors
6. Support post-surgery

### 22.6.1 Type of Initial Surgery

The greater the malabsorption in the initial surgery, the greater the remission of metabolic abnormalities and less the chances of relapse or re-emergence of comorbidities. Thus, if degree of malabsorption BPD > RYGB > SG > LAGB follows this sequence, the re-emergence of comorbidities would follow the reverse order—LAGB > SG > RYGB > BPD. Patients undergoing less malabsorptive surgery will require more frequent follow-up in order to detect early re-emergence of comorbidities like diabetes.

A review by Tice et al. [26] comparing RYGB with LAGB finds diabetes resolution in 78% after RYGB and 50% after LAGB. A meta-analysis by Buchwald et al. [27] also echoed the same finding and suggested an average of 78% achieved complete resolution without any anti-diabetic medications. Furthermore, 87% had either diabetes improved or resolved and required fewer anti-diabetic medications

following bariatric surgery and diabetes resolution were greatest for patients undergoing BPD/DS, followed by RYGB, and least for LAGB.

Another meta-analysis by Buchwald and Oien [28] involving 1846 diabetic patients finds diabetes resolution in 99%, 84%, 72%, and 48% patients after BPD/BPD-DS, RYGB, gastroplasty, and gastric banding respectively. A recent meta-analysis by Chang et al. [29] reported an overall diabetes remission of around 90% after bypass surgeries (pooled data of RYGB and BPD) and 70% after gastric banding.

The "perfect" bariatric procedure remains the topic of debate. A study by Wharton et al. [30] evaluated the impact of self-selection of bariatric procedure on weight loss and diabetes remission. After the multidisciplinary team's assessment, the patients could make their own choice of procedures (self-selected, SS), unless medical/surgical conditions limited this (medically restricted, MR). A total of 303 patients were included and 271 of them made their own choice (SS 90%). Self-selected bariatric procedures yield excellent weight loss and metabolic outcome. Providing an information-dense environment augments the choice of the right operation and could improve patients' compliance with weight loss surgery programs.

### 22.6.2 Weight Regain

Weight regain has been seen as a factor in relapse for diabetes mellitus in some but not all studies. Poorer beta-cell function at the time of surgery equally predicts relapse. However, weight regain will also predict the worsening of OSA, osteoarthritis, and PCOS symptomatology. There is little or no data to support these observations frequently seen in clinical practice.

### 22.6.3 Delayed Surgery

Often bariatric surgery is chosen for weight loss after most comorbidities have been present for many years. Thus, advanced knee osteoarthritis, long-standing hypertension, and diabetes (requiring insulin), renal failure (either because of diabetes or hypertension or both) do not resolve.

Long-standing hypertension can cause permanent and irreversible changes in vasculature. Even patients with pheochromocytoma, primary hyperaldosteronism, and acromegaly fail to be cured of hypertension post-surgery when there is a delay in diagnosis and treatment. Similarly, beta-cell exhaustion cannot be overcome by weight loss alone. Renal failure is irreversible and will mandate renal replacement therapy.

### 22.6.4 Patient Selection

This is probably the most important predictor of re-emergence of comorbidities. Patients with unresolved mental health issues, dependence on alcohol or smoking,

depression would be less likely to comply with Health care practitioner (HCP) recommendations for follow-up visits, lifestyle modifications, and nutritional supplementation. This would in turn result in poorer weight loss, greater weight regain, and re-emergence of comorbidities.

### 22.6.5 Mental Health

A paper by Meany et al. [31] reviewed the data on the development of binge eating (BE), binge eating disorder (BED), and loss of control (LOC) eating after bariatric surgery and the impact of these problems on long-term weight outcome. Fourteen of the available 15 studies suggest that the development of problems with BE, BED, or LOC eating post-bariatric surgery is associated with less weight loss and/or more weight regain post-bariatric surgery. These data suggests that it is important to identify individuals at high risk for these problems, to follow them post-operatively, and if appropriate interventions can be developed if such behaviors occur in order to maximize weight loss outcomes.

A systematic review on psychosocial predictors of success following bariatric surgery [32] found greater success in patients who are young and female, and have a high self-esteem, good mental health, a satisfactory marriage, and high socioeconomic status, who are self-critical and cope in a direct and active way, are not too obese, were obese before the age of 18, suffer from and are concerned about their obesity, have realistic expectations and undisturbed eating behaviors.

