

Review

The pluses and minuses of bariatric surgery for morbid obesity: An endocrinological perspective

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ABSTRACT

Obesity both in adults and children has emerged as a worldwide epidemic. Obesity is associated with an increased risk of a number of comorbidities including type 2 diabetes mellitus, hypertension, dyslipidemia, obstructive sleep apnea, certain types of cancer, degenerative joint disease, non-alcoholic fatty liver disease, reflux esophagitis, stroke, coronary heart disease, venous stasis ulcers, cholelithiasis, erectile dysfunction and polycystic ovary syndrome. It is now generally accepted that bariatric surgery procedures induce long-term weight loss and offer resolution or dramatic improvement in numerous comorbidities of obesity, including type 2 diabetes mellitus, hypertension and dyslipidemia. These effects mainly arise from endocrine changes resulting from the gastrointestinal surgical procedures. The aim of this short review was to evaluate the pros and cons of bariatric surgery for morbid obesity seen from the perspective of a practicing endocrinologist.

Key words: Bariatric surgery, Hypertension, Obesity comorbidities, Type 2 diabetes mellitus

INTRODUCTION

Hippocrates of the Greek island of Kos was the first in the West to state, in 410 BC, that “obese people die early”. It is now well established that, indeed, obesity augments both morbidity and mortality and it can be used as an independent risk factor for premature mortality.¹⁻³ In the present day, however, obesity has developed into an epidemic of global proportions in adults and children alike and is moreover associated with enhanced risk of multiple comorbidities including type 2 diabetes mellitus, hypertension, dyslipidemia, obstructive sleep apnea, certain types

of cancer, degenerative joint disease, non-alcoholic fatty liver disease, reflux esophagitis, stroke, coronary heart disease, venous stasis ulcers, cholelithiasis, erectile dysfunction and polycystic ovary syndrome.^{4,5} In patients with a very high body mass index (BMI) and in morbidly obese, low calorie diets, lifestyle and behavioral modification, exercise programs and pharmacotherapy in various combinations usually have poor and transient results.⁶ In these cases, bariatric surgery may be the only available effective option for long-term weight loss and for an improvement of metabolic abnormalities such as type 2 diabetes, dyslipidemia and hypertension.⁷ The beneficial effects of bariatric surgery are not only dependent on weight loss but also on the endocrine consequences of the gastrointestinal surgical procedure.^{8,9} It should be noted

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here that even a moderate reduction of body weight may improve insulin sensitivity and the metabolic profile of obese patients with diabetes, impaired glucose tolerance or impaired fasting glucose. Furthermore, there is an improvement of hypertension and of the lipid profile.¹⁰⁻¹² Indeed, long-term weight reduction may result in a decrease in overall mortality.¹³ In this review, the pros and cons of bariatric surgery in relation to its effectiveness and complications will be evaluated from an endocrinological perspective. Proposed criteria for submission to bariatric surgery are provided.

CURRENT GUIDELINES FOR PATIENT SELECTION FOR BARIATRIC SURGERY¹⁴

- BMI >40 kg/m² or BMI 35-40 kg/m² with significant comorbidities (type 2 diabetes, hypertension, sleep apnea, hyperlipidemia)
- Acceptable operational risk
- Documented failure of non-surgical weight loss programs
- Psychologically stable patient with realistic expectations
- Well informed and motivated patient
- Supportive family and social environment
- Absence of uncontrolled psychotic or depressive disorder
- No active alcohol or substance abuse

(National Institutes of Health Consensus 1991, National Heart, Lung and Blood Institute Guidelines 1998).

NON-SURGICAL APPROACH IN TREATING OBESITY

Conventional treatment of high BMI or morbid obesity (caloric restriction, pharmacologic, lifestyle modification, behavioral) usually results in short-term weight loss of approximately 5-10% body weight and, according to several published studies, up to 18.8% within twelve months.^{15,16} Surgical procedures result in weight loss between 50-75% of excess body weight or 20-40 kg of initial body weight and a reduction in

BMI of 10-15 kg/m².^{17,18} Weight loss can be sustained for more or less up to 16 years after surgical procedures compared with the typical weight regain within 6-24 months following conventional treatment.^{16,19-21}

COMMON TYPES OF BARIATRIC SURGERY

Bariatric surgical procedures are divided into three groups: restrictive, malabsorptive and mixed.²² Restrictive procedures reduce the size of the stomach resulting in early satiety and decreased caloric intake. Currently, the most frequently performed restrictive procedures are vertical banded gastroplasty, sleeve gastrectomy and laparoscopic adjustable gastric banding.⁷ Malabsorptive procedures decrease the functional length of the small intestine leading to diminished nutrient absorption.^{23,24} Both techniques are applied simultaneously in mixed procedures. Roux-en-Y and biliopancreatic diversion with duodenal switch have both restrictive and malabsorptive aspects and they are the most effective^{22,24} (Figure 1).

