



## Review

## Follow-up after bariatric surgery: A review

Geir Bjørklund <sup>a,\*</sup>, Yuliya Semenova M.D., Ph.D. <sup>b,c</sup>, Lyudmila Pivina M.D., Ph.D. <sup>b,c</sup>,  
Daniel-Ovidiu Costea M.D., Ph.D. <sup>d,e</sup>

<sup>a</sup> Council for Nutritional and Environmental Medicine (CONEM), Mo i Rana, Norway

<sup>b</sup> Semey Medical University, Semey, Kazakhstan

<sup>c</sup> Council for Nutritional and Environmental Medicine Kazakhstan Environmental Health and Safety Research Group, Semey Medical University, Semey, Kazakhstan

<sup>d</sup> Faculty of Medicine, Ovidius University of Constanta, Constanta, Romania

<sup>e</sup> 1st Surgery Department, Constanta County Emergency Hospital, Constanta, Romania



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## ABSTRACT

Bariatric surgery is becoming increasingly popular in the treatment of severely obese patients who failed to lose weight with the help of non-surgical interventions. Such patients are at increased risk for premature death, type 2 diabetes, high blood pressure, gallstones, coronary heart disease, dyslipidemia, some cancers, anxiety, depression, and degenerative joint disorders. Although bariatric surgery appears to be the most effective and durable treatment option for obesity, it is associated with a number of surgical and medical complications. These include a range of conditions, of which dumping syndrome and malnutrition due to malabsorption of vitamins and minerals are the most common. To achieve better surgery outcomes, a number of postsurgical strategies must be considered. The aim of this review was to describe possible complications, ailments, and important moments in the follow-up after bariatric surgery. Adequate lifelong monitoring is crucial for the achievement of long-lasting goals and reduction of post-bariatric complications.

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## Introduction

Bariatric surgery can be a treatment option for sickly obese patients who have not succeeded with the medical treatment of obesity [1]. Such patients are at increased risk for premature death, type 2 diabetes, high blood pressure, gallstones, coronary heart disease, dyslipidemia, some cancers, anxiety, depression, and degenerative joint disorders [2]. However, patients with additional diseases, such as severe respiratory failure, heart failure, or kidney failure, may not be approved for surgical treatment if the risk for complications is considered high. Also, patients with severe mental illness, intoxication, or mental retardation may be unsuitable candidates for obesity surgery [3].

Patients who are severely obese may benefit from non-surgical management that induces cardiometabolic effects. The currently recommended weight loss goal is 5% to 10% of the patient's initial

weight in 6 mo [4]. However, bariatric surgery presents the most effective and durable treatment option for obesity. These procedures provide significant and lasting weight reduction, improve somatic and mental obesity-related diseases and quality of life (QoL), and reduce long-term mortality. In conjunction with dietary, behavioral, and lifestyle changes, bariatric surgery could become an effective tool in obtaining an optimal body weight [5].

Currently, bariatric surgery is recommended for severely obese patients with a body mass index (BMI) >40 kg/m<sup>2</sup>, who failed to benefit from previous dietary modifications and non-surgical treatment options. Alternatively, bariatric surgery may be suggested for individuals presenting with a BMI ≥35 kg/m<sup>2</sup> but with obesity-related comorbid conditions [6]. Moreover, the International Diabetes Federation proposed to recommend bariatric surgery to patients with type 2 diabetes mellitus (T2DM) having suboptimal blood glucose control on a background of adequate medical therapy even though their BMI might be 30 kg/m<sup>2</sup> [7]. Thus, the term *metabolic surgery* has recently evolved to describe interventions targeted to control T2DM and cardiometabolic risk factors [8].

Historically, metabolic surgery appeared in the mid-20th century, and jejunoileal bypass was the first surgical approach [9]. The appearance of the laparoscopic technique helped to improve the

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\*Corresponding author.

E-mail address: [bjorklund@conem.org](mailto:bjorklund@conem.org) (G. Bjørklund).

postoperative course, and the risk for death and severe complications after surgery is now low [10]. However, bariatric surgery can still cause serious complications and several ailments. As there is an emerging pool of data regarding special considerations on post-bariatric care, this review focuses on complications, ailments, and important moments in the follow-up after bariatric surgery.