Conceição et al. [33] reported three cases where eating disorder developed anew after bariatric surgery. These case reports suggest that gastric restriction and requirements after surgery may create conditions that trigger eating disordered-like symptoms The following factors may contribute to this effect: the rapid weight loss; food restriction and even vomiting that are considered to be normal in the post-surgery period; the ritualized eating and rigorous eating schedule required at post-surgery; patients will get frequent reminders of the importance of controlling food ingestion to prevent the weight regain. All these conditions may make patients susceptible to a pattern of extreme control and rigid dietary rules. Ultimately, malnutrition and inadequate intake may help maintain the problem. The number of eating disorders that develop after bariatric surgery, particularly partial cases, is probably underreported.

### 22.6.6 Patient Continued Healthcare/Support Group Contact

Patients undergoing bariatric surgery need ongoing support in numerous ways even after surgery for nutrition, exercise, etc. Other unresolved comorbidities also require ongoing care like knee osteoarthritis, obstructive sleep apnea, chronic kidney disease.

A significant linear relationship was found between support group meeting attendance and the percentage of excess weight loss with simple regression analysis

(adjusted $R^2$ 0.061, $P$ 0.007), with age (adjusted $R^2$ 0.100, $P$ 0.002) and the baseline body mass index added to the model (adjusted $R^2$ 0.072, $P$ 0.011) in a group of 102 patients [34], predominantly women with mean BMI of 46 kg/m$^2$.

The challenge is getting patients to maintain contact. A nationwide cohort study in France [35] aimed to assess 5 year follow-up post-bariatric surgery. Some 16,620 patients were included in the study. The percentage of patients with one or more visits to a surgeon decreased between the first and fifth years, from 87 to 29% ($P < 0.001$); similar decreases were observed for visits to a nutritionist/endocrinologist (from 23 to 12%; $P < 0.001$) or general practitioner (from 93 to 83%; $P < 0.001$). The mean number of visits to a general practitioner was 7 and 6 in the first and fifth years, respectively.

In multivariable analyses, male sex, younger age, absence of type 2 diabetes, and poor 1-year follow-up were predictors of poor 5-year follow-up. This suggests that re-emergence of many comorbidities may be underreported as a result of this poor follow-up.

## 22.7 Prevention of Re-emergence of Comorbidities

Three key factors impact the risk of re-emergence of comorbidities—mental health and weight regain.

1. *Continued Contact with Mental Health Professional*: As alcohol use disorders and depression re-emerge as early as 3 years post-bariatric surgery, identifying and treating these conditions is imperative. This will necessitate visits with qualified mental health professionals not only in the immediate post-bariatric surgery setting but for the foreseeable future. It will also ensure that patients comply with post-bariatric surgery treatment recommendations like regular healthcare contact and nutritional recommendations to avoid complications ensuing from the surgery.
2. *Avoiding Weight Regain*: Reappearance of metabolic syndrome and diabetes mellitus is influenced by weight regain. Continuance of adherence to lifestyle modification with regular exercise, consistent healthy diet will greatly mitigate weight regain. This in turn necessitates long-term follow-up and consistent contact with health care personnel to ensure this.
3. *Continuing Care in MDT Setting*: Most guidelines strongly recommend performing surgery in MDT setting. In response to the growing popularity of bariatric surgery in France, the HAS issued guidelines in January 2009 with a view to monitoring this activity and preventing unnecessary surgery. These guidelines recommended the establishment of MDT meetings attended by obesity specialists, in order to (1) validate or refuse bariatric surgery, (2) define preoperative management, if required, and (3) simply check that the patients satisfied the criteria for surgical treatment of obesity.

   There exist other best practice guidelines which define very clearly what constitutes an MDT and describes in detail what needs to be done both preoperatively and postoperatively. However, very little is said about long-term fol-

low-up, documentation of comorbidity resolution and relapse and mental health evaluations postoperatively.