BENEFICIAL EFFECT ON WEIGHT

The mean percentage excess weight loss two years after bariatric surgery, according to a meta-analysis, was 61.2% for all procedures (range: 47.5% for gastric band to 70.1% for biliopancreatic diversion with duodenal switch).¹⁷ Surgical patients appear to decrease their initial body weight from 20 to 30 kg, which is maintained for up to 10 years following bariatric surgery.²⁵ In a study of 1035 surgical patients, the mean initial excess weight loss was 67.1% and was

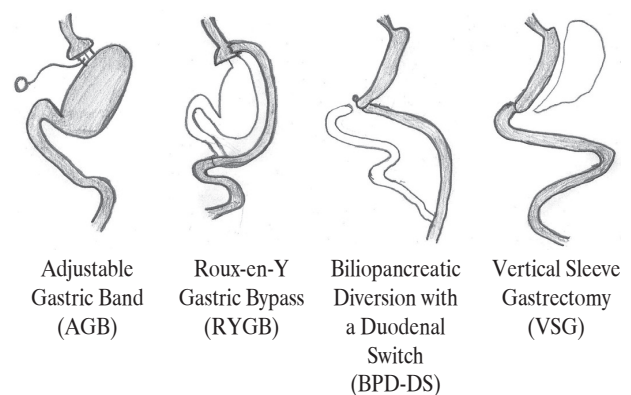


Figure 1. Most common bariatric surgical procedures.

maintained for up to 16 years.¹⁹ One to two years after bariatric surgery procedure (mainly vertical banded gastroplasty and Roux-en-Y gastric bypass), the mean weight loss is maximal, then slowly increases until year 8-10, and thereafter body weight stabilizes.¹³

BENEFICIAL EFFECTS ON MEDICAL CO MORBIDITIES

Beneficial effects of bariatric surgery on diabetes and dyslipidemias

In a meta-analysis of 136 studies and 22,094 patients, diabetes was completely resolved in 76.8% and resolved or improved in 86.0% of the patients. Diabetes mellitus resolution was 48% after laparoscopic gastric banding, 68% after vertical banded gastroplasty, 84% after Roux-en-Y and 98% after biliopancreatic diversion.¹⁷ In another large meta-analysis (621 studies, 135,246 patients), 78.1% of obese diabetics had complete diabetes resolution after a bariatric surgical procedure and 86.6% showed improvement of the disease. Additionally, 95.1% of patients had diabetes resolution after biliopancreatic diversion with duodenal switch, 80.3% after gastric bypass, 79.7% after gastroplasty and 56.7% after laparoscopic adjustable gastric banding.²⁶ Gastrointestinal surgery appears to offer a novel endpoint: complete diabetes remission.²⁷⁻²⁹ Roux-en-Y gastric bypass and a variant of biliopancreatic diversion in 26 and 111 patients with morbid obesity, respectively, was followed by resolution of diabetes in 89% and 99% of the patients up to two years after surgery, respectively.³⁰ Interestingly, euglycemia and normal insulin levels occur within days after surgery, long before there is any significant weight loss.^{31,32} The mechanisms of action of bariatric surgery procedures are the result of endocrine and neural signals that affect appetite and satiety as well as a result of a complex interaction of malabsorption and gastric restriction. All bariatric procedures improve glucose homeostasis, with gastric bypass and biliopancreatic diversion being the fastest and most effective. There are two main hypotheses to explain the acute increase in insulin sensitivity following this type of operations, the Upper and the Lower Intestinal Hypothesis.³³ According to the first, gastric bypass results in reduced secretion of factors such as ghrelin (an orexigenic

hormone) and anti-incretins that decrease insulin release and/or increase insulin resistance. According to the Lower Intestinal Hypothesis, the rapid nutrient delivery to the lower intestine stimulates the L cells resulting in increased secretion of incretins (such as the anorexigenic hormones: peptide YY and glucagon like peptide 1 - GLP1) that enhances the insulin secretion and/or action.³³ Besides these endocrine changes, neural impulses transmitted through vagal pathways may influence eating behavior, resulting in weight loss and improvement of glucose homeostasis.³⁴ Therefore, the question that arises is whether type 2 diabetes is an operable disease, despite the fact that after vertical banded gastroplasty or Roux-en-Y gastric bypass, only 36% of prior diabetic patients remained free of the disorder at 10 years.²⁹ In recent IDF recommendations for the management of type 2 diabetes, bariatric surgery is considered as an appropriate treatment for type 2 obese diabetics (BMI ≥ 35 kg/m²) not achieving recommended targets (with medical treatment). Also, mildly obese diabetics (BMI 30-35 kg/m²) under some circumstances should be eligible for bariatric surgery.³⁵

