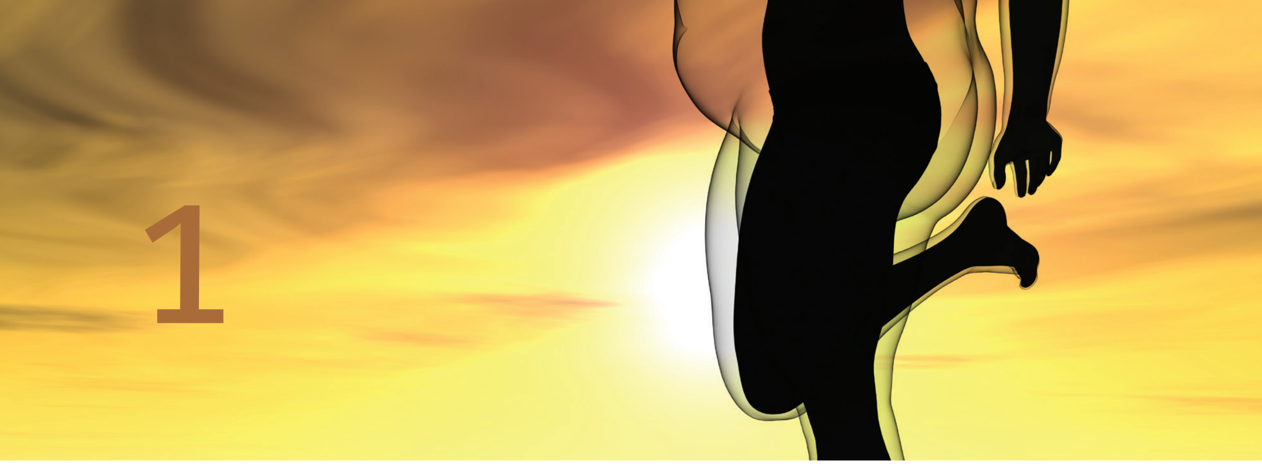

Preoperative assessment and preparation

Luca Busetto

Excess body weight is an important risk factor for mortality and morbidity from several chronic diseases, such as cardiovascular diseases, type 2 diabetes, chronic liver and gallbladder disease, some forms of cancer, osteoarthritis, and musculoskeletal disorders; it causes nearly 3 million annual deaths worldwide.[1] The prevalence of overweight and obesity is increasing worldwide. According to World Health Organization, obesity has nearly tripled in the world since 1975, and more than 1.9 billion adults were overweight in 2016. Of these, over 650 million were affected by obesity.[2] Obesity and overweight in adulthood are associated with marked decreases in life expectancy and increases in early mortality.[1]

Severe obesity (body mass index [BMI] ≥40 kg/m^2) is particularly emerging as a major public health problem in several developed countries, and most notably in the United States, where BMI >40 and >50 kg/m^2 has increased more than 4 and 10 fold, respectively, since the mid-1980s.[3] While severe obesity currently affects 6% of the U.S. adult population,[3] those belonging to this group accounted for 20% of the total per capita health-care expenditures in 2000.[4] As BMI level increases, so does the risk of death: years of life lost increases from 6.5 years for patients with a BMI of 40-45 kg/m^2 to 13.7 years for those with a BMI of 55-60 kg/m^2.[5]

Bariatric surgery has proven to be the most effective therapy for patients with severe obesity; it is associated with sustained weight loss and with a significant reduction in overall mortality, diabetes incidence, myocardial infarction, stroke, and cancer.[6] Bariatric surgery is now fully embedded in general guidelines for the optimal management of patients with obesity.[7] As a consequence, the number of bariatric procedures performed worldwide has increased very rapidly in recent years, reaching a total of 685,874 procedures in 2016.[8]

This growing diffusion of bariatric surgery has helped clinicians to better delineate how severe obesity affects surgical and anesthesiological risk, and how adequate preoperative patient evaluation and preparation could temper this operative risk. This evidence could also translate to the preoperative management of patients with severe obesity undergoing elective non-bariatric surgery. In this chapter, available evidence about the role of preoperative assessment and preparation in reducing perioperative morbidity and mortality in patients with severe obesity will be presented and discussed. The chapter is largely based on clinical practice guidelines for perioperative nutrition, metabolic considerations, and nonsurgical support of patients undergoing bariatric procedures updated in 2019 by the American Association of Clinical Endocrinologists, the American College of Endocrinology, the Obesity Society, the American Society for Metabolic and Bariatric Surgery, the Obesity Medicine Association, and the American Society of Anesthesiologists.[9]