In a national survey in the USA [36], although 95% of respondents reported using a multidisciplinary team, only 53% had a general physician, nutritionist, and mental health specialist (NIH-recommended team). Just 47% mandated primary care, nutrition, and mental health evaluations (NIH-recommended evaluations). The authors concluded that inconsistent and unpredictable patterns of multidisciplinary methods were found. Further research should explore the impact of different methods on outcomes.

Compliance with a multidisciplinary team meeting's decision prior to bariatric surgery protects against major postoperative complications. Rebibo et al. [37] found that following the introduction of MDT meetings, although the overall complication rate remained similar, the major complication rate and the reoperation rate decreased (5.8% vs. 3.2%; $P \leq 0.05$) with no deaths following the implementation of MDT meetings. However, again the paper failed to discuss what should be done by MDT for long-term monitoring and follow-up and whether the MDT has any role in the reduction of weight regain, what is the impact on mental health outcomes and impact on resolution and relapse of comorbidities.

A bariatric surgery performed without inputs from nutritionist, endocrinologist, psychologist, and psychiatrist carries a risk of poor resolution and early re-emergence of comorbidities as the patient selection may be faulty, and unresolved eating disorders, depression, and more severe psychiatric comorbidities may be missed.

Our recommendation is that bariatric surgery should not be performed outside of the multidisciplinary team approach setting. This would ensure consistency of care. However, this may not always be done in practice.

## 22.8 Weight Regain and Liraglutide

In the context of preventing or treating weight regain, we discuss in brief the use of Liraglutide for the same. Phentermine-Topiramate is not available in many countries such as ours (India), and Lorcaserin was recently withdrawn from the market in view of the suspected increase in cancer risk and Orlistat is minimally effective.

There is limited data which is mostly retrospective. Recent prospective studies available were designed with the primary objective being the treatment of Type 2 diabetes mellitus not treatment of weight regain per se but give us some insight on weight loss that can be achieved with the use of Liraglutide.

A retrospective study from UAE by Alameri et al. reviewed 59 patients who were given Liraglutide. Seven patients discontinued the medication (five due to nausea and vomiting and two due to pregnancy). Mean weight at Liraglutide initiation (0.6–3.0 mg/day) was 95.1 ± 13.3 kg and mean BMI of 36.9 ± 4.4 kg/m$^2$. After 3 months, mean weight and BMI reduction were 5.4 ± 9.8 kg and 1.3 ± 1.1 kg/m$^2$ respectively ($P < 0.01$).

Rye et al. [38] performed a retrospective chart review of 33 consecutive patients, aged 18–65, who received Liraglutide for weight loss in the setting of any previous bariatric surgery. Indications were weight recidivism (>10% weight regain from the lowest post-surgical weight), inadequate weight loss (<20% weight loss from initial clinic assessment, or pre-surgical weight if unavailable), and plateau (patient desires further weight loss but does not fit into either other category). At 16 weeks median percentage weight loss was 7.1%, and at 28 weeks 9.7%. Median BMI change was 3.5 kg/m$^2$ (16 weeks) and 4.7 kg/m$^2$ (28 weeks). There were no major adverse events.

GRAVITAS [39] was a randomized double-blind, placebo-controlled trial that enrolled adults who had undergone Roux-en-Y gastric bypass or vertical sleeve gastrectomy and had persistent or recurrent type 2 diabetes with HbA1c levels higher than 6.5% at least 1 year after surgery. Participants were randomly assigned to either subcutaneous liraglutide 1.8 mg once daily or placebo, both given together with a reduced-calorie diet, aiming for a 500 kcal/day deficit from baseline energy intake, and increased physical activity.

Significant improvements in body weight from baseline in the liraglutide group were already apparent at week 6 (–2 · 38 kg) and this weight reduction trend continued through weeks 10 (–3 · 71 kg, weeks 18 (–4 · 46 kg), and 26 (–5 · 26 kg), with no apparent plateauing of effect. Overall, 46% in the liraglutide group lost 5% or more of their baseline body weight, 15% lost 10% or more of their baseline body weight, and 4% lost 15% or more. The proportion of patients in the liraglutide group with weight loss of 5% or greater steadily increased: 17% at week 6, 33% at week 10, 38% at week 18, and 46% at week 26.

