Chapter 1

Preoperative Evaluation of Bariatric Surgery Patients

Gurdeep S. Matharoo, Erika Renick,
John N. Afthinos, Tracey Straker and
Karen E. Gibbs

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/58605

1. Introduction

Bariatric surgery has undergone a revolution since its inception in the 1960's. Great strides have been made in technique, safety and outcomes within the past decade and in the face of the advent of newer procedures. This speaks to a better organization of bariatric surgery as a specialty, improved training and the unwavering demand and pursuit of excellence. Despite substantial improvement within the specialty there are a number of comorbid conditions and preoperative findings revealed that necessitate optimization to obtain the best surgical outcomes.

The ultimate goal of bariatric surgery should be to achieve, in as safe a manner as possible, weight loss for the reduction in comorbid conditions and overall long-term effect on mortality and quality of life. A significant contribution to this task has been a more thorough understanding of obesity-related comorbidities and their effects on patient outcomes with respect to perioperative morbidity and mortality. The evaluation of different comorbid conditions through large patient databases has elucidated which comorbid factors contribute towards perioperative morbidity and mortality.

The goal of this chapter will be to review the preoperative evaluation of patients preparing for weight loss surgery. An overview of the general concepts will be described, and then a detailed discussion of the more common comorbid conditions will be presented, along with relevant points and recent literature to support the recommendations. We will utilize an organ system approach. The strategy and rationale for the evaluations that are recommended (or not) will be discussed. Their impact on outcomes will be elucidated for the reader to understand and use to appropriately assess the patient preparing for surgery. An evidence-based approach will show us how to maximize our evaluations of these patients. Awareness of these details empowers healthcare providers to choose and counsel patients appropriately in the preoperative setting.

Weight loss surgery has been shown to have a significant impact on the lives of our patients. Yet, we still face the issue of effectively evaluating and optimizing these patients in the preoperative setting to allow them to partake of the benefits that await them on the other side. The following preoperative evaluations will be addressed in the chapter: indications, cardiovascular, vascular (venous system), pulmonary, endocrine, gastrointestinal, nutritional, psychological, education, functional status. The significance of the final evaluation by the anesthesiologist will also be discussed. Irrespective of the procedure chosen (gastric bypass, gastric bypass, sleeve gastrectomy, duodenal switch), approach used (laparoscopic or open) the preoperative evaluation is essential to prepare the patient for this major lifestyle change.

2. Indications

In 1991 the National Institutes of Health published a consensus statement regarding weight loss surgery. Surgery was indicated in patients with a BMI ≥ 40 kg/m^2 and in patients with a BMI between 35 and 40 if they also had comorbidities. Severe sleep apnea, Pickwickian syndrome, obesity related cardiomyopathy, severe diabetes mellitus and lifestyle limitations were all considered comorbidities that would allow the patient to pursue surgery [1]. Since 1991 significant strides have been made in the field of weight loss surgery. It has since been proven to be a method for sustained weight loss and resolution of comorbid conditions. As the benefits to surgery continually develop, movements to change the indications to allow for more patients to achieve the benefits of weight loss have been published. In 2009, recommendations were made to expand the indications to both adolescent (12 – 18 years old) and elderly (>65 years old) patients [2].

For patients with a BMI ≥ 40 kg/m^2, surgery is indicated for ages 19 – 64, even without comorbid conditions. Adolescents with a BMI ≥ 40 kg/m^2 must have prediabetes, diabetes with Hgb A_{1c} > 9, regardless of therapy or 7-9 on maximal medical therapy, severe hypertension (SBP > 140 and DBP > 90), hyperlipidemia, any degree of sleep apnea or joint pain interfering with daily life in order to qualify for surgery. Elderly patients with BMI ≥ 40, like adolescents, require comorbid conditions to qualify for surgery. The presence of diabetes with Hgb A_{1c} > 9, regardless of therapy or 7-9 on maximal medical therapy, hypertension, hyperlipidemia, moderate to severe sleep apnea, venous stasis, or severe chronic joint pain would indicate the need for weight loss surgery.

Patients with a BMI 35 – 39 kg/m^2 and aged 19 – 64 should be recommended for surgery as outlined in the 1991 NIH consensus statement. For adolescents in this BMI range diabetes with Hgb A_{1c} > 7, refractory severe hypertension or moderate to severe sleep apnea are required to proceed with surgery. In the elderly population with BMI 35 – 39 kg/m^2, diabetes with Hgb A_{1c} > 9, regardless of therapy or 7-9 on maximal medical therapy, refractory hypertension, and moderate to severe sleep apnea are all criterion which support proceeding to surgery.

http://dx.doi.org/10.5772/58605

Around the world, the indications for surgery differ based on the populations and prevalence of obesity related comorbidities. In Europe, the guidelines allow for surgery in patients with a BMI ≥40 kg/m^2, BMI ≥ 35 kg/m^2 with severe comorbidities, BMI 30-35 kg/m^2 with diabetes, in adolescents if BMI ≥ 40 kg/m^2 and in the elderly with a favorable risk to benefit profile [3]. In the Asian population, the visceral fat percentage is higher than in Caucasian persons [4]. Asian persons also have a higher risk of developing diabetes mellitus, hypertension and hyperlipidemia at a lower BMI relative to persons of other ethnicities. These factors support the guidelines in Asia where surgery is recommended for all patients with a BMI ≥ 35 kg/m^2. Surgery is also considered for patients with a BMI > 30 kg/m^2 with diabetes mellitus or metabolic syndrome and inability to control with lifestyle alterations or medications [5].

3. Cardiovascular

Obesity has a negative effect on cardiovascular health. The presence of obesity increases the risk for coronary artery disease, heart failure, cardiomyopathy, atrial fibrillation and hypertension [6]. All of these conditions, if not optimized, can lead to poor surgical outcomes in bariatric surgery patients.