### Surgical methods

In general, bariatric surgery includes three types of procedures: blocking, restrictive, and mixed. In modern reality, the preference is given to laparoscopic interventions as opposed to open-type procedures [11]. Biliopancreatic diversion, jejunioileal bypass, and endoluminal sleeve constitute the group of blocking procedures, which lead to the blockage of food absorption [12]. In biliopancreatic diversion that is now replaced by the duodenal switch, a part of the stomach is resected, and a smaller stomach is formed [13]. Although jejunioileal bypass is no longer practiced, endoluminal sleeve gained little popularity [8].

Restrictive procedures form another group of bariatric surgical interventions and are targeted to shrinking the stomach size. Several procedures constitute the group of restrictive interventions: vertical banded gastroplasty, adjustable gastric band, sleeve gastrectomy, intragastric balloon, and stomach plication. In an adjustable gastric band, a special silicone band is used to create a small gastric pouch, and the addition or removal of saline helps to adjust its size [14]. In sleeve gastrectomy, surgical removal of the larger portion of the stomach takes place with suturing or stapling of the open edges to permanently reduce the stomach size [15]. Intragastric balloons are placed inside the stomach to decrease the intragastric space and could be left for  $\leq 6$  mo [16]. Stomach plication is, in fact, a type of gastric sleeve except that a sleeve is formed by suturing of the stomach, which helps to preserve its absorption capability [17].

So-called mixed procedures embrace both blockage and restriction of the stomach. This group of surgeries constitutes gastric bypass, sleeve gastrectomy with duodenal switch, and implantable gastric stimulation. Gastric bypass alone constitutes not less than 50% of all obesity operations. This procedure possesses hormonal properties in addition to the restriction of the stomach size [18]. Biliopancreatic diversion with duodenal switching involves resection of stomach with subsequent tubulization to a volume of around 150 mL. As a next stage of the surgery, the stomach is disconnected from the duodenum and connected to the small intestine. Like in the case with gastric bypass, weight loss occurs due to hormonal changes in addition to the restriction of stomach size [19]. Implantable gastric stimulator represents a special device that enables electrical stimulation of the external surface of the stomach. This stimulation is believed to alter the activity of the enteric nervous system with the subsequent feeling of satiety [20].

### Early postoperative period

It is a common practice to place a patient undergoing bariatric surgery in the post-anesthesia care unit after surgery. Following the gastrografin leak test in patients having a nasogastric tube, oral therapy in liquid form is started. Otherwise, the patient gets therapy in tablets or crushed tablets. There is a need to obtain a basic metabolic profile every 12 h within the first 2 d postoperatively and every 24 h within the other 3 d postoperatively [21]. As respiratory problems present a frequent complication within the first few days after bariatric surgery, oxygen is administered by nasal cannula. Patients with serious associated health disorders are at a higher risk for respiratory problems [22].

At the end of the early postoperative period, which normally lasts for the first 2 or 3 d, the patient could be transferred to the inpatient surgical postoperative unit, where he or she is monitored for the presence of an anastomotic leak following gastric bypass or sleeve gastrectomy. If no leaks are present, a clear liquid diet can be started. Such a diet includes clear broth, sugar-free drinks, diluted fruit juices, and/or gelatin desserts. After the gastrointestinal (GI) tract has recovered from the surgery, mashed food is taken for 1 to 2 wk. Such food commonly consists of high-protein, protein shakes, dairy products, and soft meats. Furthermore, it is recommended that patients consume a diet consisting of crispbread, lean dairy products, eggs, fish, chicken, lean and minced meat, and lightly cooked vegetables before returning to a normal diet [23].

At the inpatient surgical postoperative unit, the following care is commonly provided: pain control, wound care, blood pressure monitoring, intravenous infusions to monitor a basic metabolic profile, and pulmonary hygiene. As post-bariatric nausea and vomiting present a frequent complication and are more common in females and non-smokers, certain measures of prophylaxis must be applied. In general, the patients have commonly undergone volume depletion and dehydration as they experience problems with drinking the appropriate amount of fluids due to adaptation to a new gastric volume [24].