Lipid profile improved in over 70% of patients following bariatric surgery.¹⁷ Total cholesterol, low density lipoprotein and triglycerides decreased, while high density lipoprotein showed no significant change.¹⁷ The prospective controlled SOS study showed that patients two and ten years after bariatric surgery exhibited an improvement in hypertriglyceridemia and an increase of high density lipoprotein.²⁹

Beneficial effects of bariatric surgery on hypertension

The prevalence of hypertension is reduced after bariatric surgery and it appears that 79% of hypertensive obese patients experience improvement or resolution of hypertension.¹⁷ Improvement of hypertension has also been reported in non severely obese patients with BMI < 35 kg/m².³⁶

Beneficial effects of bariatric surgery on obstructive sleep apnea

Another benefit of bariatric surgery is that it reduces the prevalence of obstructive sleep apnea, as 86% of the patients with this comorbidity recovered.^{17,37} Some studies showed complete resolution of

sleep apnea for patients with a respiratory disturbance index (RDI) <40 or improvement for patients with RDI >40.³⁸

Beneficial effects of bariatric surgery on cardiac function

Weight loss after bariatric surgery results in decrease of left ventricular wall thickness, increase in left ventricular ejection fraction and improvement in overall cardiac function.³⁹ Weight loss appears to correlate with the right ventricular end-diastolic area and the right ventricular systolic pressure.⁴⁰

Beneficial effects of bariatric surgery on gastroesophageal reflux disease

The improvement seen in gastroesophageal reflux after bariatric surgery may be a result of the decrease in intra-abdominal pressure.⁴¹

Beneficial effect of bariatric surgery on non-alcoholic fatty liver disease

Bariatric surgery is associated with non-alcoholic fatty liver disease improvement in most morbidly obese patients.⁴²

Beneficial effects of bariatric surgery on the reproductive system

In Females: Obese females often suffer from infertility and polycystic ovary syndrome which is associated with insulin resistance and hyperinsulinemia. Weight loss after bariatric surgery results in decreased hyperandrogenemia and restoration of menstrual cyclicity and fertility.^{43,44}

In Males: Obesity is related to abnormalities in the pituitary-gonadal axis and hypoandrogenism in men, probably due to aromatization of testosterone to estrogen in peripheral adipose tissue. Obese men also experience erectile dysfunction. Weight loss after bariatric surgery results in significant improvement in all these abnormalities.⁴⁵

Beneficial effects of bariatric surgery on venous disease

Obese patients usually have various degrees of venous stasis (chronic venous insufficiency), leg ulcers, superficial thrombophlebitis and deep vein thrombosis. Surgically induced weight loss improves all these comorbidities.⁴⁶

Beneficial effects of bariatric surgery on pseudotumor cerebri

Severe obesity, especially in women, may be associated with intracranial hypertension, also known as pseudotumor cerebri, which is attributable to increased intra-abdominal pressure. Weight loss after bariatric surgery decreases cerebrospinal pressure and relieves symptoms such as headache and tinnitus.⁴⁷

Beneficial effects of bariatric surgery on urinary incontinence

Many women with severe obesity experience urinary incontinence due to increased intra-abdominal and bladder pressure. Surgically induced weight loss resolves this problem almost uniformly.⁴⁸

Beneficial effects of bariatric surgery on degenerative joint disease

Severe obesity is accompanied by musculoskeletal and lower back pain and leads to degenerative joint disease. Weight reduction after bariatric surgery results in pain relief and decreases the need for orthopedic surgery.⁴⁹

Beneficial effects of bariatric surgery on chronic kidney disease

It is well known that morbid obesity is associated an increased risk for the development of end stage chronic kidney disease. There is evidence that surgically induced weight loss reduces the risk of chronic kidney disease progression.⁵⁰

Beneficial effects of bariatric surgery on the quality of life

Bariatric surgery patients experience an improvement in quality of life and psychosocial functioning after weight loss.^{51,52}