The approach to perioperative cardiovascular evaluation for non-cardiac surgery has been extensively studied. The general principle to follow is that intervention is rarely needed in order to lower risk unless it is indicated irrespective of the perioperative context [7]. There are clinical predictors which place patients into categories based on risk of perioperative cardiac events. Major predictors are unstable coronary syndromes, acute or recent myocardial infarction with ongoing ischemic risk factors, unstable or severe angina, decompensated heart failure, significant arrhythmias, high-grade atrio-ventricular blocks, certain arrhythmias and severe valvular disease. Intermediate predictors include mild angina pectoris, previous myocardial infarctions, compensated or prior heart failure, diabetes mellitus and renal insufficiency. Minor predictors are advanced age, abnormal ECG, rhythm other than sinus, low functional capacity, uncontrolled systemic hypertension and previous stroke. The type of surgery is also associated with cardiac risk. Bariatric surgery is considered an intermediate risk procedure.

Hypertension is found in 13.8 to 25.7 percent of obese patients [8,9]. In patients with stage three hypertension, systolic blood pressure ≥180 mm Hg and a diastolic blood pressure ≥ 110 mm Hg, the risk of proceeding with surgery must be evaluated [7]. Presence of hypertension as a comorbidity is an independent risk factor for mortality after open or laparoscopic gastric bypass with an odds ratio of 2.783 [10]. Treatment with beta blockers has been shown to decrease the risk of myocardial infarction and cardiovascular death in high risk patients [11]. When indicated, beta blockers should be initiated several weeks prior to surgery and titrated to achieve a resting heart rate of 50 to 60 beats per minute [12]. As bariatric surgery is an elective procedure, we recommend delaying surgery until adequate blood pressure control is achieved. Hypertension should be controlled before surgery with continuation of the preoperative antihypertensive treatment through the perioperative period [7]. Caution is advised when preparing a patient taking clonidine or beta blockers for surgery, due to known rebound hypertension upon abrupt discontinuation. These antihypertensive agents may be converted to transdermal or intravenous forms, respectively, during the time a patient is nil per os (NPO)[11]. Continuation of beta blockers through the perioperative period is recommended in those patients being treated for angina, specific arrhythmias, hypertension and other American College of Cardiology (ACC)/ American Heart Association (AHA) Class 1 guideline indications [7].

The myriad of available tests to assess cardiac function can be overwhelming and choosing which test to order can be confusing. Generally evaluation begins with a 12-lead electrocardiogram (ECG). In bariatric surgery patients ECG abnormalities can uncover predictors of perioperative and long term cardiovascular risk. ECG is recommended in all patients who have had a recent episode of chest pain, asymptomatic patients with diabetes mellitus, patients with prior coronary revascularization, asymptomatic males over 45 years old or females over 55 years old with two or more atherosclerotic risk factors and those patients who have had prior hospital admissions for cardiac causes [7]. Further evaluation of cardiac function involves stress testing and coronary angiography. Both methods are geared towards identifying patients with cardiac ischemia.

Exercise or pharmacological stress testing is recommended in adult patients with intermediate pretest probability of coronary artery disease based on ECG, those undergoing initial evaluation for suspected or proven coronary artery disease and patients with a significant change in clinical status. Exercise testing is also useful to evaluate exercise capacity when subjective measures are unreliable [7]. Some patients will not tolerate an exercise stress test. In this group of patients a pharmacological stress test should be considered. Noninvasive cardiac imaging without the use of pharmacological stressing agents is able to provide visualization of left ventricular function at rest. Although this test is commonly done during preoperative evaluations it is not a consistent predictor of perioperative ischemic events. Non-invasive stress testing, such as a dobutamine stress echocardiogram, is able to predict perioperative cardiac events by visualizing the amount of myocardium at risk for ischemia [7]. It has been shown, however, that the accuracy of thallium-201 nuclear cardiac imaging can be diminished in patients who have a BMI over 30 kg/m^2, which is specific to our patient population [13]. There is mounting evidence that cardiac computed tomography angiogram can be used as a method to evaluate the coronary vasculature in patients unable to tolerate exercise prior to invasive imaging procedures [14].

Coronary angiography is the definitive test for intraluminal causes of cardiac ischemia. The procedure is diagnostic and can also be therapeutic with the usage of balloon angioplasty with or without stent placement. Coronary angioplasty should be done on patients with suspected or known coronary artery disease. These patients have a high risk of adverse outcome based on noninvasive test results, angina unresponsive to adequate medical therapy or unstable angina [7]. Percutaneous coronary intervention (PCI) does not decrease the risk of perioperative cardiac events except in those patients in whom PCI is indicated for acute coronary syndrome. Although the PCI can reduce perioperative cardiac events, one of the major limitations of treatment is the subsequent delay in surgery due to the direct mechanical effects

http://dx.doi.org/10.5772/58605

of angioplasty or the required anti platelet therapy. Patients who undergo PCI with balloon therapy alone should undergo surgery between four and eight weeks after catheterization. Before four weeks the dilated blood vessels have not fully healed and after eight weeks the risk of restenosis is high [7].

Cardiac medications after coronary artery stenting present a controversy for the surgeon as the drugs increase the risk of bleeding during the perioperative period. Stent placement requires dual anti platelet therapy with clopidogrel and aspirin in the post PCI period to prevent stent thrombosis. The American College of Cardiology and The American Heart Association recommend that dual anti platelet treatment is required for at least one month in patients receiving bare metal stents and for one year with drug eluting stents [7]. In a literature review currently in press, the authors examined the perioperative management of anti platelet therapy and they found variability among the recommendations. However, they recommend delaying surgery for at least four to twelve weeks in patients with bare metal stents. In patients with drug eluting stents they recommend postponing surgery for at least six to twelve months [15]. Specific to elective surgery, such as the bariatric population, Katkhouda et al recommends that patients with bare metal or drug eluting stents should not undergo surgery within the first year of stent placement. If, as determined by a cardiologist, the patient requires dual therapy longer than one year after stent placement, clopidogrel and other thienopyridines should be stopped five to ten days preoperatively and restarted ten days postoperatively [12]. The continuation of aspirin through the perioperative period is recommended [12,15]. In patients undergoing gastric bypass it is recommended to start proton pump inhibitors one week preoperatively and subsequently continue them through the perioperative period to minimize the risk of gastrointestinal bleeding upon restarting clopidogrel therapy [12].