### Recommendations after hospital discharge

Typically, at the time of discharge, it is recommended that patients follow a full liquid diet and monitor their hydration and urine production. During the first month postsurgery, the recommended daily calorie intake ranges from 400 to 800 kcal, which are mostly achieved by the reduction of daily glycemic load. Also, there is a need to consider the intake of multivitamins as reduced absorption of essential nutrients is very common after bariatric surgery [25]. As both epigastric pain and vomiting may follow every food intake, patients are given instructions on food practices, such as to eat slowly, to stop eating immediately after reaching satiety, and to avoid simultaneous consumption of food and drinks.

Other instructions include maintaining a healthy diet and visiting the dietitian regularly for  $\geq 1$  y after surgery [26]. Additionally, patients are instructed to change their environment as it largely shapes their food habits. If patients become intolerant to certain foods, they are advised to follow a more vegetarian-based diet, as vegetables and fruits are commonly tolerated. In general, it is not rational to recommend a fully vegetarian diet to this category of patients. For example, if the patient is intolerant to meat, there are different alternatives regarding how to cook it in order to make it more tolerable [27]. Also, zero alcohol consumption is recommended within  $\geq 12$  mo [28]. Commonly, the recommended daily protein intake ranges from 1 to 1.5 g/kg of ideal body weight (IBW) [29]. However, those patients who undergo sleeve gastrectomy or gastric bypass require higher daily protein intake in an amount of 1.5 to 2.0 g/kg of IBW [30].

Body weight and blood pressure (BP) monitoring is recommended weekly during the stage of rapid weight loss after bariatric surgery, which commonly lasts for 4 to 6 mo. As the stage of rapid weight loss slows down, BP and body weight should be monitored at 8, 10, and 12 mo postsurgery. Because diabetes mellitus appears to be a frequent comorbidity of obesity, blood glucose levels must be monitored daily in patients with diabetes. Still, it should be noted that glycemic control commonly normalizes very quickly after bariatric surgery. For this reason, the dosage of antihypertensive and diabetic medications need to be adjusted to prevent hypotension and hypoglycemia [23]. However, patients who have achieved normal blood sugar levels and BP postsurgery may have a

recurrence of diabetes and hypertension later. As a result, monitoring of blood sugar levels and BP is necessary both in the weeks after surgery and in subsequent years [31].

After obesity surgery, the uptake and metabolism of several drugs may be altered, and both reduced and increased levels of serum medications may occur [32]. Dose adjustment of medications may, therefore, be necessary. In particular, this applies to pharmaceuticals with a narrow therapeutic window such as warfarin, lithium, and some antiepileptic drugs [33]. Patients suffering from chronic vomiting may be prescribed proton pump inhibitors or prokinetic therapy [34].

### Postoperative ailments

Newly occurring GI disorders may occur  $\geq 50\%$  of patients during the first year post-gastric bypass [3]. The most common complaints are nausea, vomiting, postprandial regurgitation, dumping syndrome, air pain, gastroesophageal reflux, and diarrhea [35]. Some vomiting and postprandial regurgitation in the months after surgery are common and are usually due to the patient eating too much or too fast. This can be described as the food "stopping." Dumping syndrome is common and is likely due to hyperosmolar food, especially sugary drinks and foods, drawing fluid into the small intestine lumen. This leads to a vagal reaction with palpitations, nausea, abdominal pain, lethargy, cold sweating, dizziness, vomiting, and diarrhea that occur within 30 min of food intake.

To prevent GI symptoms after obesity, patients are advised to consume frequent and small protein- and fiber-rich meals, chew their food well, eat slowly, and drink ample meals. Often, yeast baking, pasta, rice, and non-milled meats are poorly tolerated. Most patients eventually adjust to these eating patterns and to the limitations of obesity surgery, and the ailments will often disappear.

Postprandial hypoglycemia, also called late dumping, can occur in  $\geq 7\%$  of patients after gastric bypass and is likely due to insulin hypersecretion. The condition occurs 1 to 3 h after food intake and is characterized by symptoms of low blood sugar. The symptoms may be reminiscent of dumping syndrome. In some patients, this condition could be very severe associated with neuroglycopenia that manifests as altered cognition, loss of consciousness, or even seizures. The main principle of prevention is to eat relatively small and frequent fiber-rich meals and to avoid quickly absorbable carbohydrates [36]. As for the episodes of symptomatic hypoglycemia, oral intake of carbohydrates (10–15 g) could be recommended to relieve the symptoms. When severe neuroglycopenia develops and the patient is unable to consume carbohydrates due to loss of consciousness, a family member may administer glucagon [37].

