Clinical Practice
GUIDELINE
for the Management of Obesity in Adults in Ireland

Bariatric Surgery: Selection & Pre-Operative Workup

O'Connell J[i], Garvey JF[ii], Geoghegan J[iii], Kearney C[iv], Shaamile F[v].
Chapter adapted from: Glazer S, Biertho L. Canadian Adult Obesity Clinical Practice Guidelines: Bariatric Surgery - Selection and Pre-operative Workup (version 1, 2020). Available from: https://obesitycanada.ca/guidelines/preop.

i) Consultant Endocrinologist, Level 3 and 4 Obesity Services, St Columcille's and St Vincents's University Hospitals, Dublin / ASOI
ii) Consultant Respiratory and Sleep Physician, St Vincent's University Hospital, Dublin
iii) Consultant Hepatobiliary, Transplant and Bariatric Surgeon, St Columcille's Hospital and St Vincent's University Hospital Level 4 Bariatric service
iv) Clinical Nurse Manager II, Level 3 and 4 Obesity Service, St Columcille's Hospital, Dublin
v) Endocrinology Fellow, Level 3 and 4 Obesity Service, St Columcille's Hospital, Dublin

Cite this Chapter

ASOI Adult Obesity Clinical Practice Guideline adaptation (ASOI version 1, 2022) by: O'Connell J, Garvey JF, Geoghegan J, Kearney C, Shaamile F. Chapter adapted from: Glazer S, Biertho L.
Available from:
https://asoi.info/guidelines/preop/
Accessed [date].

KEY MESSAGES FOR HEALTHCARE PROFESSIONALS

- **Criteria for selection of appropriate candidates for bariatric surgery have been established to minimise surgical complications and to maximise the benefit of these important and limited procedures.**
- **The pre-operative workup should evaluate a patient's medical, nutritional, mental and functional health status.**
- **There should be a balance between comprehensive evaluation and preparation pre-surgery, and the potential harms from mandating participation in compulsory fixed-duration "lifestyle programmes" or setting weight-change targets, which may delay surgery and reinforce obesity stigma.**
- **Special attention should be given to the care of patients living with type 2 diabetes mellitus (T2DM) who are considering bariatric surgery, to minimise complications from out-of-target glycaemia in the perioperative period.**
- **The prevalence of obstructive sleep apnoea (OSA) in patients attending an Irish bariatric clinic was 93%. As undiagnosed OSA is a risk factor for adverse perioperative outcomes, all patients should have assessment and treatment of OSA before bariatric surgery.**
- **Because of the risks of post-operative complications associated with nicotine use, cessation of smoking prior to bariatric surgery is mandatory and should be maintained lifelong.**
- **In patients living with severe obesity, bariatric surgery, in combination with behavioural interventions, is an effective option for long-term obesity and obesity-related chronic disease management, such as T2DM, hypertension, OSA and dyslipidaemia, as well as other conditions associated with increased adiposity.**

RECOMMENDATIONS

1. We suggest a comprehensive medical, nutritional, psychological, and functional evaluation be completed, and nutrient deficiencies corrected, in candidates for bariatric surgery (Level 4, Grade D)[1,2].
2. Pre-operative smoking cessation can minimise post-operative complications (Level 2a, Grade B)[3,4].
3. We suggest screening for and treatment of obstructive sleep apnoea in people seeking bariatric surgery (Level 4, Grade D)[5,6].

KEY MESSAGES FOR PEOPLE LIVING WITH OBESITY

- **Bariatric surgery is the beginning of a new treatment in your lifelong obesity management.** You should be aware of, and understand, the necessary changes required to optimise your long-term outcomes for a healthier life. Peer support groups such as the Irish Coalition for People Living with Obesity can help during this time of adjustment.
- **Before surgery you will be asked to perform several investigations, such as blood tests and cardiac or breathing testing, to ensure that you are ready and safe for surgery.**
- **You may be asked to have a sleep study to determine if you have significant obstructive sleep apnoea, which may require treatment before surgery.**
- **A current or recent history of smoking or nicotine consumption puts you at risk of complications after bariatric surgery.** Smoking cessation is required before surgery and must be maintained for life.
- **You may be given a low-calorie diet two to three weeks before surgery, which may help to shrink your liver size and make your surgery easier.**
- **If you are living with type 2 diabetes mellitus, you may be asked to monitor blood glucose closely, and obtain instructions on how to adjust your diabetes medications while on the low-calorie diet prior to bariatric surgery.**
- **Because changes in the absorption of some medications may occur with certain bariatric surgical procedures, you may be asked to change either the type or preparation of medications you are currently taking.**

Selection of appropriate patients for bariatric surgery

Extensive preparation of patients prior to bariatric surgery is required. Potential candidates for bariatric surgery should undergo multidisciplinary evaluation and optimisation of their medical, mental, nutritional and functional health to assess their eligibility and safety to proceed with surgery. Further medical evaluations may include cardiac, respiratory, metabolic, gastrointestinal and sleep apnoea testing. Once adequate evaluation and preparation have been undertaken, the patient may proceed for bariatric surgery if stable.

There should be a balance between comprehensive individualised multi-disciplinary evaluation and preparation pre-surgery, and the potential harms from mandating participation in compulsory fixed-duration, frequency and intensity "lifestyle programmes" or setting weight-change targets, which may delay surgery and reinforce obesity stigma[7].

Bariatric surgery is indicated in patients greater than 18 years of age with a body mass index (BMI) greater than or equal to 35 kg/m², who have at least one major adiposity-related complication including Type 2 diabetes (T2DM), hypertension (HTN), hyperlipidaemia, polycystic ovary syndrome, pseudotumor cerebri, obesity hypoventilation syndrome, debilitating arthritis, non-alcoholic fatty liver disease (NAFLD) or steatohepatitis (NASH), coronary artery disease, severe reflux or obstructive sleep apnoea (OSA)[1]. Bariatric surgery is also indicated for patients with a BMI greater than or equal to 40 kg/m², independent of the presence of obesity-related complications[8,9]. Bariatric surgery may also provide therapeutic benefit in patients with a BMI between 30 and 34.9 kg/m² who have been refractory to non-surgical weight loss with obesity-related complications, especially T2DM. The indications for surgery in these patients may be predicated heavily on the obesity-related complications that are present and weighing the durable response to bariatric surgery compared with existing medical interventions[10-12].

Adolescent candidates who have a BMI greater than or equal to 35 kg/m² (or BMI > 120% of 95th percentile) may be considered for a bariatric procedure if they have significant complications, including T2DM, significant OSA with an apnoea-hypopnoea index measured at 15 or higher, pseudotumor cerebri or NASH. In addition, consideration may be given to those adolescent candidates with a BMI of greater than or equal to 40 kg/m² (or BMI > 140% of 95th percentile) with other complications, such as HTN, insulin resistance or glucose intolerance, significant impairment with their quality of life or activities of daily living, hyperlipidaemia or OSA[13].

General considerations for bariatric surgery candidates

Potential surgical candidates should have a history of identifiable medical management of obesity. All patients must be committed to engage in the educational process involved in preparing for bariatric surgery, as well as adhering to the necessary long-term follow-up, both from a nutritional and medical perspective. Appropriate surveillance and treatment of potential long-term nutritional deficiencies as well as assessment and intervention for obesity-related complications and mental health is crucial for long-term success.

A pre-operative psychosocial assessment is recommended not only to identify clear contraindications for surgery but also to highlight strengths and vulnerabilities which could ultimately assist with enhancing surgical outcomes[14,15]. Several studies have shown that patients with psychiatric illnesses identified at the psychosocial evaluation (including conditions such as bipolar psychotic disorders), whose symptoms were optimised before surgery, were able to attain favourable post-surgical weight loss and psychosocial outcomes[16].