Management of valvular heart disease is dependent on the pathophysiology of the valve. Patients with symptomatic aortic stenosis should have their surgery delayed and undergo valve replacement prior to non-cardiac surgery. If the patient has severe stenosis but is asymptomatic the aortic valve should be evaluated with imaging. Patients unwilling or unable to undergo cardiac surgery for severe aortic stenosis have a 10% mortality rate from non-cardiac surgery. With mild or moderate mitral valve stenosis, the heart rate must be controlled during the perioperative period to minimize pulmonary congestion created by decreased diastolic filling times. Patients with significant mitral stenosis are at risk for heart failure during the perioperative period. Operative correction of mitral stenosis is not recommended unless the valvular condition should be corrected to prolong survival and prevent complications that are unrelated to the non-cardiac surgery [11].

Congestive heart failure (CHF) has been found to be a significant factor in perioperative cardiac events. The preoperative evaluation must include screening for CHF which can be done with history and physical exam alone – look for prior history of heart failure, symptoms of paroxysmal nocturnal dyspnea, presence of an S3 gallop, jugular venous distention, peripheral edema, bilateral rales on lung auscultation and evidence of pulmonary vascular redistribution on chest x-ray [11]. The Framingham Heart Study identified obesity as an independent risk factor for the development of heart failure; with the risk increasing by 5% in men and 7% in women for every 1 kg/m^2 in BMI [16]. The optimal treatment for CHF is determined by identifying the cause and degree of failure.

Close collaboration with the patient's cardiologist during the preoperative workup can allow for a smooth progression through preoperative cardiac testing, while accurately assessing and optimizing risk factors.

4. Venous

Venous thromboembolic events (VTE) continue to be one of the most significant postoperative complications after weight loss surgery; the other being staple line leaks and the associated septic sequelae. Obesity is considered a hypercoagulable state. The odds ratio of VTE is between 1.97 and 2.39 in those with a BMI greater than 30 kg/m^2 [17]. Bariatric surgery has been also been associated with a hypercoagulable state due to increased levels of clotting factors during the perioperative period from surgical trauma [18,19]. VTE events are a leading cause for mortality after bariatric surgery [20]. It is generally recommended that patients undergoing weight loss surgery receive VTE prophylaxis during the perioperative period. Postoperative ambulation and lower extremity sequential compression devices are safe and recommended for all bariatric patients when appropriate. The proper use of chemoprophylaxis and the preoperative insertion of inferior vena cava (IVC) filters have been controversial.

The identification of deep venous thrombosis is fundamental to preventing further complications from clot progression or embolus. The preferred method for evaluation is venous duplex ultrasound. This study has a sensitivity and specificity of 97% and 94%, respectively, of diagnosing a proximal lower extremity DVT [21]. Traditionally, many bariatric centers included this exam as part of the preoperative workup. A five year retrospective review of our own bariatric patient population revealed that only one of 555 patients (0.2%) was found to have a DVT on preoperative workup. This patient had a history of a chronic DVT, known prior to the examination. Our findings coincided with two previous studies which also showed that no preoperative investigation is needed [22,23]. Based on these finding we do not recommend routine preoperative venous duplex ultrasound; however, testing may be warranted in patients with prior history of DVT or significant venous insufficiency.

The preoperative placement of inferior vena cava (IVC) filters has been reported in high risk bariatric surgery patients. In some institutions, it was routine to have an IVC filter placed in patients with BMI greater than 55 kg/m^2, immobility, venous stasis, pulmonary hypertension, obesity hypoventilation syndrome, hypercoagulability, and a history of VTE [20]. It was recommended that patients with BMI greater than 55 kg/m^2 undergoing open gastric bypass undergo placement of IVC filter while those having laparoscopic surgery could forego the filter placement [24,25]. Recently, however, the routine use of IVC filters has undergone scrutiny. The Michigan Bariatric Surgery Collaborative (MBSC) published the largest series to date regarding the efficacy of preoperative IVC filters in gastric bypass patients. They found that there was no difference in the rates of VTE, serious complications and death or permanent disability [26]. In the same month, the United States Food and Drug Administration (FDA) published an advisory report regarding the use of retrievable IVC filters. They highlighted 921 device related adverse events since 2005. The FDA recommended a judicious approach to placement and vigilant follow up for prompt removal of IVC filters [27]. This prompted another study from the MBSC to investigate outcomes in patients treated with IVC filters. They discovered that patients with IVC filters had worse outcomes than comparable patients without IVC filters. A significant number of patients with IVC filters were also subjected to device related complications, such as thrombosis and occlusion, filter migration, contrast induced nephropathy and incision site infection. They found the rate of DVT and VTE were significantly higher in patients with IVC filters, odds ratios 2.7 and 3.3, respectively. Furthermore, there was no difference in the rates of pulmonary embolus between the groups. They concluded that IVC filters do not reduce the risk of pulmonary embolism in high risk bariatric surgery patients and that their use should be discouraged in bariatric surgery patients [28].

Chemoprophylaxis is generally achieved with subcutaneous injections of unfractionated heparin (UFH) or low molecular weight heparin (LMWH). Since patients are most susceptible to venous stasis during the induction of anesthesia, the first dose of chemoprophylaxis should be given preoperatively [29]. Our patients receive 5,000 units of unfractionated heparin administered subcutaneously immediately prior to entering the operating room. All patients are also treated with bilateral lower extremity sequential compression devices, which are placed prior to induction of anesthesia. This combination of chemical and mechanical prophylaxis has been shown to limit the development of deep venous thrombosis and bleeding complications [22]. Dosages and frequency vary among the different formulations of low molecular weight heparinoids, as does their method of action. A recent literature review concluded that there are three “standard regimens” for chemoprophylaxis of VTE – UFH 5000 units 2 – 3 daily, LMWH 30 mg twice daily, 40 mg once daily or weight adjusted LMWH [30]. The authors concluded that there was no difference in the rate of VTE among the different regimens, but the use of weight adjusted dosing increased the risk of major bleeding.