One hundred seventeen post-bariatric surgery patients from the Wharton Medical Clinic [40] were analyzed for changes in weight while taking Liraglutide 3.0 mg were examined post-bariatric surgery (Roux-en-Y gastric bypass—45%, gastric banding—43%, and gastric sleeve—22%). Over 7.6 ± 7.1 months taking liraglutide 3.0 mg, patients lost a statistically significant amount of weight (−6.3 ± 7.7 kg, $P < 0.05$) regardless of the type of surgery they had ($P > 0.05$). This decrease in weight remained significant after 1-year of taking liraglutide 3.0 mg ($P < 0.05$). Nausea was the most prevalent side effect, reported by 29.1% patients. While options for excess weight management in post-bariatric surgery patients are limited, the results of this study suggest that post-bariatric surgery patients can lose a significant amount of weight while taking liraglutide 3.0 mg regardless of the type of surgery they had. Further, similar to non-surgical populations, post-bariatric surgery patients taking liraglutide 3.0 mg may experience gastrointestinal side effects such as nausea and can continue to lose weight for up to 1 year.

**Key Points**

1. *Psychological issues are amongst the earliest comorbidities to re-emerge after BS.*
2. *The major late comorbidity to re-emerge is diabetes mellitus, often in a less severe form than the original disease.*
3. *Certain diseases like Hypertension, dyslipidemia, OSA, PCOS & MOSH improve post-bariatric surgery but may not resolve completely and there is limited research available regarding their re-emergence post BS.*

4. *In case of cardiovascular and renal disease, there may be irreversible damage to vasculature that precludes remission.*
5. *The relationship between weight regain and re-emergence of comorbidities is complex and not as yet fully elucidated.*

## References


1. de Zwaan M, Enderle J, Wagner S, et al. Anxiety and depression in bariatric surgery patients: a prospective, follow-up study using structured clinical interviews. J Affect Disord. 2011;133(1–2):61–8. https://doi.org/10.1016/j.jad.2011.03.025.
2. Alosco ML, Galioto R, Spitznagel MB, et al. Cognitive function after bariatric surgery: evidence for improvement 3 years after surgery. Am J Surg. 2014;207(6):870–6. https://doi.org/10.1016/j.amjsurg.2013.05.018.
3. King WC, Chen J-Y, Mitchell JE, et al. Prevalence of alcohol use disorders before and after bariatric surgery. JAMA. 2012;307(23) https://doi.org/10.1001/jama.2012.6147.
4. King WC, Chen J-Y, Belle SH, et al. Use of prescribed opioids before and after bariatric surgery: prospective evidence from a U.S. multicenter cohort study. Surg Obes Relat Dis. 2017;13(8):1337–46. https://doi.org/10.1016/j.soard.2017.04.003.
5. de Zwaan M, Hilbert A, Swan-Kremeier L, et al. Comprehensive interview assessment of eating behavior 18–35 months after gastric bypass surgery for morbid obesity. Surg Obes Relat Dis. 2010;6(1):79–85. https://doi.org/10.1016/j.soard.2009.08.011.
6. White MA, Kalarchian MA, Masheb RM, Marcus MD, Grilo CM. Loss of control over eating predicts outcomes in bariatric surgery patients: a prospective, 24-month follow-up study. J Clin Psychiatry. 2010;71(02):175–84. https://doi.org/10.4088/JCP.08m04328blu.
7. Pizato N, Botelho P, Gonçalves V, Dutra E, de Carvalho K. Effect of grazing behavior on weight regain post-bariatric surgery: a systematic review. Nutrients. 2017;9(12):1322. https://doi.org/10.3390/nu9121322.
8. Adams TD, Mehta TS, Davidson LE, Hunt SC. All-cause and cause-specific mortality associated with bariatric surgery: a review. Curr Atheroscler Rep. 2015;17(12):74. https://doi.org/10.1007/s11883-015-0551-4.
9. Backman O, Stockeld D, Rasmussen F, Näslund E, Marsk R. Alcohol and substance abuse, depression and suicide attempts after Roux-en-Y gastric bypass surgery. Br J Surg. 2016;103(10):1336–42. https://doi.org/10.1002/bjs.10258.
10. Tindle HA, Omalu B, Courcoulas A, Marcus M, Hammers J, Kuller LH. Risk of suicide after long-term follow-up from bariatric surgery. Am J Med. 2010;123(11):1036–42. https://doi.org/10.1016/j.amjmed.2010.06.016.
11. Gloy VL, Briel M, Bhatt DL, et al. Bariatric surgery versus non-surgical treatment for obesity: a systematic review and meta-analysis of randomised controlled trials. BMJ. 2013;347:f5934. https://doi.org/10.1136/bmj.f5934.
12. Arterburn DE, Bogart A, Sherwood NE, et al. A multisite study of long-term remission and relapse of type 2 diabetes mellitus following gastric bypass. Obes Surg. 2013;23(1):93–102. https://doi.org/10.1007/s11695-012-0802-1.
13. Mingrone G, Panunzi S, De Gaetano A, et al. Bariatric surgery versus conventional medical therapy for type 2 diabetes. N Engl J Med. 2012;366(17):1577–85. https://doi.org/10.1056/NEJMoa1200111.
14. Schauer PR, Bhatt DL, Kirwan JP, et al. Bariatric surgery versus intensive medical therapy for diabetes — 5-year outcomes. N Engl J Med. 2017;376(7):641–51. https://doi.org/10.1056/NEJMoa1600869.
15. Courcoulas AP, King WC, Belle SH, et al. Seven-year weight trajectories and health outcomes in the longitudinal assessment of bariatric surgery (LABS) study. JAMA Surg. 2018;153(5):427–34. https://doi.org/10.1001/jamasurg.2017.5025.
16. Sjöström L, Peltonen M, Jacobson P, et al. Bariatric surgery and long-term cardiovascular events. JAMA. 2012;307(1):56. https://doi.org/10.1001/jama.2011.1914.