Other typical postoperative ailments are loss of hair, neuropathies, anemia (and related cold sensation), and poor wound healing. This is most pronounced during the weight reduction phase and usually normalizes as the weight stabilizes. The most common reason for this is micronutrient deficiency, which could be more profound after malabsorptive procedures. Intake of vitamins and minerals could lead to a speedy recovery [38].

### Adjuvant weight loss medications

Although most patients gain from advances in bariatric surgery in terms of weight loss, some patients may experience weight recidivism [39]. The causation of this phenomenon is multifactorial and includes poor compliance with the proposed diet, impaired food behaviors like binge eating or grazing, inadequate physical activity and sedentary lifestyle, physiologic compensatory mechanisms, metabolic imbalances, and even postoperative complications [40]. It should be noted that obesity is a chronic condition,

and thus it might be refractory to treatment in a subset of patients as a result of environmental influences or genetic predisposition. Several options were proposed to solve the issue of weight recidivism, and they cover the whole spectrum of interventions beginning with lifestyle modifications and ending with medical therapy and revisional surgical procedures [5].

In cases when anatomic causes are responsible for weight regain after bariatric surgery, revisional procedures are the best solution [41]. Still, it is worth remembering that they have an increased rate of complications compared with the primary procedures. This is why medical therapy may be proposed to those patients who carry a higher risk for undergoing revisional surgery or are less compliant with lifestyle changes. Phentermine is an appetite suppressant with a good safety profile, and its use started in 1959. Phentermine is prescribed alone or in combination with topiramate, and it results in 12.8 % excess weight loss in patients who have undergone bariatric surgery [42].

Although other weight loss medications like lorcaserin, naltrexone/bupropion, and liraglutide have recently appeared, phentermine is still most commonly prescribed in the United States, perhaps because it is the least expensive [43]. Since 2012, lorcaserin has been marketed under the brand name Belviq on the U.S. market. However, the FDA recently asked its manufacturer to voluntarily withdraw it owing to the potential risk for cancer [44].

There is a significant positive correlation between BMI before bariatric surgery and total weight loss after the use of weight loss medications [45]. Still, many questions regarding a protocol for adjuvant weight loss therapy after bariatric surgery remain unanswered. The range of these questions includes an optimal time for initiation of adjuvant pharmacotherapy, an adequate drug choice, and dosages. Additionally, there is a need to tailor adjuvant pharmacotherapy to the needs of the individual patient and to practice it in conjunction with dietary education and behavioral changes to prevent weight recidivism.

### Vitamin and mineral deficiencies

Obese patients often have low serum vitamin levels even before surgery [46]. Postsurgically decreased absorptive surface area of the GI tract causes micronutrient deficiencies that are more obvious in patients who have undergone gastric bypass, duodenal switch, or sleeve gastrectomy. Moreover, some patients may develop an aversion to specific foods, which further deteriorates their micronutrient status [47]. The following micronutrient deficiencies are most frequently observed: vitamins B<sub>1</sub> (thiamin), B<sub>9</sub> (folate), and B<sub>12</sub> (cobalamin), and D; and trace elements iron, copper, and zinc [48].

Although it is recommended that take vitamin and mineral supplements, micronutrient deficiency is rather common and may even induce clinically significant morbidity [49]. As such, after gastric bypass, 60% to 80% of patients taking only one multivitamin tablet daily become deficient in vitamin B<sub>12</sub>, iron, and vitamin D [50]. As is the case with other major surgical interventions, anemia secondary to iron or vitamin B<sub>12</sub> deficiency is common [51]. The bone density in the hip and thigh is reduced, but it is unclear whether this is a physiologic adaptation to lower body weight or a pathophysiologic process [52]. There is no reliable evidence that obesity surgery increases the risk for fractures [53]. In rare cases, severe thiamine deficiency in the months after obesity surgery can lead to Wernicke encephalopathy [54].