Preoperative clinical evaluation and laboratory assessment

Patients with obesity who are candidates for bariatric surgery must undergo preprocedural evaluation for obesity-related complications and causes of obesity, with special attention directed to those factors that could influence a recommendation for bariatric procedures or surgical risk. This evaluation should include a comprehensive medical history, psychosocial history, physical examination, and appropriate laboratory testing. The preprocedural checklist suggested by the clinical practice guidelines for perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures updated in 2019 is reported in Table 1.I. If possible, this evaluation should be performed or guided by a specialist in obesity medicine.[9]

Extensive diagnostic workout for secondary forms of endocrine obesity or rare monogenic obesities should not be performed in all candidates for bariatric surgery, but only in patients with relevant clinical features. Patients evaluated for bariatric procedures have a significant number of thyroid abnormalities, with nodular goiter and autoimmune thyroiditis among the most prevalent. In a series of 783 consecutive patients screened before bariatric surgery, the prevalence of hypothyroidism was 18.1%.[10] However, mild hypothyroidism is associated with modest weight gain, and it is not listed as a cause of severe obesity. Moreover, obesity is associated with an elevation of thyroid-stimulating hormone (TSH) levels in the absence of a primary thyroid disease.[11] Therefore, routine measurement of TSH levels before surgery may result in considerable overdiagnosis and unnecessary levothyroxine treatment. A serum TSH level should be obtained only if clinical evidence of hypothyroidism is present.[9] Cushing syndrome is rare in patients with severe obesity, with a reported prevalence of <1%.[10] Screening for Cushing's syndrome (1 mg overnight dexamethasone test, 24-hour urinary free cortisol, 11 PM salivary cortisol) should be performed only in case of clinical suspicion (Table 1.I).[9] Similar to screening for Cushing's syndrome, extensive hormonal evaluation and testing for polycystic ovary syndrome (PCOS) should only be performed in symptomatic women (Table 1.I).[9] Monogenic obesities and obesities linked to dysfunction or lesions of the hypothalamic regulatory areas (craniopharyngioma, head trauma, etc.) are usually recognizable or they can be suspected from the clinical history and associated morphologic and hormonal abnormalities.

The anatomical and functional modifications of the gastrointestinal tract produced by bariatric surgery can alter the absorption of micronutrients and cause procedure-specific nutritional deficiencies. Unfortunately, several surveys have demonstrated that micronutrient deficiencies are frequently present in patients with severe obesity even before surgery.[12] With the aim to arrive at surgery in the best possible nutritional status, all patients must undergo an appropriate nutritional evaluation, including micronutrient measurements, before any bariatric procedure. In comparison with purely restrictive procedures, more extensive nutritional evaluations are required for malabsorptive procedures.[9]

Surgical stress can be associated with exacerbation of hyperglycemia in patients with type 2 diabetes. Among hospitalized patients, adverse outcomes (hospital mortality, infection, heart failure after

Table 1.I. The preprocedural checklist suggested by the clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures - 2019 update (American Association of Clinical Endocrinologists/American College of Endocrinology, The Obesity Society, American Society for Metabolic & Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologists).[9]

◗ Complete history and physical examination (obesity-related comorbidities, causes of obesity, weight, body mass index, weight-loss history, commitment, and exclusions related to surgical risk)
◗ Routine labs (including fasting blood glucose and lipid panel, kidney function, liver profile, lipid profile, urine analysis, prothrombin time/internalized normal ratio, blood type, complete blood count)
◗ Nutrient screening with iron studies, B12 and folic acid (RBC folate, homocysteine, methylmalonic acid optional), and 25-vitamin D (vitamins A and E optional); consider more extensive testing in patients undergoing malabsorptive procedures based on symptoms and risks
◗ Cardiopulmonary evaluation with sleep apnea screening (electrocardiogram, circumferential strain rate, echocardiography if cardiac disease or pulmonary hypertension suspected; deep-venous thrombosis evaluation, if clinically indicated)
◗ GI evaluation (*Helicobacter pylori* screening in areas of high prevalence; gallbladder evaluation and upper endoscopy, if clinically indicated)
◗ Endocrine evaluation (glycated hemoglobin [A1c] with suspected or diagnosed prediabetes or diabetes; thyroid stimulating hormone with symptoms or increased risk of thyroid disease; androgens with polycystic ovary syndrome suspicion (total/bioavailable testosterone, SHEAS, Δ4-androstenedione); screening for Cushing's syndrome if clinically suspected (1 mg overnight dexamethasone test, 24-hour urinary free cortisol, 11 PM salivary cortisol)
◗ Lifestyle medicine evaluation: healthy eating index; cardiovascular fitness; strength training; sleep hygiene (duration and quality); mood and happiness; alcohol use; substance abuse; community engagement
◗ Clinical nutrition evaluation by a registered dietician
◗ Psychosocial-behavioral evaluation
◗ Assess for individual psychological support/counseling
◗ Document medical necessity for bariatric surgery
◗ Informed consent
◗ Provide relevant financial information
◗ Continue efforts for preoperative weight loss
◗ Optimize glycemic control
◗ Pregnancy counseling
◗ Smoking-cessation counseling
◗ Verify cancer screening by primary care physician