Patients with a history of heparin induced thrombocytopenia (HIT) type 2 present a unique challenge in VTE prophylaxis. This population has not been studied in bariatric surgery; however, VTE prophylaxis in the orthopedic population with HIT type 2 is accomplished by the use of desirudin administered subcutaneously [31]. More investigation is needed to recommend this medication usage beyond the specialty of orthopedics.

5. Pulmonary

Obesity related impairment of respiratory function is caused by mechanical restriction of adequate ventilation. The increased adipose tissue reduces diaphragmatic excursion, chest wall expansion and oropharyngeal patency. Obesity is also a risk factor for airway disease and there is a 50% higher incidence of severe asthma in obese patients when compared to normal controls [32,33].

A reduction in the expiratory reserve volume (ERV) is the most commonly identified abnormality on spirometry. Both body mass index and body fat distribution contribute to the degree of decrease in ERV. Hamoui et al has shown that in patients undergoing open duodenal switch procedures there is a relative risk of 2.29 to develop postoperative complications for every 10% decrease in percent of predicted value of vital capacity (VC). They also found that patients with a VC of less than 80% of predicted have a 54.5% prevalence of postoperative complications [34].

The increased rate of complications was also found in laparoscopic bariatric surgery. In 2013, van Huisstede et al prospectively examined their patients undergoing laparoscopic gastric bypass and laparoscopic sleeve gastrectomy. Among the 485 patients studied, they found patients with airflow obstruction ($FEV_1/FVC < 70\%$) or airflow reversibility (change in $FEV_1 >$ 12%) after administration of a bronchodilator, had an increased risk of postoperative complications with an adjusted odds ratio of 2.9 [35]. They recommend spirometry be done routinely on all patients being evaluated for bariatric surgery. The authors of this chapter follow these recommendations and routinely evaluate all patients with preoperative pulmonary function tests.

As pulmonary function tests are often abnormal in obese patients, the causes for abnormality must be identified and optimized prior to surgery [34]. Smoking is a common entity which significantly impacts pulmonary function therefore smoking cessation is an essential component of the preoperative assessment. In a study of over 300,000 patients from the Nationwide Inpatient Sample database smoking was identified as an independent factor associated with a greater incidence of acute respiratory failure after bariatric surgery [36]. Smoking has also been shown to be an independent predictor of increased hospital length of stay. Current and past smokers have been shown to require four and one days longer in the hospital, respectively, than patients that never smoked [37]. Nicotine, in all forms, is known to have vasoconstrictor properties. This may add to the microvascular disease caused by smoking which has been reported to increase the incidence of marginal ulceration and gastrointestinal anastomotic dehiscence [38,39]. It is our recommendation to not offer surgery to patients who are current smokers and to those using a nicotine replacement in an attempt to quit smoking. It is our practice to require smoking cessation to minimize the above mentioned morbidities.

Obstructive sleep apnea (OSA) is a condition in which the upper airway periodically becomes narrowed or obstructed during sleep and results in reduction or cessation of breathing during sleep. The reduction in airway caliber is due to the sleep induced loss of muscle tone in the soft tissues of the oropharyngeal airway. Obstructive sleep apnea is found in 38 – 88% of morbidly obese patients [40]. There are many screening tools available to the bariatric surgeon to identify patients at risk for having OSA. The Epworth Sleepiness Score, the Maintenance of Wakefulness Test, the Berlin Questionnaire and the STOP-BANG Questionnaire are designed to quickly asses if a patient should be screened further. The definitive diagnosis of OSA is made with an overnight polysomnography. The test measures the number of hypopnea (30% or greater decrease in airflow for at least 10 seconds followed by an arousal and/or 3% oxygen desaturation) and apnea (complete or near complete cessation of airflow for at least 10 seconds followed by an arousal and/or 3% oxygen desaturation) events and results with an 'apnea hypopnea index', which is classified to the severity of the sleep apnea [41]. Nonoperative treatment of OSA is achieved with non invasive positive pressure ventilation in the form of

http://dx.doi.org/10.5772/58605

continuous positive airway pressure (CPAP) or bi-level positive airway pressure (Bi-PAP). Many patients receive the diagnosis for the first time during the preoperative work up for bariatric surgery. These patients should be allowed to adapt to the device prior to undergoing surgery. With regards to anastomotic integrity, the use of CPAP has been proven to be safe after roux-en-y gastric bypass [42]. In order to maximize compliance, patients should bring their own machine and mask to the hospital. Although the use of CPAP or BiPAP is recommended in the postoperative setting, its omission has also been proven safe provided the patient is an a monitored setting with aggressive pulmonary physiotherapy [40].

In addition to OSA, patients with super morbid obesity can have pulmonary derangements while awake; this is termed obesity hypoventilation syndrome (OHS). More specifically, obesity hypoventilation syndrome manifests with daytime hypercapnia with $PaCO_2 > 44$ mm Hg or 6 kPa, elevated hematocrit, and sleep disordered breathing. These patients are at high risk for pulmonary complications and VTE [40]. Obesity hypoventilation syndrome occurs in 11% of patients with OSA and in 8% of bariatric surgical patients [43]. Patients with OHS have severe upper airway obstruction, impaired respiratory mechanics, blunted central respiratory drive and increased incidence of pulmonary hypertension. The diagnosis of OHS is also made with polysomnography. The treatment of OHS is similar to OSA in that positive airway pressure and supplemental oxygen are used to facilitate adequate respiration.

We reviewed our patient database and found that approximately 85% of patients had undiagnosed obstructive sleep apnea with 51% of patients having severe sleep apnea. In the lower BMI range (35-39.9 kg/m^2) our population showed 92% prevalence of OSA. There was a 100% prevalence of obstructive sleep apnea in those with a BMI greater than or equal to 60 kg/m^2. Based on these results, we can see that BMI does not correlate with the presence of OSA. In a larger study of 2,458 patients, 509 patients underwent polysomnography within one year prior to bariatric surgery. In this population 80.7% of patients were found to have obstructive sleep apnea and 35.5% of these patients had severe sleep apnea [44]. Although some authors advise that polysomnography should only be used if the patient exhibits symptoms of OSA or OHS, we recommend that all patients be actively evaluated with polysomnography in the preoperative period. If found to have sleep apnea, the patients are started on positive pressure ventilation by mask, at the settings recommended, for several weeks prior to surgery. On the day of the surgery, the patient is instructed to bring their machine to the hospital and the machine is routinely used, starting in the recovery room.