Patients with unstable psychiatric illness, malignancy or other diseases associated with decreased life expectancy, substance abuse or an inability to adhere to long-term follow-up, may be considered inappropriate candidates for surgery due to a high risk of short- and long-term complications.

Advanced patient age is not an absolute contraindication to bariatric surgery. The outcomes and complication rates for patients greater than 60 years of age appear to be comparable to those of a younger population, regardless of the surgical procedure performed[17,18].

NAFLD/NASH is common in patients living with obesity and can lead to liver cirrhosis. The risk of bariatric surgery in patients carefully selected with Child-Pugh Class A liver cirrhosis is not prohibitive, but caution and additional surveillance should be undertaken as their overall risk for perioperative complications and mortality is increased[19,20]. In addition, non-alcoholic steatohepatitis is the third-most-common indication for transplantation of the liver and, with growing incidence, NAFLD/NASH is becoming an increasingly frequent reason for liver transplantation[21-23].

The morbidity and mortality rate of bariatric surgery before or after liver transplantation is increased but remains acceptable in tertiary care centres[24-26].

Predictors of successful post-operative weight loss

Behavioural changes

Exercise in conjunction with obesity-management programmes has been demonstrated to improve weight loss and body composition. Thirty minutes per day (150 minutes per week) of moderate-intensity exercise after bariatric surgery is associated with a 3.6 kg additional weight loss compared with individuals who do not exercise after bariatric surgery[27].

In preparation for bariatric surgery, candidates may benefit from implementing health behaviour-change interventions. Interventions include education on nutrition and activity, and behavioural strategies for weight loss and weight maintenance, exploring topics such as self-monitoring, mindful eating and goal setting. However, bariatric surgical patients who undertook a behavioural intervention programme for six months prior to bariatric surgery experienced no significant difference in the degree of weight loss at 24 months after surgery compared with control subjects[28].

Patients' concurrent eating patterns may play a significant role in the effect of post-operative weight loss. In addition, past traumas may also impact upon weight-loss outcomes post-bariatric surgery. The presence of a history of binge eating disorder or a previous history of sexual abuse did not seem to predict difference in weight-loss outcomes at two years post-bariatric surgery, but this area remains controversial and requires further study[29]. Although eating disorders are generally not considered absolute contraindications for bariatric surgery, patients and healthcare professionals (HCPs) should be aware that eating disorder symptoms can manifest after surgery and adversely affect weight loss, mental health and quality of life[16].

Pre-operative weight loss

Weight reduction is associated with improvement of cardiac risk factors and the associated complications of obesity. A 5% – 10% weight loss can improve cardiovascular risk factors and reduce complications, such as HTN, hyperlipidaemia, T2DM, visceral fat and hepatic steatosis, as well as liver volume.

Pre-operative weight loss may decrease the difficulty of performing bariatric surgery, minimise blood loss, improve short-term weight loss and short-term complications, as well as decrease operative time[30-32].

However, longer-term studies reviewing pre-operative weight loss did not identify any advantage at four years with respect to weight-loss outcomes. Therefore, based on the best available evidence, the American Society for Metabolic and Bariatric Surgery took the position in 2016 that there was no evidence that pre-operative weight loss had any impact on post-operative outcomes[16].

Pre-surgical medical nutrition therapy

Many pre-operative protocols include the use of a low-energy diet for two to three weeks prior to surgery. In Ireland, Level 4 bariatric centres use a combination[33] of food-based, milk-based and commercial meal replacement products. A pre-op dietary protocol may support some patients to develop a structured approach to eating in preparation for the necessary changes post-op; however, the evidence in relation to enhanced outcomes is less clear.

A systematic review of low-calorie diets (LCDs; 800 kcal – 1200 kcal daily for two to eight weeks) demonstrated efficacy in liver volume reduction (12% – 27%) and weight loss (-4% to -17%), with acceptable patient adherence. The evidence for improvement in surgical complexity and outcomes is less clear[34].

Very low calorie diets (VLCDs; 450 kcal – 800 kcal daily) have been shown to be more effective than LCDs in achieving significant weight loss prior to surgery (-3 kg to -15 kg), but there is less evidence for any difference in liver volume reduction, rate of surgical complications or length of hospital stay[35].

The effect of pre-operative weight management may have benefits for some patients in preparation for bariatric surgery. However, adherence to pre-operative meal supplements may be challenging and occasionally not well tolerated. In addition, meal supplements may be expensive. Patients may need HCP support during this period.

Risk assessment prior to bariatric surgery

Nutritional evaluation

Pre-operative evaluation and collaborative support from a registered dietitian is recommended for all patients considering bariatric surgery[1,2,9,16,36].

Observational studies have indicated that patients living with obesity have a higher risk for inadequate nutritional status and micronutrient deficiencies[2,37-39]. Malnutrition prior to surgery may be associated with increased mortality, morbidity, re-admission, post-op nausea and vomiting, therefore optimisation of pre-op nutrition status is important[15,40-42].

Pre-operative lab work should include full blood count, renal and liver profiles, thyroid stimulating hormone, iron profile, ferritin, vitamin B12, folate, vitamin D, calcium, fasting glucose, haemoglobin A1C and lipid profile, as part of the evaluation of obesity-related metabolic complications. Vitamin A, parathyroid hormone, phosphate, zinc, selenium and copper levels can be assessed more selectively, due to cost considerations[36]. Pre-operative optimisation of micronutrient levels prior to surgery, specifically levels of vitamin D, vitamin B12 and iron, is recommended[2]. A complete multi-vitamin and mineral complex may be considered if energy and nutrient intake is insufficient to meet micronutrient requirements in the pre-operative period. Of note, patients taking proton pump inhibitors and/or metformin have a higher prevalence of vitamin B12 deficiency[2,43].

Smoking and nicotine use

Smoking and nicotine cessation should be recommended for all patients undergoing bariatric surgery.

A systematic review of 48 studies identified that smoking within one year prior to bariatric surgery was an independent risk factor for increased 30-day mortality and major post-operative complications, particularly wound and pulmonary complications. Smoking was also significantly associated with long-term complications, including marginal ulceration and bone fractures [4].

Pathophysiological mechanisms from cigarette smoke include accelerated atherosclerosis, endothelial dysfunction, reactive oxygen species, platelet aggregation, impaired immune cell migration and poor pulmonary clearance. The cumulative effect is impaired healing and increased susceptibility to infection[44]. Many, but not all, of these adverse effects are reversible within four to eight weeks[16,44].

Nicotine contributes to ulcer development by potentiating acid and pepsin secretion, increasing bile salt reflux, increasing Helicobacter pylori (*H. pylori*) infection risk and diminishing prostaglandin synthesis, mucosal blood flow and gastric mucus production[45]. Smoking post-bariatric surgery may also be associated with pneumonia and post-operative complications with subsequent surgeries involving body contour surgery and mastopexy[3,46-50].

Patients may be aware that smoking cessation is associated with weight gain in the general population and have concerns about smoking cessation and the impact on weight loss after surgery. It may be helpful to advise them that most current evidence demonstrates smoking habits are not associated with weight-loss outcomes after bariatric surgery[51].

Nicotine replacements, such as gum, lozenges or patches, improve the success rates of smoking-cessation programmes, and have not been to shown to be associated with adverse surgical outcomes[52]. Other forms of nicotine replacement, such as e-cigarettes/vaping do not have an evidence base demonstrating safety, but there is emerging evidence of harm[53,54].

Although current best practice guidelines recommend a minimum of six weeks of abstinence from smoking prior to bariatric surgery, the optimal pre-operative duration of smoking cessation to minimise surgical risk is not clear. Because smoking is a major risk factor for marginal ulceration after gastric bypass, some surgeons have the position that bypass should be avoided in patients who report smoking in the previous year[55].