For all these reasons, there is a need to understand which vitamins and micronutrients should be monitored and at which intervals after different types of bariatric interventions. This may help to identify deficiencies at a subclinical stage before they become clinically evident and cause associated health problems. However,

a number of financial issues arise as vitamin assays are not cheap, and interpretation of their results may be rather misleading. Thus, the use of health care resources needs to be balanced in relation to the expected outcomes [55].

Given the dangers of vitamin and mineral deficiencies after surgery, it is recommended that all patients take prophylactic vitamin and mineral supplements. Although a number of guidelines for post-surgical monitoring of patients exist, their recommendations for prophylactic supplementation vary [21,56,57], primarily because of the scarcity of solid evidence in this field. Still, it is quite obvious that patients with several micronutrient deficiencies require more comprehensive follow-up and aggressive case management.

After malabsorptive bariatric interventions, a slow process of adaptation to intestinal malabsorption occurs and is accompanied by an increase of the absorptive surface area of the GI tract [58]. Being responsible for micronutrient absorption, channel proteins, and carrier proteins are produced in higher amounts that may decrease the need for micronutrient supplementation over time [59]. To our knowledge, however, is a lack of long-term studies investigating an increase in micronutrient absorption after post-surgical GI adaptation.

### Physical activity

In those patients who are not considered suitable candidates for bariatric surgery, routine physical exercise is an integral part of a long-term weight reduction program. However, physical activity alone does not result in substantial body weight loss and needs to be supported by food restriction [60]. As for patients who have undergone bariatric interventions, little is known as to whether physical exercise can provide any benefits in terms of additional weight loss, prevention of weight recidivism, and improved health outcomes.

According to different estimates, suboptimal weight loss is observed in 10% to 30% of bariatric surgery patients and high preoperative BMI, older age, T2DM, impairment of cognitive functions, and mental health are the strongest predictors [61,62]. It might be hypothesized that in such a category of patients, physical exercise is an important adjunctive therapy for weight loss. However, a number of intervention studies failed to establish any additional effects of exercise on weight loss in post-bariatric patients [63,64]. Similarly, one study reported an improvement of excess weight loss at 12, but not 36 mo after surgery [65]. This lack of effect on weight loss might be attributed to the strong influence produced by the surgery itself. However, these findings do not exclude the possibility that additional weight loss might be induced by a higher dose/intensity of exercise.

As for the prevention of weight recidivism after bariatric surgery, physical activity has been shown to produce beneficial effects on long-term normalization of body weight subsequent to dietary restrictions [66]. Although the data obtained from National Weight Control Registry demonstrate that moderate-intensity exercise plays a significant role in the maintenance of weight loss [67], there is no evidence to support these findings in the context of bariatric surgery. That is why the question of the importance of physical exercise for weight loss maintenance after obesity surgery remains unanswered.

In addition to depletion of adipose tissue, 31.3% of weight loss after gastric bypass is due to the loss of fat-free mass (FFM) that is composed of skeletal muscles, body organs, and bones [68]. Although clinical effects produced by that loss are not fully understood yet, FFM significantly affects the resting energy expenditure and regulates the core body temperature [69]. For this reason, a loss of FFM may induce weight recidivism in the long term [70]. It was reported that regular physical exercise (30 min of exercise per

session, more than three sessions a week) in post-bariatric patients induced 28% excess loss of adipose tissue and 8% excess gain in skeletal muscle [71].

As for senile post-bariatric patients, a decrease of bone density and depletion of skeletal muscle might significantly deteriorate physical functioning, cause the progression of sarcopenia, and reduce QoL [72]. It has been demonstrated that physical exercise might be particularly effective in the preservation of skeletal muscle in older adults [73] and thus, might prove to be useful in senile post-bariatric patients.

Apart from weight loss, bariatric surgery facilitates a number of positive metabolic changes, including improved glycemic control and insulin sensitivity [74]. Although bariatric surgery enables significant loss of adipose tissue, lean metabolically healthy individuals have better insulin sensitivity [75]. Because lean mass is primarily responsible for glucose utilization after meals, physical activity may play a role in the improvement of peripheral insulin sensitivity after bariatric surgery. This is confirmed by the findings of a randomized controlled trial that demonstrated the potential of moderate aerobic exercise in additional improvements in insulin sensitivity in a cohort of patients who had undergone gastric bypass [64].