6. Anesthesia

The anesthesia preoperative assessment is the culmination of all consults pertinent to the optimization of the physiological status of the patient. Provided that major cardiopulmonary issues, cerebral, and metabolic derangements have been addressed, the anesthesiologist should be able to proceed with the surgery in a controlled and safe manner. As the preoperative optimization of these organ systems have been addressed previously in this chapter, the focus of the anesthesiology section will be intravenous access, blood pressure monitoring, aspiration risk, and airway management on induction of anesthesia.

Peripheral intravenous access in the bariatric patient may be difficult. The anesthesiologist should be prepared to use ultrasound guided techniques or central venous access placement in patients where intravenous access is difficult. Arterial line placement may be utilized when an appropriately sized blood pressure cuff may not reflect accurate readings secondary to the conical shaped arms in this population [45]. The possibility of central line placement preoperatively should be discussed with the patient prior to going into the operating room.

Airway management during anesthesia induction may be challenging in the bariatric population. BMI ≥ to 40 kg/m^2 has been associated with significant airway management challenges. Some institutions have mandated having an attending and one other experienced anesthesia provider (attending, an anesthesia resident with floor intubation credentialing, or CRNA available for intubation in this population). Due to excess soft tissue related to the anatomy, face mask ventilation of the morbidly obese patient may be difficult. Increased BMI and a history of OSA also increase the possibility of difficult face mask ventilation [46]. When a Mallampati 3 or 4 score is assessed, there has been increased difficulty in intubation, see figure 1 [47].

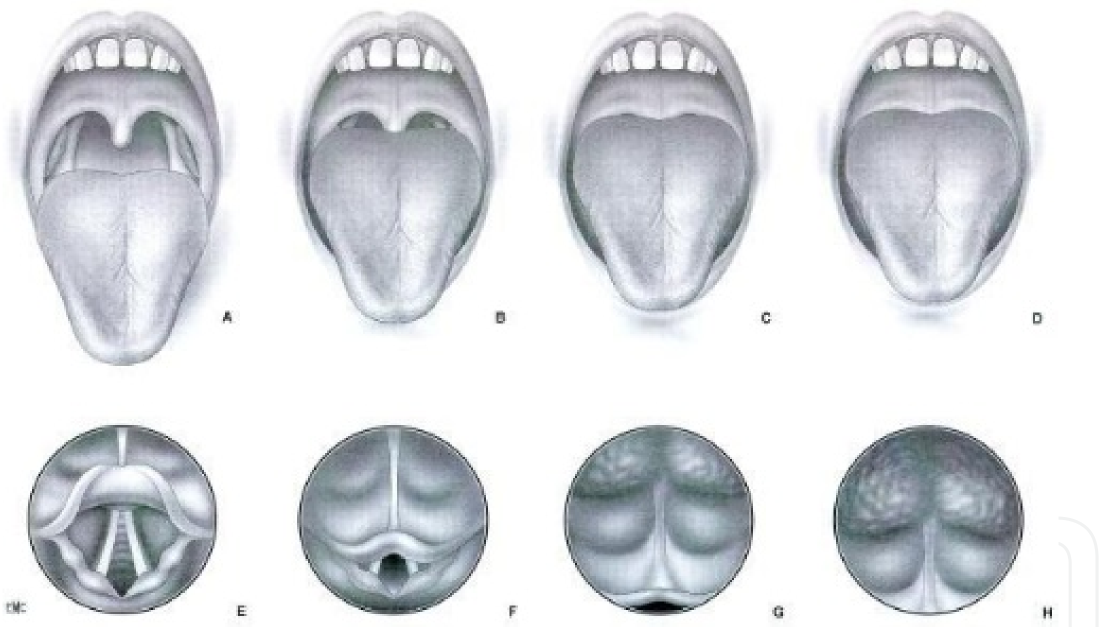

Figure 1. Mallampati Classification and Laryngoscopic View Grades.

Positioning of the bariatric patient in the supine position, as seen in figure 2, such that the external auditory meatus is in line with the sternal notch, known as ramping, is recommended [48]. A recent study demonstrated that in the morbidly obese population undergoing bariatric surgery, when using the "ramping" position, there was no correlation between difficult direct laryngoscopy and OSA in Mallampati 1 and 2 classifications. Patients with a BMI of 35kg/m2 have been associated with a greater than 6 fold increase in difficult direct laryngoscopy. Neck circumference over 40 cm has also been implicated in difficult direct laryngoscopy [49].

Figure 2. Ramping position.

In addition to ventilation and intubation concerns, aspiration risk must be considered. It has been reported that the gastric fluid of morbidly obese patients is more voluminous and of lower pH than that of the leaner patients [50]. These patients can be considered for rapid sequence induction, a technique for inducing a patient without ventilation. This technique may expose the anesthesiologist to a greater chance of airway failure. Neutralization of gastric acid with clear antacid solutions such as sodium citrate can be prophylactically given preoperatively.

There are many adjunct airway devices available to assist in the intubation of a challenging airway. The advent of video laryngoscopy, a plethora of supraglottic airways and flexible fiber optic intubation has provided multiple modalities and techniques for intubation of the challenging airway.

When assessing the airway of the bariatric patient, a preoperative plan for securing the airway safely is invaluable. The American Society of Anesthesiology (ASA) Difficult Airway Algorithm gives several pathways for the management of the difficult airway, whether the patient is awake or asleep, see figure 3 [51].