myocardial infarction, need for intensive care unit [ICU] admission, and increased length of hospital stay) are more frequent in patients with hyperglycemia compared to those with normal glucose levels.[13] An obvious consequence of this background is that, ideally, not a single patient with type 2 diabetes should arrive at surgery unrecognized or undertreated. The screening should include a complete assessment of major cardiovascular risk factors (lipids, blood pressure, microalbuminuria) and, given the strong association between type 2 diabetes and cardiovascular disease, a more detailed diagnostic workup for the detection of ischemic heart disease or carotid artery atherosclerotic lesions may be recommended in all patients with a positive diabetes history and in the newly diagnosed cases.

Cardiovascular complications are the leading cause of death within 30 days after noncardiac surgery. The need for an electrocardiogram and other noninvasive cardiac testing should be determined on the basis of the individual risk factors and findings on history and physical examination.[9] The latest American College of Cardiology/American Heart Association guidelines on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery could be used for an evidence-based clinical decision regarding the need for preoperative noninvasive cardiac testing.[14] According to these guidelines, the decision should be based on two major parameters: 1) the risk for perioperative major cardiovascular events, which can be calculated according to patient-related characteristics (history of ischemic heart disease, congestive heart failure, cerebrovascular disease, insulin therapy for diabetes, kidney disease) and procedure-related risk; and 2) the functional capacity of the patient estimated with an objective measurement or scale.[14] In practical terms, no further cardiac testing is needed in patients with a <1% risk of periprocedural major cardiovascular events. In patients with a risk >1%, the need for additional testing is dictated by the functional status. No further cardiac testing is needed if the patient has moderate, good, or excellent functional capacity (≥4 metabolic equivalents [METs] or the patient can walk up a flight of steps or walk on a flat surface at 4.8-6.4 km/hour). In patients with low functional capacity, echocardiography and stress testing is considered appropriate.[14] In case of positive findings, patients should undergo coronary angiography and eventual revascularization before surgery.[9]

Obstructive sleep apnea syndrome (OSAS) is a well-known independent risk factor for prolonged hospital stays and higher complication rates after bariatric surgery.[15] Current guidelines suggest a clinical screening for OSAS with confirmatory polysomnography if screening tests are positive.[9] Patients diagnosed with moderate-to-severe OSAS should be adapted to nocturnal noninvasive ventilation with continuous positive airways pressure (CPAP), with the ventilation resumed early after the procedure.[9] This recommendation is still controversial. Considering the very high prevalence of OSAS in bariatric patients (35-95%) and the fact that the sensitivity and specificity of clinical tests are questionable, routine use of polysomnography or nocturnal breathing monitoring in all patients has been advocated.[16] On the other hand, some studies have shown no risk reduction with OSAS screening or treatment and have valued the role of active and stringent perioperative monitoring.[17] An entire chapter of this book will be dedicated to the diagnosis and management of OSAS in patients with obesity undergoing surgery. Further pulmonary evaluations, like arterial blood gas measurement or spirometry, should be performed only in patients with intrinsic lung disease or proven disordered sleep patterns.[9]

Clinically significant gastrointestinal symptoms should be evaluated before bariatric procedures with imaging studies, upper gastrointestinal series, or upper endoscopy.[9] Systematic reviews and meta-analyses have demonstrated that preoperative endoscopy in patients with gastrointestinal symptoms mandate a change in surgical planning in roughly 10% of patients.[18,19] Limiting gastrointestinal preoperative evaluation to symptomatic patients has also been questioned. Severe gastroesophageal reflux disease, not always a symptomatic condition, is usually a contraindication for sleeve gastrectomy, and the use of preoperative endoscopy may be considered in all patients being evaluated for sleeve gastrectomy.[9] Moreover, *Helicobacter pylori* infection was the strongest independent predictor of marginal ulcers after gastric bypass in a large retrospective study with 253,765 patients.[20] At the moment, no consensus has been reached on the use of routine versus selective preoperative esophagogastroduodenal endoscopy in patients considered for bariatric surgery.[21]