Covid-19 infection and post-operative complications

Studies of elective or emergency surgery on patients with Covid-19 illness during the perioperative period report increased risk of pulmonary complications, thromboembolic events and 30-day mortality from 9% to 33%[56,57]. A large US study that included patients with recent but resolved Covid-19 infection identified an increased risk of post-operative complications up to eight weeks following Covid-19 diagnosis. Complications included post-operative pneumonia, respiratory failure, pulmonary embolus and sepsis. Surgery eight weeks or more after Covid-19 infection was not associated with increased risk of complications, compared to patients undergoing surgery before January 2020 (pre-Covid-19)[58]. Based on these findings, the authors suggest waiting until at least eight weeks following the first date of confirmed Covid-19 infection before proceeding with major elective surgery.

Pre-operative investigations

The pre-operative evaluation of a bariatric surgical candidate is similar to those patients considered for similar-risk surgery, with some caveats. Bariatric surgical candidates may have additional factors which may make their clinical evaluation more challenging. Many patients referred for bariatric surgery may have a low or exceptionally low functional capacity.

Cardiac evaluation: Exercise tolerance is a predictor for surgical outcomes. Symptom-limited stairclimbing, for example, is predictive of post-operative cardiopulmonary complications in patients undergoing high-risk surgery[59]. In addition, obesity is an independent risk factor for cardiovascular disease. Many patients with obesity may also convey symptoms of shortness of breath or chest pain, and the aetiology of these symptoms may be varied. Furthermore, the physical examination in patients living with obesity may be challenging, in that physical findings such as distant heart sounds or the evaluation of the jugular venous pressure may be difficult to obtain.

Patients undergoing bariatric surgery may have abnormalities in their electrocardiogram (ECG). An abnormal ECG in patients undergoing bariatric surgery may be independently associated with a higher likelihood of a complicated post-operative course, including the need for post-operative intensive care (ICU) admissions[60]. Obesity may also be associated with changes in cardiac morphology, including left ventricular hypertrophy, diastolic dysfunction or left ventricular dysfunction. Bariatric surgery is associated with a decrease in left ventricular mass index, left ventricular end-diastolic volume, improvement in diastolic dysfunction and systolic function and left atrial diameter[61].

ECG is not typically performed during pre-operative evaluations but may be required to detect suspected left or right ventricular dysfunction, valvular heart disease or pulmonary HTN. Visualisation of the echocardiographic images may be suboptimal. Computed tomographic coronary angiography, cardiac nuclear stress testing and cardiac magnetic resonance imaging are alternative methods of assessing ejection fraction and other aspects of cardiac function, but performing these scans may be challenging, with limits of aperture dimensions and weight restrictions. The gold standard for cardiac evaluation remains coronary angiography, which was not associated with an increase in minor or major complication rates in patients living with obesity[62].

Pulmonary evaluation: The respiratory system is also significantly affected in patients with an elevated BMI. Impairment in pulmonary function due to restriction in lung volumes, and abnormalities in respiratory mechanics resulting in increased work of breathing, may detrimentally affect the respiratory status of bariatric surgical candidates[63,64].

Sleep-disordered breathing apnea: It is not uncommon for people living with obesity to experience sleep-related disorders, which may result in significant respiratory, cardiovascular and neuropsychiatric conditions[65]. OSA, one type of a sleep-related disorder, is either the complete cessation of airflow (apnoea) or the significant reduction of airflow (hypopnoea) measured during sleep. The presence of OSA has been associated with premature death[66], motor vehicle accidents[67], hypertension[68], coronary artery disease and cerebrovascular accidents[69], nocturnal cardiac arrhythmias[70] and T2DM[71]. In addition, OSA has been associated with a significant increase in the incidence of sudden death from all cardiac causes[72]. OSA has been demonstrated to affect the white matter within the limbic system, pons, frontal, temporal and parietal cortices, and projections connecting the cerebellum, which are key areas for brain function and memory[73].

The incidence of OSA in middle-aged adults in the Wisconsin Sleep Cohort Study was approximately 24% in males and 9% in females[74]. In patients undergoing bariatric surgery, the prevalence of OSA can be ≥ 90%, with clinically significant sleep apnoea underdiagnosed in as many as 50% of these patients. The recognition of the diagnosis of OSA is even more challenging as there may be no correlation between the severity of OSA and BMI[75]. A study of patients attending a Level 3 obesity service in Ireland (mean BMI 53 kg/m^2), identified overall OSA prevalence of 91%, with 77% commenced on positive airway pressure (CPAP). The authors suggested that BMI > 50 kg/m^2 should be an indication for referral for sleep assessment, even in the absence of symptoms[76]. The prevalence of OSA is much higher in males compared with female bariatric surgical candidates[77].

Obesity hypoventilation syndrome (OHS), another type of sleep disorder, is defined by the combination of obesity (BMI ≥ 30 kg/m^2), sleep-disordered breathing and daytime hypercapnia (arterial carbon dioxide tension (PaCO2) ≥ 45 mmHg at sea level) during wakefulness occurring in the absence of an alternative neuromuscular, mechanical or metabolic explanation for hypoventilation[78]. It is estimated that the prevalence of OHS is between 8% and 20% in patients with obesity referred to sleep centres for evaluation of sleep-disordered breathing[79]. Metabolic and cardiovascular diseases (in particular pulmonary HTN, heart failure and coronary heart disease) are prevalent comorbidities in patients with OHS who also have increased mortality[80].

OSA in obesity is believed to be caused by excess fat deposition in or around the neck, causing the patient's upper airway passages to collapse[77]. The pathophysiology of OHS is related to obesity-related changes in the respiratory system, alterations in respiratory drive and breathing abnormalities during sleep[79]. Patients undergoing bariatric surgery who have sleep-disordered breathing may have a higher complication rate, which may include a prolonged hospital stay, the occurrence of thromboembolic phenomena, the need for reintervention and an increased 30-day mortality rate[81]. In addition, the presence of sleep-disordered breathing may be associated with more challenging intubations and increased ICU admissions[82-84].

The gold standard in the diagnosis of OSA is a level 1 polysomnogram (PSG)[85]. Resources for overnight in-laboratory PSG testing can be limited and expensive[86]. As a result, alternative methods for identifying patients at risk for OSA have been established. Polygraphy comprises a montage to monitor cardiorespiratory data, but electroencephalogram is not recorded. It is particularly useful for the diagnosis of OSA without significant comorbid conditions and in the absence of other sleep disorders. Peripheral arterial tonometry with oximetry and actigraphy is another alternative.

Utilising screening questionnaires, including the STOP-Bang Questionnaire, Berlin Questionnaire and Epworth Sleepiness Scale, has become routine for patients undergoing surgery, but relying on subjective screening questionnaires may fail to identify at-risk patients[6,87]. There may also be no significant correlation between the Epworth Sleepiness Score and severity of OSA[88]. There should be a high clinical suspicion for the presence of sleep-disordered breathing in bariatric patients undergoing surgery, with a low threshold for referring the patient for diagnostic sleep testing. In addition, the definitive test for diagnosing alveolar hypoventilation in the context of OHS is a room air arterial blood gas. However, a serum bicarbonate of ≥ 27 mEq/L should prompt clinicians to perform a confirmatory arterial blood gas analysis but a serum bicarbonate < 27 mEq/L has a 97% negative predictive value for excluding a diagnosis of OHS[89,90].

The use of CPAP immediately post-operatively after surgery is safe and should be administered if deemed clinically indicated[91].

Bariatric surgery is beneficial in improving sleep-disordered breathing[88]. However, despite significant weight loss post-operatively, bariatric surgical patients may have persistence of sleep-disordered breathing at one year post-operatively[91]. The long-term relationship between weight loss and sleep-disordered breathing is complex. There should be hypervigilance for recurrence of OSA in patients with this diagnosis pre-operatively, as reappearance can occur in the absence of weight regain[92-95].