If the anesthesiologist's evaluation raises doubt in the ability to safely manage the airway, awake intubation should be undertaken [52]. It is also important to remember that BMI alone does not predict the probability of a difficult intubation. Preparedness, vigilance and communication with the surgeon will result in a favorable patient outcome.

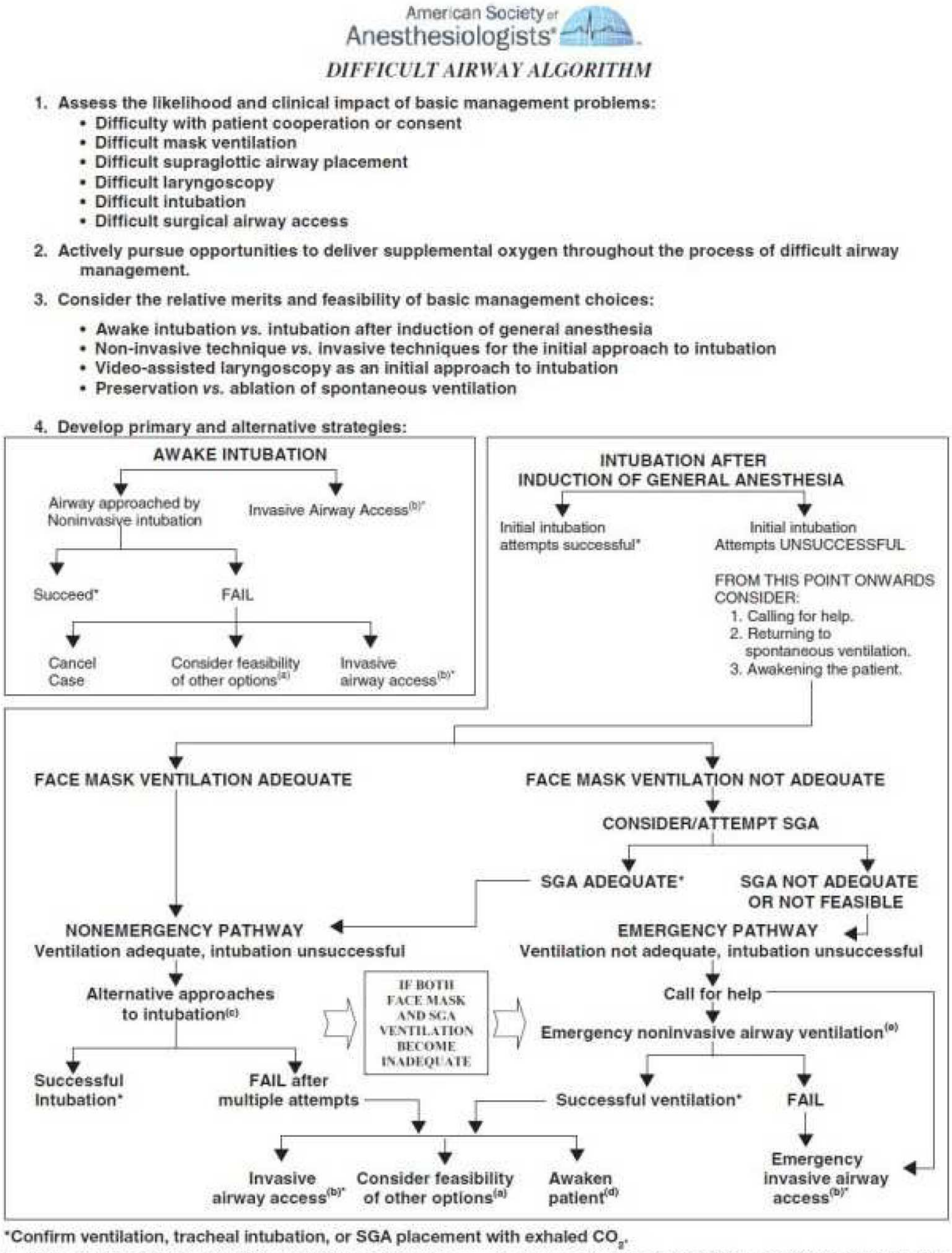

Figure 3. Difficult Airway Algorithm.

http://dx.doi.org/10.5772/58605

7. Endocrine

Evidence is accumulating that suggests obesity is closely related to endocrine disorders, some at a subclinical level. Obesity has been found to be associated with type 2 diabetes mellitus (T2DM) and hypothyroidism [53,54].

Management of T2DM is important during the perioperative period. Targets have been established by the American Association of Clinical Endocrinologists, The Obesity Society and the American Society for Metabolic and Bariatric Surgery for preoperative glycemic control which may be associated with improved outcomes, see table 1 [53].

• Hemoglobin A_{1c} of 6.5 – 7.0 % or less
• Fasting blood glucose level of less than or equal to 110 mg/dL
•2-hour postprandial blood glucose concentration of less than or equal to 140 ml/dL

Table 1. Recommendations for preoperative glycemic control

Optimal glycemic control should be achieved preoperatively, as patients with an elevated preoperative hemoglobin A_{1c} are found to have a higher incidence of postoperative complications. A hemoglobin A_{1c} level greater than 8% increases the risk of wound infection and acute renal failure postoperatively. An elevated A_{1c} in the preoperative setting also increases the likelihood of elevated blood glucose in the postoperative setting and decreases the rate of resolution of T2DM after bariatric surgery [55]. Preoperative control can be achieved with a combination of diet modification, weight loss and pharmaceuticals.

Hypothyroidism is a known cause of obesity; however, de novo thyroid dysfunction has been observed in obese patients. It has been suggested that subclinical hypothyroidism is associated with obesity [54]. In some patients, the TSH level has been shown to return to normal levels after significant weight loss, however the outcome is not universal. The ASMBS does not recommend routine screening for primary hypothyroidism in the obese patients, however many bariatric programs require such preoperative screening in keeping with the NIH guidelines to ensure there is no organic cause to the obesity [53,56].