Preoperative optimization

In an ideal scenario, every patient with severe obesity should arrive at surgery in better clinical condition than when he or she started treatment, with an optimized management of obesity-related comorbidities and even nonobesity-related underlying diseases. Preparation of the patients and preoperative optimization should be considered as an integral part of the work of the bariatric multidisciplinary team and an appropriate clinical pathway should be organized for this purpose.

Optimization of obesity-related complication management is particularly important in patients with type 2 diabetes. Good preoperative glucose control, represented by a glycated hemoglobin value ≤7%, has been associated with decreased perioperative infectious complications. Dronge *et al.*[22] analyzed postoperative infections (pneumonia, wound infection, urinary tract infection, or sepsis) according to preoperative glycated hemoglobin in 490 diabetic patients undergoing several types of surgical procedures at the Veteran Affairs Connecticut Healthcare System, a tertiary referral center. Before and after adjustment for several possible confounding variables, a glycated hemoglobin level of more than 7% was significantly associated with a doubled rate of infectious complications.[22] Moreover, patients who arrive to surgery with poor glycemic control with orally administered medications may require insulin for several days after bariatric surgery.[12] Preprocedural glycemic control must be optimized using a comprehensive diabetes care plan, including a healthy, low-calorie dietary patterns, medical nutrition therapy, physical activity, and, as needed, pharmacotherapy.[9] In framing or reframing a pharmacotherapy management plan before surgery, the effects of antidiabetic drugs on body weight should be considered. Reasonable targets for preoperative glycemic control, which may be associated with shorter hospital stays and improved bariatric procedure outcomes, include a glycated hemoglobin value of 6.5-7.0% or lower and periprocedural blood glucose levels of 80-180 mg/dL.[9] More liberal preprocedural targets, such as a glycated hemoglobin value of 7-8%, are recommended in patients with advanced microvascular or macrovascular complications, extensive comorbid conditions, or long-standing diabetes in which the general goal has been difficult to attain despite intensive efforts.[9] In patients with a glycated hemoglobin value >8% or otherwise uncontrolled diabetes, clinical judgment determines the need and timing for a bariatric procedure.[9]

Cigarette smoking is a well-known factor for an increased risk of perioperative morbidity and mortality. Smoking history (and not BMI) was the only prognostic factor for airway-related complications among 12,062 patients undergoing bariatric surgery in Western Australia.[23] Tobacco use must be avoided at all times by all patients, but patients who smoke cigarettes should receive advice to stop as soon as possible, preferably 1 year, but at the very least, 6 weeks before bariatric procedures.[9] Structured intensive cessation programs are more effective than general advice and should be implemented.[9]

Preoperative weight loss

The role of preoperative weight loss in improving clinical outcomes is still a matter of debate and has been the subject of some randomized controlled trials.[24-26] Van Nieuwenhove *et al.*[24] compared intraoperative complication rates, the surgeon's perceived difficulty, and the 30-day postoperative complication rates in 298 patients randomly allocated to a 2-week preoperative very-low calorie diet (VLCD) or no preoperative dietary restriction. Kalarchian *et al.*[25] compared 30-day postoperative complication rates and postoperative weight loss in 143 patients who received a 6-month behavioral lifestyle intervention or usual presurgical care. Coffin *et al.*[26] evaluated the impact of an intragastric balloon on operating time and postoperative weight loss. The sample size and the major results for specific outcomes in these three trials are reported in Table 1.II.