Endoscopy: There exists controversy in the utility of pre-operative endoscopy in patients undergoing bariatric surgery. Most patients who undergo endoscopy have normal or non-clinically significant findings. The consideration for performing endoscopy should be individualised based on symptoms, risk factors and type of procedure being considered for each patient[96].

Patients considering sleeve gastrectomy who have dyspepsia, reflux, dysphagia or symptoms suggestive of foregut pathology, as well as those on chronic antacid therapy, should undergo pre-operative endoscopy to rule out the presence of hiatus hernia, oesophagitis or Barrett's oesophagus, or other diseases such as peptic ulcer disease and tumours[97-101]. Screening for *H. pylori* can be performed at the time of endoscopy. The incidence of *H. pylori* in patients with obesity planning to undergo bariatric surgery is variable, ranging between 15% and 85%[101,102]. *H. pylori* may be implicated in the development of gastritis, peptic ulcer and gastric carcinoma[103,104]. Screening for *H. pylori* is recommended for this reason in patients undergoing gastric bypass procedure. The benefits for patients undergoing other types of surgeries are controversial[105].

Cancer screening: Screening investigations for malignancy should be considered prior to bariatric surgery due to the association between certain malignancies and obesity[106]. Patients undergoing preparation for bariatric surgery should be encouraged to participate in established national screening programmes for breast, colon and cervical cancer[106].

Risk of thromboembolism: The 90-day incidence of venous thromboembolism after bariatric surgery is 0.42%[107]. Although uncommon, the clinical consequences can be devastating. Up to 40% of perioperative deaths may be attributed to pulmonary embolism. This remains one of the most common causes of perioperative death, along with myocardial infarction and sepsis from anastomotic leak[108]. Prophylaxis with low molecular weight heparin to prevent thromboembolism post-operatively after gastric bypass is common practice. The prophylactic use of an inferior vena cava filter is no longer recommended, even in patients at high risk of pulmonary embolism, as it is associated with increased risk of post-operative deep vein thrombosis and overall mortality, without decreasing the risk of pulmonary embolism[109].

Other considerations: Evaluation of the bariatric surgical patient with an abdominal ultrasound is not routinely recommended, except in those patients requiring an investigation for symptomatic biliary disease and elevated liver enzymes or non-alcoholic fatty liver disease[110].

Following bariatric surgery, decreases in bone density may be observed due to bone loss. Mixed restrictive and malabsorptive procedures, such as Roux-en-Y gastric bypass and biliopancreatic diversion, increase risk for bone fractures. Sleeve gastrectomy may result in bone loss to a lesser degree. Bone loss post-bariatric surgery may be attributed to many factors, including nutritional factors, skeletal unfolding, changes in calcium handling, body and bone marrow fat changes and changes in gut hormones. Baseline bone-density evaluation may be considered prior to bariatric surgery and two years post-bariatric surgery depending on risk factors, which include post-menopausal women, older men, patients with prior fragility fractures or a family history of osteoporosis. Vitamin D and parathyroid hormone levels may be obtained pre-operatively in the screening for patients at risk for metabolic bone disease[111].

Medication considerations

Prior to bariatric surgery, patients need to receive instructions and general precautions surrounding their medications. Avoidance of aspirin may be required prior to surgery in patients taking it for primary prevention. In addition, anti-inflammatory agents must be discontinued prior to surgery. The utilisation of these agents post-operatively will depend on their indication, risk tolerance and the surgical procedure. Chronic use of non-steroidal anti-inflammatory drugs is contraindicated for Roux-en-Y Gastric bypass, due to the risk of anastomotic ulcer.

Anti-platelet and anti-coagulant medication will also require cessation prior to surgery. In some cases, bridging anti-coagulation may be necessary. Data on the effectiveness and safety of direct oral anti-coagulants (DOACs) for patients with atrial fibrillation or history of venous thromboembolism (VTE) who have undergone bariatric surgery is minimal. There is some preliminary data to suggest that rivaroxaban and apixaban may retain efficacy following bariatric surgery, and that dabigatran has reduced efficacy. However, in the absence of sufficient pharmacokinetic and pharmacodynamic, and clinical outcome data, in patients taking DOACs post-bariatric surgery, their use is currently not recommended in this population, at prophylactic or therapeutic dose. Vitamin K antagonists, like warfarin, remain the preferred oral agent for anti-coagulation[112-114]. Patients should be made aware of the current recommendation to switch to vitamin K antagonists after bariatric procedures.

Immune-modulating medication used in the treatment of connective tissue and inflammatory disorders, skin disorders and immune-mediated gastrointestinal diseases may need to be held prior to surgery as well as post-operatively for a period of time, at the discretion of the prescribing specialist.

Long-acting release medications may need to be converted after bariatric surgery to short-acting preparations. Medications dependent upon absorption or an acid environment within the stomach and upper gastrointestinal tract may need to be re-evaluated[115-117]. Certain medications may need to be crushed, while encapsulated formulations may need to be opened in the early post-operative period. A comprehensive pharmacologic consultation prior to surgery should be considered.

Women taking oestrogen therapy in the form of oral contraception should discontinue their medication four weeks prior to surgery, while post-menopausal women may discontinue hormone replacement therapy three weeks prior to surgery, due to increased risk of post-operative VTE[83].

Women are recommended to defer pregnancy until after the period of rapid weight loss (12 to 18 months), so reliable contraception is important. Obesity can be associated with impaired fertility, so patients may not be using contraception pre-surgery. They should be advised that fertility increases with weight loss post-operatively, and that oral contraceptives may not be reliable. The use of long-acting reversible contraception such as intra-uterine device should be encouraged[118].

Pre-operative management of patients living with diabetes

In preparation for bariatric surgery, blood glucose readings of patients living with T2DM should be optimised. Re-evaluation of the comprehensive care plan should be undertaken, as well as re-evaluation of nutrition, activity level and the status of pharmacotherapy. Existing guidelines recommend targets for glycaemia with the hope of improving bariatric surgical outcomes. Suggested targets include glycated haemoglobin (HbA1c) less than 7%, fasting blood sugar level less than 6.1 mmol/L and a two-hour post-prandial blood sugar of 7.7 mmol/L. However, there is limited data guiding the management of glycaemia in bariatric surgery, both pre-operatively and post-operatively.

One study reported that patients with HbA1c > 8% prior to gastric bypass surgery were associated with increased post-operative complications, decreased weight loss and less resolution of the patient's T2DM[119]. With regard to impact of lower HbA1c pre-operatively and long-term outcomes such as diabetes remission, two studies reported a significant improvement in diabetes remission with pre-operative HbA1c < 7%, whereas one small study found no difference in HbA1c at one year following surgery, between intensive and usual care arms. There were only 35 people in this study and the mean HbA1c achieved in the intensive arm was 8.4%, versus a mean of 9.7% in the usual care arm[120,121].

Less aggressive blood glucose targets may be required prior to bariatric surgery in some patients, as often bariatric surgical patients with T2DM have high insulin resistance, resulting in suboptimal control[122].

With other surgeries, such as orthopaedic and colorectal surgery, an elevated HbA1c pre-operatively may be associated with prolonged length-of-stay post-operatively and worsened post-operative outcomes[123-127].

If the patient with T2DM is on a VLCD in preparation for bariatric surgery, re-evaluation of their diabetes medications should be undertaken, as a patient's requirements for medication may be significantly altered. For diet-managed patients with T2DM, no significant interventions are required.

Patients undergoing VLCD and taking sulfonylureas or insulin will need close monitoring and adjustment of dose as indicated, in order to avoid hypoglycaemia. Insulin requirements while on meal-replacement therapy in preparation for surgery decrease. Intermediate and long-acting insulin require a decreased dose, often by 50%, and short-acting insulins may require significant re-adjustment[128,129]. Frequent blood glucose monitoring is required while on VLCDs in preparation for bariatric surgery. Symptomatic hypoglycaemia is treated in the usual fashion[130].