17. Schiavon CA, Bersch-Ferreira AC, Santucci EV, et al. Effects of bariatric surgery in obese patients with hypertension: the GATEWAY randomized trial (gastric bypass to treat obese patients with steady hypertension). Circulation. 2018;137(11):1132–42. https://doi.org/10.1161/CIRCULATIONAHA.117.032130.
18. Spivak H, Sakran N, Dicker D, et al. Different effects of bariatric surgical procedures on dyslipidemia: a registry-based analysis. Surg Obes Relat Dis. 2017;13(7):1189–94. https://doi.org/10.1016/j.soard.2017.03.013.
19. Shah K, Johnny Nergard B, Stray Frazier K, Geir Leifsson B, Aghajani E, Gislason H. Long-term effects of laparoscopic Roux-en-Y gastric bypass on metabolic syndrome in patients with morbid obesity. Surg Obes Relat Dis Off J Am Soc Bariatr Surg. 2016;12(8):1449–56. https://doi.org/10.1016/j.soard.2016.03.017.
20. Maglio C, Peltonen M, Neovius M, et al. Effects of bariatric surgery on gout incidence in the Swedish Obese Subjects study: a non-randomised, prospective, controlled intervention trial. Ann Rheum Dis. 2017;76(4):688. https://doi.org/10.1136/annrheumdis-2016-209958.
21. Peromaa-Haavisto P, Tuomilehto H, Kössi J, et al. Obstructive sleep apnea: the effect of bariatric surgery after 12 months. A prospective multicenter trial. Sleep Med. 2017;35:85–90. https://doi.org/10.1016/j.sleep.2016.12.017.
22. Escobar-Morreale HF, Santacruz E, Luque-Ramírez M, Botella Carretero JI. Prevalence of 'obesity-associated gonadal dysfunction' in severely obese men and women and its resolution after bariatric surgery: a systematic review and meta-analysis. Hum Reprod Update. 2017;23(4):390–408. https://doi.org/10.1093/humupd/dmx012.
23. Adams TD, Stroup AM, Gress RE, et al. Cancer incidence and mortality after gastric bypass surgery. Obes Silver Spring Md. 2009;17(4):796–802. https://doi.org/10.1038/oby.2008.610.
24. Derogar M, Hull MA, Kant P, Östlund M, Lu Y, Lagergren J. Increased risk of colorectal cancer after obesity surgery. Ann Surg. 2013;258(6):983–8. https://doi.org/10.1097/SLA.0b013e318288463a.
25. Maestro A, Rigla M, Caixàs A. Does bariatric surgery reduce cancer risk? A review of the literature. Endocrinol Nutr Engl Ed. 2015;62(3):138–43. https://doi.org/10.1016/j.endoen.2014.12.005.
26. Tice JA, Karliner L, Walsh J, Petersen AJ, Feldman MD. Gastric banding or bypass? A systematic review comparing the two most popular bariatric procedures. Am J Med. 2008;121(10):885–93. https://doi.org/10.1016/j.amjmed.2008.05.036.
27. Buchwald H, Estok R, Fahrbach K, et al. Weight and type 2 diabetes after bariatric surgery: systematic review and meta-analysis. Am J Med. 2009;122(3):248–256.e5. https://doi.org/10.1016/j.amjmed.2008.09.041.
28. Buchwald H, Oien DM. Metabolic/bariatric surgery worldwide 2011. Obes Surg. 2013;23(4):427–36. https://doi.org/10.1007/s11695-012-0864-0.
29. Chang S-H, Stoll CRT, Song J, Varela JE, Eagon CJ, Colditz GA. The effectiveness and risks of bariatric surgery: an updated systematic review and meta-analysis, 2003-2012. JAMA Surg. 2014;149(3):275–87. https://doi.org/10.1001/jamasurg.2013.3654.
30. Wharton S, Serodio K, VanderLelie S. Morbidly obese patients self select bariatric surgery regardless of EOSS stage. Can J Diabetes. 2015;39:S73. https://doi.org/10.1016/j.jcjd.2015.01.274.
31. Meany G, Conceição E, Mitchell JE. Binge eating, binge eating disorder and loss of control eating: effects on weight outcomes after bariatric surgery. Eur Eat Disord Rev. 2014;22(2):87–91. https://doi.org/10.1002/erv.2273.
32. van Hout GCM, Verschure SKM, Van Heck GL. Psychosocial predictors of success following bariatric surgery. Obes Surg. 2005;15(4):552–60. https://doi.org/10.1381/0960892053723484.
33. Conceição E, Vaz A, Bastos AP, Ramos A, Machado P. The development of eating disorders after bariatric surgery. Eat Disord. 2013;21(3):275–82. https://doi.org/10.1080/10640266.2013.779193.
34. Kaiser KA, Franks SF, Smith AB. Positive relationship between support group attendance and one-year postoperative weight loss in gastric banding patients. Surg Obes Relat Dis. 2011;7(1):89–93. https://doi.org/10.1016/j.soard.2010.07.013.