### Mental illnesses

Many postbariatric patients present with the symptoms of mental distress before the surgery. For instance, it has been reported that the prevalence of depression and anxiety at the time of preoperative evaluation is around 20% to 60% and 30% to 50%, respectively [76,77]. In general, 16% of patients are considered to be inappropriate candidates for bariatric surgery and are thus referred to psychological counseling. Psychotropic medications are commonly prescribed to candidates for bariatric surgery, and nearly 50% of them receive at least one medication [78]. Antidepressants are being prescribed most frequently, followed by anxiolytics and mood stabilizers [79].

Mental symptoms, eating disorders, and QoL generally improve after obesity surgery, and this change is proportional to weight loss [80]. At the time of a 1-y follow-up, 50% of bariatric patients are no longer taking any psychotropic medication, however, 4% are newly prescribed some antidepressant medication [79]. This implies that few patients free from depression at preoperative evaluation develop it at the time of a 1-y follow-up. This may be due to underdiagnosed and undertreated psychopathology presenting before and after bariatric surgery.

Prescription of antidepressants and psychotropic medication to a patient after bariatric surgery causes special considerations related to intestinal drug absorption and metabolism. This is predisposed by a number of physiologic and pathologic factors induced by surgery, alterations in electrolyte balance, and nutritional status. Also, these patients may have altered drug elimination compared with their preoperative status because of changes in enterohepatic circulation [81].

It is important to be aware that positive psychological effects are often most pronounced in the weight reduction phase and that they can be transient [82]. Inadequate weight loss, failure to lose weight, or early weight loss plateau may predispose bariatric patients to depression and anxiety. In turn, this may provoke the impairment of food behavior and binge eating disorder [83]. Increased incidence of suicide after obesity surgery has been reported [84], and the rates of suicide are 58% higher than those in the control groups. Expressed in terms of per 10 000 persons per year, the postsurgical incidence of suicide ranges from 4.1 to 11.1 [85,86]. Of interest is the fact that around 30% of suicides are observed during the first year of follow-up, and the remaining 70% occur during the 3 y after bariatric

surgery [87]. Thus, patients with serious mental illness may need close postoperative follow-up from local obesity centers, physicians, and psychiatric specialist health services.

### Pregnancy

Women of childbearing potential undergoing obesity surgery are advised to avoid pregnancy before surgery and for the first 12 to 18 mo postoperatively. Because fertility is affected by obesity due to oligo-anovulation and irregular menstrual cycle [88], women should be informed that fertility may increase as a result of weight loss. Apart from preconception, obesity is associated with an increased risk for miscarriage before 20 wk of gestation [89]. Excess body weight also carries elevated risks for maternal, fetal, and neonatal complications, including gestational hypertension, gestational diabetes mellitus, and pre-eclampsia [90], large-for-gestational-age newborn, birth injuries and premature delivery, and neonatal hypoglycemia and hyperbilirubinemia [91].

There are publications that addressed the issue of pregnancy after bariatric surgery in terms of maternal and neonatal outcomes. Although obesity surgery can substantially reduce the incidence of the irregular menstrual cycle by nearly 50% and of polycystic ovary syndrome by close to 40% [92], it is important to maintain an optimal lifelong BMI to preserve fertility. According to a meta-analysis conducted by Milone et al., women with higher presurgical BMIs had lower rates of postsurgical spontaneous pregnancies and the number of kilograms lost did not significantly improve it [93]. As for gestational diabetes mellitus, its rates decrease significantly in post-bariatric pregnant women compared with obese women with no previous bariatric surgery. Also, the rates of pregnancy-related hypertensive disorders and pre-eclampsia decrease significantly in women who have undergone bariatric surgery compared with their obese counterparts [94,95].