Sodium glucose cotransporter 2 inhibitors should be stopped while on VLCD due to the risk of dehydration and/or diabetic ketoacidosis[131]. While on meal-replacement therapy, there may be an increased risk of intravascular volume depletion. Close observation of a patient's volume status, electrolytes and kidney function is a prudent and cautious approach[132]. Diuretics should be dose adjusted or held. In addition, close evaluation of blood pressure readings is required, and adjustment to anti-hypertensive medication may be necessary[133]. Patients with HTN on blood pressure medication and concurrent meal replacement therapy should be educated about the possibility of developing orthostatic HTN.

Individuals on meal-replacement therapy and warfarin may also require closer observation of their international normalised ratio level[134,135].

Conclusion

Bariatric surgery is a life-altering and effective obesity-management intervention. Several considerations must be undertaken to prepare a potential candidate for surgery. The patient's medical, mental, nutritional and functional health should be evaluated prior to surgery. Once adequate evaluation, preparation and optimisation have been undertaken, establishing an acceptable perioperative risk profile, the patient may proceed with bariatric surgery.

Correspondence:
info@asoi.info

References

1. Mechanick JI, Youdim A, Jones DB, et al. Clinical practice guidelines for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient--2013 update: cosponsored by American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery. Obesity (Silver Spring) 2013; 21 Suppl 1: S1-27.
2. Parrott J, Frank L, Rabena R, Craggs-Dino L, Isom KA, Greiman L. American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional Guidelines for the Surgical Weight Loss Patient 2016 Update: Micronutrients. Surg Obes Relat Dis 2017; 13(5): 727-41.
3. Myers K, Hajek P, Hinds C, McRobbie H. Stopping smoking shortly before surgery and postoperative complications: a systematic review and meta-analysis. Arch Intern Med 2011; 171(11): 983-9.
4. Chow A, Neville A, Kolozsvari N. Smoking in bariatric surgery: a systematic review. Surg Endosc 2021; 35(6): 3047-66.
5. Gasa M, Salord N, Fortuna AM, et al. Obstructive sleep apnoea and metabolic impairment in severe obesity. Eur Respir J 2011; 38(5): 1089-97.
6. Glazer SA, Erickson AL, Crosby RD, Kieda J, Zawisza A, Deitel M. The Evaluation of Screening Questionnaires for Obstructive Sleep Apnea to Identify High-Risk Obese Patients Undergoing Bariatric Surgery. Obes Surg 2018; 28(11): 3544-52.
7. Brazil J, Finucane F. Structured Lifestyle Modification Prior to Bariatric Surgery: How Much is Enough? Obes Surg 2021; 31(10): 4585-91.
8. National Institutes of Health. Executive summary of the clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. Arch Intern Med 1998; 158(17): 1855-67.
9. Di Lorenzo N, Antoniou SA, Batterham RL, et al. Clinical practice guidelines of the European Association for Endoscopic Surgery (EAES) on bariatric surgery: update 2020 endorsed by IFSO-EC, EASO and ESPCOP. Surg Endosc 2020; 34(6): 2332-58.
10. Busetto L, Dixon J, De Luca M, Shikora S, Pories W, Angrisani L. Bariatric surgery in class I obesity : a Position Statement from the International Federation for the Surgery of Obesity and Metabolic Disorders (IFSO). Obes Surg 2014; 24(4): 487-519.
11. ASMBS Clinical Issues Committee. Bariatric surgery in class I obesity (body mass index 30-35 kg/m(2)). Surg Obes Relat Dis 2013; 9(1): e1-10.
12. Aminian A, Chang J, Brethauer SA, Kim JJ. ASMBS updated position statement on bariatric surgery in class I obesity (BMI 30-35 kg/m(2)). Surg Obes Relat Dis 2018; 14(8): 1071-87.
13. Pratt JSA, Browne A, Browne NT, et al. ASMBS pediatric metabolic and bariatric surgery guidelines, 2018. Surg Obes Relat Dis 2018; 14(7): 882-901.
14. Sogg S, Lauretti J, West-Smith L. Recommendations for the presurgical psychosocial evaluation of bariatric surgery patients. Surg Obes Relat Dis 2016; 12(4): 731-49.
15. Mechanick JI, Apovian C, Brethauer S, et al. Clinical practice guidelines for the perioperative nutrition, metbolic, and nonsurgical support of patients undergoing bariatric procedures - 2019 update: Cosponsored by American Association of Clinical Endocrinologists / American College of Endocrinology, The Obesity Society, American Society for Metabolic and Bariatric Surgery, Obesity Medicine Association, and the American Society of Anesthesiologists - Executive Summary. Endocr Pract 2019; 25(12): 1346-59.
16. Carter J, Chang J, Birriel TJ, et al. ASMBS position statement on preoperative patient optimization before metabolic and bariatric surgery. Surg Obes Relat Dis 2021; 17(12): 1956-76.
17. Vallois A, Menahem B, Alves A. Is Laparoscopic Bariatric Surgery Safe and Effective in Patients over 60 Years of Age?" an Updated Systematic Review and Meta-Analysis. Obes Surg 2020; 30(12): 5059-70.
18. Giordano S, Victorzon M. Bariatric surgery in elderly patients: a systematic review. Clin Interv Aging 2015; 10: 1627-35.
19. Shimizu H, Phuong V, Maia M, et al. Bariatric surgery in patients with liver cirrhosis. Surg Obes Relat Dis 2013; 9(1): 1-6.
20. Jan A, Narwaria M, Mahawar KK. A Systematic Review of Bariatric Surgery in Patients with Liver Cirrhosis. Obes Surg 2015; 25(8): 1518-26.
21. Agopian VG, Kaldas FM, Hong JC, et al. Liver transplantation for nonalcoholic steatohepatitis: the new epidemic. Ann Surg 2012; 256(4): 624-33.
22. Mandell MS, Zimmerman M, Campsen J, Kam I. Bariatric surgery in liver transplant patients: weighing the evidence. Obes Surg 2008; 18(12): 1515-6.
23. Angulo P. Nonalcoholic fatty liver disease and liver transplantation. Liver Transpl 2006; 12(4): 523-34.
24. Lazzati A, Iannelli A, Schneck AS, et al. Bariatric surgery and liver transplantation: a systematic review a new frontier for bariatric surgery. Obes Surg 2015; 25(1): 134-42.
25. Patton H, Heimbach J, McCullough A. AGA Clinical Practice Update on Bariatric Surgery in Cirrhosis: Expert Review. Clin Gastroenterol Hepatol 2021; 19(3): 436-45.

26. Mendoza YP, Becchetti C, Watt KD, Berzigotti A. Risks and Rewards of Bariatric Surgery in Advanced Chronic Liver Diseases. Semin Liver Dis 2021; 41(4): 448-60.

27. Egberts K, Brown WA, Brennan L, O'Brien PE. Does exercise improve weight loss after bariatric surgery? A systematic review. Obes Surg 2012; 22(2): 335-41.

28. Kalarchian MA, Marcus MD, Courcoulas AP, Cheng Y, Levine MD. Preoperative lifestyle intervention in bariatric surgery: a randomized clinical trial. Surg Obes Relat Dis 2016; 12(1): 180-7.

29. Fujioka K, Yan E, Wang HJ, Li Z. Evaluating preoperative weight loss, binge eating disorder, and sexual abuse history on Roux-en-Y gastric bypass outcome. Surg Obes Relat Dis 2008; 4(2): 137-43.

30. Van Nieuwenhove Y, Dambrauskas Z, Campillo-Soto A, et al. Preoperative very low-calorie diet and operative outcome after laparoscopic gastric bypass: a randomized multicenter study. Arch Surg 2011; 146(11): 1300-5.