8. Gastrointestinal

Obesity is a risk factor for gastroesophageal reflux disease, erosive esophagitis, and esophageal adenocarcinoma [57]. The presence of gastrointestinal diseases has an effect on the type of bariatric procedure, which can be recommended for a patient and may require treatment prior to weight loss surgery. In addition, after surgery, the restrictions and rearrangement of the alimentary tract can limit evaluation and surveillance options. There are many modalities for assessing the gastrointestinal tract in the preoperative setting.

The American Society for Gastrointestinal Endoscopy (ASGE) recommends an upper endoscopy be performed in all patients with upper GI tract symptoms and in all patients undergoing weight loss surgery [58]. Preoperative esophagogastroduodenoscopy has been found to reveal abnormalities in 46 to 90% of patients, with 62% having clinically significant findings. In our practice, all patients being evaluated for bariatric surgery undergo upper endoscopy. However, a five year, internal review of 555 patients has shown 98% of our patients had positive findings on routine upper endoscopy yet the findings did not cause a delay or impact on the choice of surgical procedure – questioning the clinical significance of the findings.

During endoscopy tissue biopsies should be obtained to evaluate for *H. pylori.* If the bacterium is isolated, eradication with one of several standard regimens is recommended. Recently, there has been growing support for non-invasive testing for *H. pylori* in an effort to reduce costs associated with preoperative testing [59]. One potential algorithm for non-invasive testing involves screening patients with serum *H. pylori* test and treating the patient if it is positive. In either case, proof of eradication should be obtained, typically via urea breath test. Recently published data indicates that preoperative *H. pylori* status does not increase the risk for marginal ulcer or stomal stenosis post roux-en-y gastric bypass [60].

The World Health Organization (WHO) reports the incidence of gastric cancer is highest in the western pacific region, which comprises 27 countries including China, Japan, Republic of Korea, Malaysia, Singapore and the Philippines. The incidence in this region was 521,000 cases in 2004, greater than 50% of the worldwide incidence [61]. In countries where gastric and other upper gastrointestinal cancers are more prevalent, the importance of preoperative upper endoscopy cannot be underestimated. Ultimately, practice patterns should reflect the prevalence of significant findings specific to the patient population being prepared for weight loss surgery.

As an adjunct to endoscopic examination of the gastrointestinal tract several radiographic investigations are also considered during the preoperative evaluation for bariatric surgery. Gastroesophageal reflux disease associated with hiatal hernias is commonly found in obese patients. Completing a bariatric procedure without recognizing and repairing a hiatal hernia can potentially lead to worsening of reflux and poor surgical outcomes [62]. In order to identify a hiatal hernia some surgeons obtain contrast enhanced upper GI series. We do not employ upper GI series routinely in our preoperative evaluations. Hiatal hernias that are identified on preoperative upper endoscopy are discussed with the patient for informed consent and subsequently investigated during the operation. In our experience, clinically significant hiatal hernias are readily identifiable upon laparoscopic inspection and repaired as indicated.

In our practice we routinely assess the size of the liver prior to surgery by abdominal ultrasound. Greater than 30% of morbidly obese patient show fatty infiltration of the liver [63]. As an enlarged liver is one of the most common reasons for conversion to an open procedure, it is our practice to place the patient on a liquid diet for two weeks prior to surgery if hepatic steatosis is identified [64]. Two weeks of a low energy diet has been shown to decrease liver size and body fat by greater than 5% [63]. In addition to liver size, the gallbladder is also evaluated for the presence of stones and wall thickening to suggest chronic gallstone disease. The management of concurrent gallstones in the morbidly obese patient undergoing bariatric surgery has been a controversial topic. During the era of open weight loss surgery concomitant cholecystectomy was recommended for all patients undergoing open gastric bypass [65,66].

http://dx.doi.org/10.5772/58605

The view on cholecystectomy has changed since the widespread adoption of laparoscopic bariatric surgery. Addition of cholecystectomy to laparoscopic roux-en-y gastric bypass was found to add approximately 50 minutes to the operative time and significantly increased hospital length of stay, 2.69 days versus 4.35 days [67]. A study of 625 patients by D'Hount et al showed that only 6.9% of patients developed symptomatic gallstone disease post gastric bypass. The mean time between gastric bypass and cholecystectomy was 17.4 ± 13.1 months [68]. We do not advocate performing cholecystectomy at the same time as primary bariatric procedures unless absolutely necessary due to the increased operative time and length of stay. We do employ the use of ursodeoxycholic acid in the postoperative period to reduce the rate of gallstone formation in our gastric bypass patients due to the challenge of addressing choledocholithiasis in this patient population [53].

9. Nutritional

A preoperative nutritional assessment with a registered dietitian is essential when preparing for surgery. The preoperative nutritional assessment is designed to help the patient recognize the need for positive lifestyle changes and develop a plan to implement them. This will likely result in improvement of nutritional status, better management of nutrition-related comorbidities and development of habits that will positively influence weight loss outcomes and maintenance [69]. It is also a time to thoroughly review the postoperative diet with the patient, which includes gradually advancing the diet in terms of texture and variety, including exercise on a regular basis, staying hydrated with appropriate fluids, and adhering to the recommended vitamin and mineral regimen. In this section, we will discuss preoperative behavior changes that could potentially affect long-term outcomes.

A thorough preoperative nutritional assessment should include review of anthropometrical data, weight history, past diet history, medical history, available laboratory values, psychological history (including history of eating disorders), social history, substance abuse history, nutrition-focused physical findings (such as poor dentition), dietary intake, physical activity, and psychosocial factors that affect weight loss [70]. When discussing dietary intake with a patient, it is important to determine how many meals the patient includes on a daily basis, whether or not the patient snacks all day (i.e. grazing, picking, nibbling), if the patient has a past or current history of eating disorders, macronutrient and micronutrient composition of frequently chosen foods and beverages, and alcohol intake [69]. Preoperative nutrition counseling should be adapted to each individual patient.