35. Thereaux J, Lesuffleur T, Païta M, et al. Long-term follow-up after bariatric surgery in a national cohort. BJS. 2017;104(10):1362–71. https://doi.org/10.1002/bjs.10557.
36. Santry HP, Chin MH, Cagney KA, Alverdy JC, Lauderdale DS. The use of multidisciplinary teams to evaluate bariatric surgery patients: results from a national survey in the U.S.A. Obes Surg. 2006;16(1):59–66. https://doi.org/10.1381/096089206775222096.
37. Rebibo L, Maréchal V, De Lameth I, et al. Compliance with a multidisciplinary team meeting's decision prior to bariatric surgery protects against major postoperative complications. Surg Obes Relat Dis. 2017;13(9):1537–43. https://doi.org/10.1016/j.soard.2017.05.026.
38. Rye P, Modi R, Cawsey S, Sharma AM. Efficacy of high-dose liraglutide as an adjunct for weight loss in patients with prior bariatric surgery. Obes Surg. 2018;28(11):3553–8. https://doi.org/10.1007/s11695-018-3393-7.
39. Miras AD, Pérez-Pevida B, Aldhwayan M, et al. Adjunctive liraglutide treatment in patients with persistent or recurrent type 2 diabetes after metabolic surgery (GRAVITAS): a randomised, double-blind, placebo-controlled trial. Lancet Diabetes Endocrinol. 2019;7(7):549–59. https://doi.org/10.1016/S2213-8587(19)30157-3.
40. Wharton S, Kuk JL, Luszczynski M, Kamran E, Christensen RAG. Liraglutide 3.0 mg for the management of insufficient weight loss or excessive weight regain post-bariatric surgery. Clin Obes. 2019;9(4) https://doi.org/10.1111/cob.12323.