31. Alami RS, Morton JM, Schuster R, et al. Is there a benefit to preoperative weight loss in gastric bypass patients? A prospective randomized trial. Surg Obes Relat Dis 2007; 3(2): 141-5.

32. Cassie S, Menezes C, Birch DW, Shi X, Karmali S. Effect of preoperative weight loss in bariatric surgical patients: a systematic review. Surg Obes Relat Dis 2011; 7(6): 760-7.

33. Holderbaum M, Casagrande DS, Sussenbach S, Buss C. Effects of very low calorie diets on liver size and weight loss in the preoperative period of bariatric surgery: a systematic review. Surg Obes Relat Dis 2018; 14(2): 237-44.

34. Romeijn MM, Kolen AM, Holthuijsen DDB, et al. Effectiveness of a Low-Calorie Diet for Liver Volume Reduction Prior to Bariatric Surgery: a Systematic Review. Obesity Surgery 2021; 31(1): 350-6.

35. Bettini S, Belligoli A, Fabris R, Busetto L. Diet approach before and after bariatric surgery. Reviews in endocrine & metabolic disorders 2020; 21(3): 297-306.

36. O'Kane M, Parretti HM, Pinkney J, et al. British Obesity and Metabolic Surgery Society Guidelines on perioperative and postoperative biochemical monitoring and micronutrient replacement for patients undergoing bariatric surgery-2020 update. Obesity reviews : an official journal of the International Association for the Study of Obesity 2020; 21(11): e13087.

37. Peterson LA, Cheskin LJ, Furtado M, et al. Malnutrition in Bariatric Surgery Candidates: Multiple Micronutrient Deficiencies Prior to Surgery. Obes Surg 2016; 26(4): 833-8.

38. Sanchez A, Rojas P, Basfi-Fer K, et al. Micronutrient Deficiencies in Morbidly Obese Women Prior to Bariatric Surgery. Obes Surg 2016; 26(2): 361-8.

39. Sherf Dagan S, Zelber-Sagi S, Webb M, et al. Nutritional Status Prior to Laparoscopic Sleeve Gastrectomy Surgery. Obes Surg 2016; 26(9): 2119-26.

40. Weimann A, Braga M, Carli F, et al. ESPEN guideline: Clinical nutrition in surgery. Clin Nutr 2017; 36(3): 623-50.

41. Fieber JH, Sharoky CE, Wirtalla C, Williams NN, Dempsey DT, Kelz RR. The Malnourished Patient With Obesity: A Unique Paradox in Bariatric Surgery. J Surg Res 2018; 232: 456-63.

42. Major P, Malczak P, Wysocki M, et al. Bariatric patients' nutritional status as a risk factor for postoperative complications, prolonged length of hospital stay and hospital readmission: A retrospective cohort study. Int J Surg 2018; 56: 210-4.

43. Miller JW. Proton Pump Inhibitors, H2-Receptor Antagonists, Metformin, and Vitamin B-12 Deficiency: Clinical Implications. Adv Nutr 2018; 9(4): 511s-8s.

44. Sørensen LT. Wound healing and infection in surgery. The clinical impact of smoking and smoking cessation: a systematic review and meta-analysis. Arch Surg 2012; 147(4): 373-83.

45. Endoh K, Leung FW. Effects of smoking and nicotine on the gastric mucosa: a review of clinical and experimental evidence. Gastroenterology 1994; 107(3): 864-78.

46. Felix EL, Kettelle J, Mobley E, Swartz D. Perforated marginal ulcers after laparoscopic gastric bypass. Surg Endosc 2008; 22(10): 2128-32.

47. Gupta PK, Gupta H, Kaushik M, et al. Predictors of pulmonary complications after bariatric surgery. Surg Obes Relat Dis 2012; 8(5): 574-81.

48. Gravante G, Araco A, Sorge R, Araco F, Delogu D, Cervelli V. Wound infections in body contouring mastopexy with breast reduction after laparoscopic adjustable gastric bandings: the role of smoking. Obes Surg 2008; 18(6): 721-7.

49. Coupaye M, Sabate JM, Castel B, et al. Predictive factors of weight loss 1 year after laparoscopic gastric bypass in obese patients. Obes Surg 2010; 20(12): 1671-7.

50. Garb J, Welch G, Zagarins S, Kuhn J, Romanelli J. Bariatric surgery for the treatment of morbid obesity: a meta-analysis of weight loss outcomes for laparoscopic adjustable gastric banding and laparoscopic gastric bypass. Obes Surg 2009; 19(10): 1447-55.

51. Mohan S, Samaan JS, Samakar K. Impact of smoking on weight loss outcomes after bariatric surgery: a literature review. Surg Endosc 2021; 35(11): 5936-52.

52. Nolan MB, Warner DO. Safety and Efficacy of Nicotine Replacement Therapy in the Perioperative Period: A Narrative Review. Mayo Clin Proc 2015; 90(11): 1553-61.

53. Srikanth N, Xie L, Morales-Marroquin E, Ofori A, de la Cruz-Muñoz N, Messiah SE. Intersection of smoking, e-cigarette use, obesity, and metabolic and bariatric surgery: a systematic review of the current state of evidence. J Addict Dis 2021; 39(3): 331-46.

54. Christiani DC. Vaping-Induced Acute Lung Injury. N Engl J Med 2020; 382(10): 960-2.

55. Di Palma A, Liu B, Maeda A, Anvari M, Jackson T, Okrainec A. Marginal ulceration following Roux-en-Y gastric bypass: risk factors for ulcer development, recurrence and need for revisional surgery. Surg Endosc 2021; 35(5): 2347-53.

56. Nepogodiev D, Bhangu A, Glasbey JC, et al. Mortality and pulmonary complications in patients undergoing surgery with perioperative SARS-CoV-2 infection: an international cohort study. The Lancet 2020; 396(10243): 27-38.

57. Knisely A, Zhou ZN, Wu J, et al. Perioperative Morbidity and Mortality of Patients With COVID-19 Who Undergo Urgent and Emergent Surgical Procedures. Ann Surg 2021; 273(1): 34-40.

58. Deng JZ, Chan JS, Potter AL, et al. The Risk of Postoperative Complications After Major Elective Surgery in Active or Resolved COVID-19 in the United States. Ann Surg 2022; 275(2): 242-6.

59. Girish M, Trayner E, Dammann O, Pinto-Plata V, Celli B. Symptom-limited stair climbing as a predictor of postoperative cardiopulmonary complications after high-risk surgery. Chest 2001; 120(4): 1147-51.

60. Gonzalez R, Bowers SP, Venkatesh KR, Lin E, Smith CD. Preoperative factors predictive of complicated postoperative management after Roux-en-Y gastric bypass for morbid obesity. Surg Endosc 2003; 17(12): 1900-4.

61. Aggarwal R, Harling L, Efthimiou E, Darzi A, Athanasiou T, Ashrafian H. The Effects of Bariatric Surgery on Cardiac Structure and Function: a Systematic Review of Cardiac Imaging Outcomes. Obes Surg 2016; 26(5): 1030-40.

62. McNulty PH, Ettinger SM, Field JM, et al. Cardiac catheterization in morbidly obese patients. Catheter Cardiovasc Interv 2002; 56(2): 174-7.

63. Aguiar IC, Freitas WR, Jr., Santos IR, et al. Obstructive sleep apnea and pulmonary function in patients with severe obesity before and after bariatric surgery: a randomized clinical trial. Multidiscip Respir Med 2014; 9(1): 43.

64. Wei YF, Wu HD. Candidates for bariatric surgery: morbidly obese patients with pulmonary dysfunction. J Obes 2012; 2012: 878371.

65. Shahi B, Praglowski B, Deitel M. Sleep-related Disorders in the Obese. Obes Surg 1992; 2(2): 157-68.

66. Hallowell PT, Stellato TA, Schuster M, et al. Potentially life-threatening sleep apnea is unrecognized without aggressive evaluation. Am J Surg 2007; 193(3): 364-7.