There is ample literature reporting neonatal outcomes in post-bariatric pregnancies. The most recent meta-analysis published by Kwong et al. reported significantly reduced rates of large-for-gestational-age infants (odds ratio [OR], 0.31) in post-bariatric women [96]. However, there was a significant increase in small-for-gestational-age infants (OR, 2.16), intrauterine growth restriction (OR, 2.16), and preterm deliveries (OR, 35) compared with women who did not have bariatric surgery. The same meta-analysis failed to establish the differences in rates of stillbirths, admissions to neonatal intensive care unit, congenital malformations, and neonatal death [96]. A significant risk for preterm birth in pregnancies after bariatric surgery was also confirmed by two other meta-analyses [94,95]. Nevertheless, an earlier published large study identified a trend toward a higher combined risk for neonatal mortality and stillbirth in post-bariatric women [97].

Although it is commonly recommended that women should avoid conception during a phase of active weight loss that usually lasts for the first 12 mo postsurgery due to the risks for impaired fetal growth, little is known about those who conceive within this period. Still, no differences in neonatal birth weight, small-for-gestational-age and large-for-gestational-age newborns, prematurity, congenital anomalies, and neonatal intensive care unit admission were reported for women who conceived before and after 12 mo [98]. Nevertheless, a recommendation to ensure a proper follow-up and monitoring for those women who become pregnant after bariatric surgery appears to be reasonable.

### Plastic surgery

Being a common consequence of bariatric surgery, massive weight loss is characterized  $\geq 50\%$  loss of excess weight [99].

Postbariatric patients frequently present with excess skin and loss of skin elasticity that causes many cosmetic issues. Post-bariatric patients may have breast ptosis, upper and mid-back rolls, “deflated” arms, and abdominal “apron.” The newly appeared skin folds lead to intertrigo and skin irritation that often are resistant to medical therapy. This is why these patients represent a challenge to plastic surgeons.

The most suitable candidates for post-bariatric plastic surgery are those who maintain a stable weight for  $\geq 3$  to 6 mo 1 y after the surgery. Although postbariatric patients have a BMI of 25 to 35 kg/m<sup>2</sup>, the commonly used indications for body contouring are BMI <30 kg/m<sup>2</sup>, absence of comorbidities or very few health problems, non-smoking, and realistic expectations considering the possible outcomes [100]. As for realistic expectations after postbariatric contouring procedures, the patients need to realize that they will require a number of surgeries over a period of time and that there will be scars in the places of skinfolds. However, many patients readily accept those limitations in exchange for improved body contours [101].

The abdomen is an area of most common interventions. Liposuction is often done on patients with BMI >30 kg/m<sup>2</sup> as patients presenting with lower BMI may only need skin excision. Apart from the abdominal area, liposuction could be applied to the back, thighs, arms, and neck. As many post-bariatric patients present with abdominal pannus, panniculectomy is one of the frequently performed contouring procedures. Because this procedure does not address flanks, abdominoplasty helps to remodel the entire abdomen, and it could be combined with circumferential procedures if back deformities are also present [102].

Breast ptosis is another consequence of massive weight loss, and mastopexy or breast lift surgery may be performed. Although those patients who preserve excess BMI may benefit from breast reduction, decreased breast volume could be corrected by augmentation with autologous fat or breast implants. In contrast with women, post-bariatric men may benefit from the rejuvenation of the breast as other breast surgeries could be feminizing for them [103]. Because many postbariatric patients present with “wings,” brachioplasty is done to enable an appropriate arm contouring [104]. Perhaps, the most challenging task for a plastic surgeon is to address the remaining adiposity in thighs. Although lateral thigh may be reached during lower body lifting, medial thigh requires a different approach, which resembles brachioplasty [105].

### Provision of post-bariatric services

Several clinical practice guidelines consider the issue of the provision of medical services to post-bariatric patients. A minimum of 2 y of follow-up should be provided at regular intervals by a team of qualified professionals consisting of a surgeon, a dietician, and a nurse. Access to other health care professionals, such as a clinical psychologist, should be provided if needed. Hematologic parameters must be evaluated at each follow-up, in addition to biochemical and nutritional evaluations. The tests must be repeated promptly if any unexpected symptoms are demonstrated [106].