Of note, no study observed a difference in postoperative weight loss between the intervention and the control arms. The absence of any relationship between preoperative and postoperative weight loss has also been confirmed by several retrospective studies. Giordano and Victorzon[27] compared patients who achieved different levels of preoperative weight loss (<5%, 5-10%, and >10%) in a retrospective study with a total sample of 548 patients: Postoperative weight loss was higher in patients who achieved >10% weight loss at 12 months, but there were no significant differences at 24 months. Sherman *et al.*[28] analyzed a cohort of 141 patients treated with sleeve gastrectomy; the weight loss 1 year after surgery was not statistically different between those who lost weight and those who gained weight before surgery. Finally, McNickle and Bonomo[29] found no association between preoperative weight loss and 1-year outcome in a cohort of 127 patients treated with a standardized 6-month medical weight loss program and a 2-week preoperative diet with meal replacements. In conclusion, successful preoperative weight loss cannot be considered a reliable predictor of the postoperative outcome. The use of mandated preoperative weight loss targets as a method for the selection of patients for bariatric surgery is therefore not justified.[30]

The situation looks less negative if we consider, instead of postoperative results, the impact that preoperative weight loss may have on the safety of the procedure itself. In one of the randomized trials, a 2-week preoperative VLCD regimen led to a 4.9 kg preoperative weight loss (*vs.* 0.4 kg in the control group); this weight loss was associated with a decrease in the surgeon's perceived difficulty in performing the procedure and a reduced rate of 30-day postoperative complications (18% *vs.* 8%) (Table 1.II).[24] During laparoscopic bariatric surgery, hepatomegaly and visceral fat in the left upper quadrant may limit preliminary exposure of the surgical field and may increase the conversion rate and operative time.[31] The overall conversion rate in Roux-en-Y gastric bypass is approximately 4%, and an enlarged liver is responsible for approximately 50% of the conversions.[31] A brief VLCD course

Table 1.II. Sample size and major results for specific outcomes in three randomized controlled trials specifically comparing patients in whom preoperative weight loss was actively pursued before bariatric surgery with patients treated with standard care.

	Van Nieuwenhove *et al.*[24]	Kalarchian *et al.*[25]	Coffin *et al.*[26]
Sample size	273	143	115
Operating time	NS	-	NS
Intraoperative complications	NS	-	-
Surgeons' perceived difficulty	Higher in control group *vs.* WL	-	-
30-days postoperative complications	Higher in control group *vs.* WL	NS	-
Postoperative WL	-	NS	NS

NS: no significant difference between weight loss group and control group; WL: weight loss immediately before surgery reduced liver volume (5-20% of the initial volume) and visceral fat accumulation.[32] However, the effect of preoperative weight loss on the rate of perioperative complications has been less consistently demonstrated.[32] This lack of uniformity in the results linking preoperative weight loss to surgical outcomes could be due to the extremely low actual rates of perioperative complications in modern laparoscopic bariatric surgery, thus imposing a large sample size in order to demonstrate a significant reduction. Alternatively, preoperative weight loss may only be effective in patients with visceral obesity and enlarged liver, thus limiting its utility in the general bariatric population.

More recently, a very low-calorie ketogenic diet (VLCKD) has been proposed as a more effective and safe method for achieving effective preoperative weight loss. Leonetti *et al.*[33] evaluated in an uncontrolled study the compliance, safety, and effectiveness of a sequential regimen (a VLCKD for 10 days, followed by a VLCD for 10 days, and then a low calorie diet [LCD] for 10 days) in patients with obesity scheduled for bariatric surgery. They showed an adequate short-term reduction of body weight and waist circumference, without dangerous alterations in renal, hepatic, and metabolic functions.[33] A similar 30-day sequential preoperative regimen was used in another uncontrolled study that showed a significant reduction in weight, waist circumference, liver volume (-30%) and visceral fat, and an improvement in several clinical parameters, including glycemic and lipid profiles.[34] Finally, in a third (nonrandomized) study, patients were treated with either a VLCKD or a VLCD for 3 weeks prior to bariatric surgery: Weight loss was not significantly better in the VLCKD compared with the VLCD group, but the VLCKD group had better results on surgical outcomes, influencing drainage output, postoperative hemoglobin levels, and hospital stay.[35]

In conclusion, preoperative weight loss cannot be used as a marker or a predictor for future postoperative body weight reduction. However, preprocedural weight loss can reduce liver volume and may help to improve the technical aspects of surgery in patients with an enlarged liver or fatty liver disease; hence, it may be recommended as an optimization measure before a bariatric procedure.[9] Moreover, preprocedural weight loss or medical nutritional therapy may be recommended to patients in selected cases to improve comorbidities, such as preprocedural glycemic targets in patients with type 2 diabetes.[9]