67. Marshall NS, Wong KK, Liu PY, Cullen SR, Knuiman MW, Grunstein RR. Sleep apnea as an independent risk factor for all-cause mortality: the Busselton Health Study. Sleep 2008; 31(8): 1079-85.

68. Teran-Santos J, Jimenez-Gomez A, Cordero-Guevara J. The association between sleep apnea and the risk of traffic accidents. Cooperative Group Burgos-Santander. N Engl J Med 1999; 340(11): 847-51.

69. Somers VK, Dyken ME, Clary MP, Abboud FM. Sympathetic neural mechanisms in obstructive sleep apnea. J Clin Invest 1995; 96(4): 1897-904.

70. Parra O, Arboix A, Bechich S, et al. Time course of sleep-related breathing disorders in first-ever stroke or transient ischemic attack. Am J Respir Crit Care Med 2000; 161(2 Pt 1): 375-80.

71. Mehra R, Benjamin EJ, Shahar E, et al. Association of nocturnal arrhythmias with sleep-disordered breathing: The Sleep Heart Health Study. Am J Respir Crit Care Med 2006; 173(8): 910-6.

72. Tasali E, Mokhlesi B, Van Cauter E. Obstructive sleep apnea and type 2 diabetes: interacting epidemics. Chest 2008; 133(2): 496-506.

73. Macey PM, Kumar R, Woo MA, Valladares EM, Yan-Go FL, Harper RM. Brain structural changes in obstructive sleep apnea. Sleep 2008; 31(7): 967-77.

74. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med 1993; 328(17): 1230-5.

75. O'Keeffe T, Patterson EJ. Evidence supporting routine polysomnography before bariatric surgery. Obes Surg 2004; 14(1): 23-6.

76. Meurling IJ, Russell A, O'Malley E, Dunlevy C, O'Shea D, Garvey JF. Prevalence of Sleep Disordered Breathing in an Ambulatory Bariatric Population. Irish Medical Journal 2021; 114(6): 2-5.

77. Peromaa-Haavisto P, Tuomilehto H, Kossi J, et al. Prevalence of Obstructive Sleep Apnoea Among Patients Admitted for Bariatric Surgery. A Prospective Multicentre Trial. Obes Surg 2016; 26(7): 1384-90.

78. Mokhlesi B, Kryger MH, Grunstein RR. Assessment and management of patients with obesity hypoventilation syndrome. Proc Am Thorac Soc 2008; 5(2): 218-25.

79. Masa JF, Pépin J-L, Borel J-C, Mokhlesi B, Murphy PB, Sánchez-Quiroga MA. Obesity hypoventilation syndrome. European Respiratory Review 2019; 28(151): 180097.

80. Nowbar S, Burkart KM, Gonzales R, et al. Obesity-associated hypoventilation in hospitalized patients: prevalence, effects, and outcome. Am J Med 2004; 116(1): 1-7.

81. Quintas-Neves M, Preto J, Drummond M. Assessment of bariatric surgery efficacy on Obstructive Sleep Apnea (OSA). Rev Port Pneumol (2006) 2016; 22(6): 331-6.

82. Fritscher LG, Canani S, Mottin CC, et al. Bariatric surgery in the treatment of obstructive sleep apnea in morbidly obese patients. Respiration 2007; 74(6): 647-52.

83. Longitudinal Assessment of Bariatric Surgery Consortium, Flum DR, Belle SH, et al. Perioperative safety in the longitudinal assessment of bariatric surgery. N Engl J Med 2009; 361(5): 445-54.

84. Gupta RM, Parvizi J, Hanssen AD, Gay PC. Postoperative complications in patients with obstructive sleep apnea syndrome undergoing hip or knee replacement: a case-control study. Mayo Clin Proc 2001; 76(9): 897-905.

85. Gentil B, de Larminat JM, Boucherez C, Lienhart A. Difficult intubation and obstructive sleep apnoea syndrome. Br J Anaesth 1994; 72(3): 368.

86. Nagappa M, Liao P, Wong J, et al. Validation of the STOP-Bang Questionnaire as a Screening Tool for Obstructive Sleep Apnea among Different Populations: A Systematic Review and Meta-Analysis. PLoS One 2015; 10(12): e0143697.

87. Sharkey KM, Orff HJ, Tosi C, Harrington D, Roye GD, Millman RP. Subjective sleepiness and daytime functioning in bariatric patients with obstructive sleep apnea. Sleep Breath 2013; 17(1): 267-74.

88. Serafini FM, MacDowell Anderson W, Rosemurgy AS, Strait T, Murr MM. Clinical predictors of sleep apnea in patients undergoing bariatric surgery. Obes Surg 2001; 11(1): 28-31.

89. Mokhlesi B, Tulaimat A, Faibussowitsch I, Wang Y, Evans AT. Obesity hypoventilation syndrome: prevalence and predictors in patients with obstructive sleep apnea. Sleep Breath 2007; 11(2): 117-24.

90. Macavei VM, Spurling KJ, Loft J, Makker HK. Diagnostic predictors of obesity-hypoventilation syndrome in patients suspected of having sleep disordered breathing. J Clin Sleep Med 2013; 9(9): 879-84.

91. Ramirez A, Lalor PF, Szomstein S, Rosenthal RJ. Continuous positive airway pressure in immediate postoperative period after laparoscopic Roux-en-Y gastric bypass: is it safe? Surg Obes Relat Dis 2009; 5(5): 544-6.

92. Sarkhosh K, Switzer NJ, El-Hadi M, Birch DW, Shi X, Karmali S. The impact of bariatric surgery on obstructive sleep apnea: a systematic review. Obes Surg 2013; 23(3): 414-23.

93. Peromaa-Haavisto P, Tuomilehto H, Kossi J, et al. Obstructive sleep apnea: the effect of bariatric surgery after 12 months. A prospective multicenter trial. Sleep Med 2017; 35: 85-90.

94. Pillar G, Peled R, Lavie P. Recurrence of sleep apnea without concomitant weight increase 7.5 years after weight reduction surgery. Chest 1994; 106(6): 1702-4.

95. Sampol G, Munoz X, Sagales MT, et al. Long-term efficacy of dietary weight loss in sleep apnoea/hypopnoea syndrome. Eur Respir J 1998; 12(5): 1156-9.

96. Parikh M, Liu J, Vieira D, et al. Preoperative Endoscopy Prior to Bariatric Surgery: a Systematic Review and Meta-Analysis of the Literature. Obes Surg 2016; 26(12): 2961-6.

97. Praveenraj P, Gomes RM, Kumar S, et al. Diagnostic Yield and Clinical Implications of Preoperative Upper Gastrointestinal Endoscopy in Morbidly Obese Patients Undergoing Bariatric Surgery. J Laparoendosc Adv Surg Tech A 2015; 25(6): 465-9.

98. Peromaa-Haavisto P, Victorzon M. Is routine preoperative upper GI endoscopy needed prior to gastric bypass? Obes Surg 2013; 23(6): 736-9.

99. Che F, Nguyen B, Cohen A, Nguyen NT. Prevalence of hiatal hernia in the morbidly obese. Surg Obes Relat Dis 2013; 9(6): 920-4.

100. Steinbrook R. Surgery for severe obesity. N Engl J Med 2004; 350(11): 1075-9.

101. Kuper MA, Kratt T, Kramer KM, et al. Effort, safety, and findings of routine preoperative endoscopic evaluation of morbidly obese patients undergoing bariatric surgery. Surg Endosc 2010; 24(8): 1996-2001.

102. Al-Akwaa AM. Prevalence of Helicobacter pylori infection in a group of morbidly obese Saudi patients undergoing bariatric surgery: a preliminary report. Saudi J Gastroenterol 2010; 16(4): 264-7.