Safety and mortality of bariatric surgery

Mortality rates after bariatric surgical procedures appear to be equivalent with those of minimal abdominal surgeries such as laparoscopic cholecystectomy (0.3-0.6%).⁵³ The mortality rate in many bariatric surgery cohorts is very low.¹³ In one study, the mortality rate was 0.68% in the surgery group compared with 6.17% in control subjects, which translates to an impressive 89% reduction in the relative risk of death.¹⁹ The early overall mortality after bariatric surgery in

a meta-analysis was 0.28% and increased to 0.35% between 30 days and two years after surgery.⁵⁴ Mortality rises in patients aged over 60 with preexisting cardiopathies.⁵⁵ Generally, bariatric surgery reduces long-term mortality in operated patients compared to conventionally treated patients. In a recent meta-analysis from 8 trials (14,052 operated patients and 29,970 controls), gastric banding and gastric by-pass were associated with a reduced risk of global mortality (OR=0.55, CI 0.49–0.63), of cardiovascular mortality (OR=0.58, CI 0.46–0.73) and of all cause mortality (OR=0.70, CI 0.59–0.84).⁵⁶

Cost-effectiveness of bariatric surgery

Bariatric surgical procedures appear to be cost-effective compared with non-surgical interventions. Further research is required in order to clarify the long-term cost-effectiveness.⁵⁷

Detrimental effects of bariatric surgery on micronutrients

Anemia due to iron, folic acid and vitamins B12 and C deficiencies is a side effect of bariatric surgery procedures, especially of the restrictive type.⁵⁸ Iron deficiency is very common after gastric bypass. Vitamin D and calcium deficiency and subsequent secondary hyperparathyroidism lead to overt bone loss and osteoporosis.⁵⁹ Deficiencies of vitamin B12, thiamin or copper result in peripheral neuropathy and also in central nervous system deficits. Furthermore, lack of thiamine results in Wernicke's encephalopathy.⁶⁰ Bariatric surgery incorporating restrictive or mixed procedures is usually associated with vitamin K and A and zinc and selenium depletion.⁶¹ All these deficiencies result in numerous pathologies such as: mixed sensorimotor disturbances (copper), night blindness (niacin), coagulopathy (vitamin K), rash (vitamin E), edema and alopecia (protein malnutrition), pellagra (niacin), acrodermatitis (zinc) and cardiomyopathy (selenium and thiamin).^{22,62} Therefore, there is a need for lifelong substitution therapy and follow-up. In order to avoid or to minimize nutritional complications and to prevent weight regain, all patients "should receive care from a multidisciplinary team including an experienced primary care physician, endocrinologist or gastroenterologist and consider enrolling postoperatively in a comprehensive program for nutrition and lifestyle management".^{63,64} A small

number of patients (0.2%) after gastric bypass surgery experience hypoglycemia as a result of increased GLP1 levels or gastric dumping.⁶⁵

Other detrimental effects of bariatric surgery

Drug malabsorption is another potential problem after bariatric surgery.⁶⁶ Renal stones due to oxalosis and liver failure are serious postoperative complications.⁶⁵ Many patients after surgically induced weight loss experience significant skin excess, laxity and ptosis leading to a large number of unpleasant consequences including hygienic, dermatologic and cosmetic impairments, the latter requiring expensive cosmetic surgical procedures including abdominoplasty.⁶⁷

Detrimental effects of bariatric surgery on behavior

Some patients after bariatric surgery experience binge and night eating and depression.^{68,69} Some studies have shown an increased mortality rate due to accidents and suicides after bariatric surgery.⁶⁹⁻⁷¹

Postoperative complications of bariatric surgery

In the immediate postoperative period, venous thromboembolism and sepsis, as well as anastomotic leaks at the site of gastrojejunostomy, are the most serious complications.²⁴ The incidence of venous thromboembolism is from 0.4 to 3.1% and the incidence of anastomotic leaks is 0.5-3%.²⁴ Increased heart rate and respiratory distress are the most common symptoms of anastomotic leaks. Other short-term postoperative complications are bleeding, infections, small bowel obstruction and hernias.²⁴

Long-term surgical complications include dumping syndrome, nausea and vomiting (especially after vertical banded gastroplasty), ulcers, gastritis and erosions (especially after laparoscopic adjustable gastric banding), adhesions, bile reflux, gallstones, diarrhea, band erosion, slippage and dilatation.^{24,62}

In conclusion: It is now generally accepted that bariatric surgery is the most effective procedure for long-term weight loss among the morbidly obese. Additionally, bariatric surgery offers an improvement in metabolic abnormalities such as type 2 diabetes, dyslipidemia and hypertension. These beneficial effects stem not only from weight loss but also from endocrine changes resulting from the gastrointestinal

surgical procedures. In summary, bariatric surgery is associated with decreased overall mortality. All these favorable effects of bariatric surgery are closely related to judicious selection of patients who are candidates for surgery, to the efficiency of the surgical group and to good postoperative management of the patients.

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