At every visit, a patient’s weight should be checked and recorded, and evaluation of weight-related health problems must be made with a subsequent adaptation of a dosage of previously prescribed medications. Commonly, a surgeon is invited when postsurgical complications, such as a stricture, are suspected [107]. Still, several patient groups require more frequent follow-up. The sample of these could be made of pregnant and breastfeeding women, patients receiving proton pump inhibitors or thyroxine, patients who underwent to duodenal switch surgery, patients with preexisting intestinal disorders, patients with chronic kidney disease or cardiovascular disease, immobile patients or wheelchair

**Table 1**  
Summary of key recommendations after bariatric surgery

Patient care domain	Intervention	Expected outcome
Early postoperative period		
Diet	Clear liquid diet for a short time period Full liquid diet and pureed foods for first 1–2 wk	Prevention of postoperative anastomosis leakage Early return to normal bowel functioning
Medical therapy	Provision of multimodal analgesics Oral therapy in liquid form or crushed tablet	Pain control Prevention of postoperative anastomosis leakage
Medical evaluation	Oxygen administration via nasal cannula Evaluation of basic metabolic profile every 12–24 h within the first 5–7 postoperative days	Prevention of respiratory problems Early identification of any related health problems for timely management
Ambulation	Encouragement of early ambulation	Prevention of venous thromboembolism
Late postoperative period		
Diet and eating behavior	A well-balanced diet with limited intake of carbohydrates and an emphasis on protein sources Monitoring with a qualified dietitian Promotion of healthy eating behavior	Preservation of optimal body weight and bowel functioning. Prevention of obesity recidivism
Micronutrient supplementation	A supplement of vitamins, minerals, and essential trace elements	Prevention and management of deficiency states, and decrease the load of comorbidity
Medical evaluation	Monitoring of physiologic parameters with dosage adjustments of medication Regular checkups by a team of qualified professionals	Prevention of associated morbidity and mortality
Ambulation	Encouragement of routine physical exercise	Preservation of optimal body weight, prevention of sarcopenia
Psychological support	Provision of psychology services	Prevention of mental distress

users, and patients with mental health problems [21]. Because other medical professionals commonly follow such categories of patients, there is a need to establish good communication with them to enable a prompt exchange of information.

Patient support groups are becoming increasingly popular, and post-bariatric peer support is not an exception. Apart from offline meetings, many patients could benefit from visiting online forums and specialized websites [108]. Those patients who are lost from follow-up present a big challenge as the timely evaluation of their health status is jeopardized. Thus, professionals providing post-bariatric services have to make every effort to contact such patients either personally or via a general practitioner.

Many countries established specialized bariatric centers to provide a comprehensive postsurgical follow-up. However, usually after 2 y postsurgery, the patients are discharged to primary care facilities where they receive lifelong monitoring with at least annual checks of their nutritional status and evaluation of obesity-related problems. Both post-bariatric patients and their general practitioners have to be informed about a list of symptoms that would require referral to a specialized bariatric center as they are indicative of late surgical complications [109].

In general, maintaining close contact with a patient is a key aspect of improving patient satisfaction with the quality of medical care provided [110]. In turn, this leads to strengthening the provider–patient relationship and increased adherence to treatment recommendations [111]. Thus, a number of international guidelines were published over the past decade in order to improve the quality of medical services available to post-bariatric patients [1,112–114]. In many ways, these guidelines share similar approaches in specifying different aspects of follow-up after bariatric surgery. Table 1 presents an overview of key recommendations on immediate and long-term postoperative care for bariatric patients.

## Conclusions

At present, bariatric surgery is becoming increasingly popular in the management of patients with severe obesity. Although generally bariatric surgery is safe and effective, certain clinical problems may arise postsurgically and will require special knowledge and skills from the side of medical professionals involved. This

covers a range of preventive, diagnostic, and treatment strategies designed to deliver appropriate care to the post-bariatric patient. A comprehensive post-bariatric follow-up should be provided to all patients regularly as an integral part of their clinical pathway. Perhaps the best approach to the provision of such care is to establish specialized bariatric centers. Still, taking into account the growing number of bariatric patients, the concept of shared care could also be considered. Under this concept, immediately after the early surgical period, a part of post-bariatric care is transferred to general practitioners who, along with obesity specialists and dietitians, monitor a patient's health status. Regardless of the model of care, it is crucial to provide a long-term follow-up and monitoring to all bariatric patients, which will improve surgery outcomes and safety.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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