103. Carabotti M, D'Ercole C, Iossa A, Corazziari E, Silecchia G, Severi C. Helicobacter pylori infection in obesity and its clinical outcome after bariatric surgery. World J Gastroenterol 2014; 20(3): 647-53.

104. Sauerland S, Angrisani L, Belachew M, et al. Obesity surgery: evidence-based guidelines of the European Association for Endoscopic Surgery (EAES). Surg Endosc 2005; 19(2): 200-21.

105. Goday A, Castaner O, Benaiges D, et al. Can Helicobacter pylori Eradication Treatment Modify the Metabolic Response to Bariatric Surgery? Obes Surg 2018; 28(8): 2386-95.

106. Health Service Executive (HSE). About Cancer Screening - Health Professionals. 2021. https://www.hse.ie/eng/services/list/5/cancer/profinfo/screening/ (accessed 3 March 2022).

107. Winegar DA, Sherif B, Pate V, DeMaria EJ. Venous thromboembolism after bariatric surgery performed by Bariatric Surgery Center of Excellence Participants: analysis of the Bariatric Outcomes Longitudinal Database. Surg Obes Relat Dis 2011; 7(2): 181-8.

108. Omalu BI, Ives DG, Buhari AM, et al. Death rates and causes of death after bariatric surgery for Pennsylvania residents, 1995 to 2004. Arch Surg 2007; 142(10): 923-8.

109. Kaw R, Pasupuleti V, Wayne Overby D, et al. Inferior vena cava filters and postoperative outcomes in patients undergoing bariatric surgery: a meta-analysis. Surg Obes Relat Dis 2014; 10(4): 725-33.

110. Abou Hussein BM, Khammas A, Makki M, et al. Role of Routine Abdominal Ultrasound Before Bariatric Surgery: Review of 937 Patients. Obes Surg 2018; 28(9): 2696-9.

111. Mechanick JI, Kushner RF, Sugerman HJ, et al. American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic & Bariatric Surgery medical guidelines for clinical practice for the perioperative nutritional, metabolic, and nonsurgical support of the bariatric surgery patient. Obesity (Silver Spring) 2009; 17 Suppl 1: S1-70.

112. Leven C, Hoffmann C, Roche C, Couturaud F, Thereaux J, Lacut K. Impact of bariatric surgery on oral anticoagulants pharmacology, and consequences for clinical practice: a narrative review. Fundam Clin Pharmacol 2021; 35(1): 53-61.

113. Nasser MF, Jabri A, Gandhi S, Rader F. Oral Anticoagulant Use in Morbid Obesity and Post Bariatric Surgery: A Review. Am J Med 2021; 134(12): 1465-75.

114. Martin KA, Lee CR, Farrell TM, Moll S. Oral Anticoagulant Use After Bariatric Surgery: A Literature Review and Clinical Guidance. Am J Med 2017; 130(5): 517-24.

115. de Sousa Prado Geraldo M, Fonseca FLA, de Fatima Veiga Gouveia MR, Feder D. The use of drugs in patients who have undergone bariatric surgery. Int J Gen Med 2014; 7: 219-24.

116. Padwal R, Brocks D, Sharma AM. A systematic review of drug absorption following bariatric surgery and its theoretical implications. Obes Rev 2010; 11(1): 41-50.

117. Miller AD, Smith KM. Medication and nutrient administration considerations after bariatric surgery. Am J Health Syst Pharm 2006; 63(19): 1852-7.

118. Shawe J, Ceulemans D, Akhter Z, et al. Pregnancy after bariatric surgery: Consensus recommendations for periconception, antenatal and postnatal care. Obes Rev 2019; 20(11): 1507-22.

119. Perna M, Romagnuolo J, Morgan K, Byrne TK, Baker M. Preoperative hemoglobin A1c and postoperative glucose control in outcomes after gastric bypass for obesity. Surg Obes Relat Dis 2012; 8(6): 685-90.

120. English TM, Malkani S, Kinney RL, Omer A, Dziewietin MB, Perugini R. Predicting remission of diabetes after RYGB surgery following intensive management to optimize preoperative glucose control. Obes Surg 2015; 25(1): 1-6.

121. de Oliveira VLP, Martins GP, Mottin CC, Rizzolli J, Friedman R. Predictors of Long-Term Remission and Relapse of Type 2 Diabetes Mellitus Following Gastric Bypass in Severely Obese Patients. Obes Surg 2018; 28(1): 195-203.

122. Kahn BB, Flier JS. Obesity and insulin resistance. J Clin Invest 2000; 106(4): 473-81.

123. Estrada CA, Young JA, Wiley Nifong L, Chitwood WR. Outcomes and perioperative hyperglycemia in patients with or without diabetes mellitus undergoing coronary artery bypass grafting. The Annals of Thoracic Surgery 2003; 75(5): 1392-9.

124. Marchant MH, Viens NA, Cook C, Vail TP, Bolognesi MP. The impact of glycemic control and diabetes mellitus on perioperative outcomes after total joint arthroplasty. J Bone Joint Surg Am 2009; 91(7): 1621-9.

125. Walid MS, Newman BF, Yelverton JC, Nutter JP, Ajjan M, Robinson JS. Prevalence of previously unknown elevation of glycosylated hemoglobin in spine surgery patients and impact on length of stay and total cost. J Hosp Med 2010; 5(1): E10-4.

126. O'Sullivan CJ, Hynes N, Mahendran B, et al. Haemoglobin A1c (HbA1C) in non-diabetic and diabetic vascular patients. Is HbA1C an independent risk factor and predictor of adverse outcome? Eur J Vasc Endovasc Surg 2006; 32(2): 188-97.

127. Gustafsson UO, Thorell A, Soop M, Ljungqvist O, Nygren J. Haemoglobin A1c as a predictor of postoperative hyperglycaemia and complications after major colorectal surgery. Br J Surg 2009; 96(11): 1358-64.

128. Sievenpiper JL, Chan CB, Dworatzek PD, Freeze C, Williams SL. Clinical Practice Guidelines Nutrition Therapy Diabetes Canada Clinical Practice Guidelines Expert Committee. Can J Diabetes 2018; 42: S64-S79.

129. Shiau JY, So DYF, Dent RR. Effects on Diabetes Medications, Weight and Glycated Hemoglobin Among Adult Patients With Obesity and Type 2 Diabetes: 6-Month Observations From a Full Meal Replacement, Low-Calorie Diet Weight Management Program. Can J Diabetes 2018; 42(1): 56-60.

130. Nestle Health Science. Diabetes and the OPTIFAST VLCD Program. 2022. https://www.optifast.com.au/healthcare-professionals/clinical-treatment-protocol/diabetes (accessed 3 March 2022).

131. Mazer CD, Arnaout A, Connelly KA, et al. Sodium-glucose cotransporter 2 inhibitors and type 2 diabetes: clinical pearls for in-hospital initiation, in-hospital management, and postdischarge. Curr Opin Cardiol 2019; 35(2): 178-86.

132. Saiki A, Nagayama D, Ohhira M, et al. Effect of weight loss using formula diet on renal function in obese patients with diabetic nephropathy. Int J Obes (Lond) 2005; 29(9): 1115-20.

133. Valenta LJ, Elias AN. Modified fasting in treatment of obesity. Effects on serum lipids, electrolytes, liver enzymes, and blood pressure. Postgrad Med 1986; 79(4): 263-7.

134. Couris R, Tataronis G, McCloskey W, et al. Dietary vitamin K variability affects International Normalized Ratio (INR) coagulation indices. Int J Vitam Nutr Res 2006; 76(2): 65-74.

135. Pedersen FM, Hamberg O, Hess K, Ovesen L. The effect of dietary vitamin K on warfarin-induced anticoagulation. J Intern Med 1991; 229(6): 517-20.