Preoperative chronic medications management

Bariatric surgeries induce substantial anatomical and physiological changes in the gastrointestinal tract and elsewhere that may affect drugs pharmacokinetics in different directions, including absorption, tissue distribution, metabolism, and clearance. The potential effects and consequences that any bariatric procedure may have on absorption and the action of medications should be carefully considered before surgery, especially for medications where changes in blood levels may have critical effects on the patient's conditions or can cause significant adverse events (*e.g.*, anticoagulants, antiepileptics, drugs for Parkinson's disease, drugs for autoimmune conditions, etc.).[36]

Hormone therapy, including oral hormonal contraception, postmenopausal hormone therapy, and use of selected estrogen-receptor modulators, has been associated with an increased risk of venous thromboembolism (VTE).[37] Estrogen therapy should be discontinued before a bariatric procedure (one cycle of oral contraceptives in premenopausal women; 3 weeks of hormone replacement therapy in postmenopausal women) to reduce the risks for postprocedural VTE.[9]

There is insufficient evidence for any recommendation regarding optimal timing of hormone therapy resumption after a bariatric procedure.[9] Pregnancy is not recommended in the first 12-18 months following bariatric surgery.[36] Women should be informed that their fertility is likely to increase immediately after surgery, and contraception should be discussed and offered.[36] The choice of contraceptive method has been the subject of debate, due to concerns about absorption and effectiveness of oral preparations of hormonal contraception, in particular after gastric bypass or biliopancreatic diversion. Hence, parenteral forms of hormonal contraception should be recommended as the first line, at least in the malabsorptive procedure.[36] Contraception and plans for pregnancy following bariatric surgery should be discussed early and they should be part of preoperative counselling and education, particularly in adolescents.[36]

Oral and noninsulin injective antidiabetic drugs, including metformin, thiazolidinediones, sulfonylureas and meglitinides, dipeptidyl-dipeptidase 4 inhibitors, sodium-glucose cotransporter-2 inhibitors, and incretins, should be discontinued 24 hours before surgery.[36] In patients requiring insulin therapy before surgery, basal insulin dosage should be reduced to 0.3 units/kg body weight.[36] On the day of surgery, glucose levels should be targeted at <140 mg/dL, and short-acting insulin should be used according to a correction factor of one unit of insulin for every 40 mg/dL above the level of 140 mg/dL.[36]

Perioperative VTE prophylaxis

VTE is a leading cause of morbidity and mortality after bariatric surgery; it includes deep vein thrombosis (DVT) and pulmonary embolism (PE). The Bariatric Outcomes Longitudinal Database (BOLD) prospectively evaluated 73,921 patients undergoing bariatric surgery in centers of excellence and analyzed VTE events within 90 days of surgery.[38] The overall risk for VTE after surgery was 0.42%, and 73% of these events occurred after discharge, most within 30 days postsurgery.[38] The risk was greater after gastric bypass compared with gastric banding (0.55% *vs.* 0.16%) and higher after open compared with laparoscopic procedures (1.54% *vs.* 0.34%).[38] More recently, Helm *et al.*[39] analyzed VTE events in 59,424 bariatric procedures identified from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) dataset. The postoperative incidence of VTE was 0.5%, with an average time to diagnosis of 11.6 days and 80% of the events occurring after hospital discharge.[39] In that study, the occurrence of a perioperative complication greatly increased the risk for VTE: Major complications occurred prior to VTE in one fifth of cases, with VTE likelihood directly related to the number of complications.[39] Despite its relatively low prevalence, VTE has a great impact on mortality after bariatric surgery. In the ACS-NSQIP dataset, unadjusted 30-day mortality increased 13.89 fold in patients presenting a VTE event.[39]

Apart from surgical techniques and perioperative complications, the risk for a VTE after bariatric surgery varies according to a patient's baseline characteristics. In the BOLD database, patients with a VTE event were more frequently men, older, and affected by a more severe obesity than patients who did not have a VTE event.[38] History of VTE is another very relevant baseline predictor of VTE risk: a previous VTE event was registered in 16.5% of the patients with a current VTE and in only 3.7% in patients without current VTE events in the BOLD database.[38] Therefore, patients with a history of previous VTE or cor pulmonale should undergo a risk assessment for bariatric surgery and an appropriate diagnostic evaluation for active DVT.[9]

In patients with a high risk for VTE, the routine concurrent prophylactic placement of an inferior vena cava filter (IVCF) has been proposed. Based on BOLD, a total of 322 IVCFs were used in 97,218 bariatric procedures.[40] Patients with IVCP had a higher baseline risk for VTE than patients without IVCF.[40] IVCF placement was associated with a higher incidence of DVT and a higher mortality from