Patients' eating habits and exercise patterns are determined by a variety of environmental, psychological, biological, and social factors. Environmental factors include work schedule, occupation, socioeconomic status, and family traditions. Psychological factors include low self-esteem, feeling a lack of control in life, feeling inadequate, depression, anxiety, stress, and loneliness. Social factors include cultural glorification of the "perfect body", society placing more value on physical appearance and not on inner qualities, and stress related to size/body shape due to past discrimination [71]. Biological and biochemical factors are still being explored, but recent research has shown that gastrointestinal hormone imbalance can affect hunger and appetite [72]. It is important for patients to understand that, regardless of the reasons behind them, current eating patterns will likely result in poor weight loss, weight regain, and malnutrition after surgery. Preoperative nutritional counseling should focus on addressing these behaviors, working with the patient to avoid or manage them, and having the patient demonstrate compliance with the recommended changes.

Two environmental factors that are of particular concern are socioeconomic status and shift work. In low-income areas, access to nutrient-rich foods is oftentimes limited [73]. Planning grocery lists and affordable recipes with a low-income patient would be an appropriate intervention. Having the patient complete food logs that show more meals are prepared in the home with the ingredients purchased from the grocery list will demonstrate that he/she is able to incorporate this healthy behavior on a routine basis, thus lowering the risk of postoperative malnutrition. Obesity is frequently seen in people who work overnight shifts or who have alternating shifts and late shift workers have higher rates of weight gain after starting their jobs [74,75]. In our practice, patients report that they feel it is inappropriate to eat in the middle of the night. This often results in eating large portions before work and after work, as well as grazing on empty-calorie foods during the night. Working with the patient to break the idea that it is "bad" to be eating in the night is key when it comes to changing behaviors to positively affect weight loss and nutrition status postoperatively. Including regularly-timed meals and snacks that include an appropriate balance of protein, carbohydrates, and fat will set the patient up for long-term success.

Sometimes, patients have a past or present history of eating disorders that likely require additional psychological counseling in addition to nutritional counseling. Hence, coordination between the dietitian and the mental health care provider is critical. There is a fair amount of literature regarding Binge Eating Disorder (BED), subdiagnostic BED, and night eating syndrome in the preoperative setting, most of which states that psychological counseling is encouraged for patients that have either been diagnosed with an eating disorder or show tendencies towards one [76-78]. Some studies have suggested that patients with preoperative BED might be more inclined to graze after surgery, thus sabotaging weight loss, while other research suggests that prior history of eating disorders is not a predictor of poor outcomes following bariatric surgery [78,79]. Emotional eating is technically not considered an eating disorder, but its presence oftentimes has psychological roots. Some case studies have shown that cognitive behavioral therapy can help manage emotional eating both pre and postoperatively [80]. The only eating disorder that is a contraindication to bariatric surgery is active bulimia nervosa, but ultimately it is up to the multidisciplinary bariatric surgery team to decide if they feel a patient's past history of eating disorders could potentially jeopardize the patient's health [78]. Bariatric surgical teams should keep in mind that the psychological evaluation is not the only setting in which a patient might disclose episodes of disordered eating. Questions inquiring about eating disorders should be included in the nutrition evaluation, and if during subsequent visits the patient suggests that he or she has tendencies towards these behaviors, the patient should undergo psychological treatment before proceeding with surgery.

Most commonly, the areas dietitians will find they need to counsel patients on before surgery include portion control, macronutrient and micronutrient composition of frequently chosen foods, skipping meals, and physical activity. Dietitians use various tools to help assess a patient's food and beverage intake, including the 24-hour recall and food frequency questionnaires. When counseling patients preoperatively, it is important to put the emphasis on how dietary and lifestyle changes positively affect long-term weight maintenance. Adhering to portion control before surgery will likely lead to preoperative weight loss, resulting in a lower weight 24 months after surgery. It will also help patients maintain their weight loss over the long term. Patients often state they are limited in food choices postoperatively. Developing a menu before surgery that includes a variety of soft proteins (e.g. low-fat dairy, beans, nut butters, fish), whole grains, fruits, vegetables, and healthy fats will empower patients to try new foods and recipes after surgery that are appropriate for the texture that they are able to tolerate. This will help stave off taste fatigue and provide a more nutritious diet as they are able to include more solid, textured foods [81]. Patients should also be working towards eliminating intake of sugar-sweetened beverages in the preoperative period and including mostly water and sugar-free beverages. While skipping any meal is discouraged, observational studies highlight that eating breakfast regularly can be an effective tool for weight management [82]. Regularly eating breakfast is associated with lower BMI in adults, and inclusion of whole grains, fruit, and low-fat dairy may be related to appetite control and blood glucose regulation, both contributing factors to obesity [83]. Patients often have the misconception that skipping breakfast will lead to eating fewer calories in the day, when in fact, skipping breakfast can lead to cravings of high-calorie foods later in the day [84]. Therefore, patients should be encouraged to include breakfast daily in order to better maintain weight loss after surgery.

Lastly, physical activity is consistently cited as a predictor of weight loss maintenance [85]. Despite being aware that physical activity has health benefits, barriers to exercise still remain. They include inability to self-motivate, lack of encouragement from family and friends, time constraints, low self-efficacy, fear of being injured, recent injury, and lack of resources (i.e. no sidewalks or parks in neighborhood) [86]. Overcoming barriers to exercise will likely take a team approach, including the dietitian, psychologist, and possibly a physical therapist. The patient should be encouraged to begin a rather simple exercise program that takes into account reservations about exercise and physical limitations. We often see that as patients begin exercise programs, they are hesitant and resistant; however, as their self-esteem improves and physical activity becomes less taxing on the body, they build upon the program and welcome the exercise. They report having more energy, looking forward to the time by themselves, and overall mood improvement. Walking for as little as 5 minutes per day can often lead to walking for 30 minutes 3-4 times per week over a 3-month span.

With regard to micronutrients, it is estimated that 2 billion people worldwide suffer from vitamin and mineral malnutrition despite adequate calorie intake. In the United States greater than 75% of people are taking in below the daily recommended value of vitamins A, D and E. Additionally, 50 to 75% of Americans are also not taking enough vitamin C [87]. These deficiencies are also seen in patients presenting for weight loss surgery. Obese patients are at increased risk for nutritional abnormalities in the preoperative setting; they have been found to be deficient in thiamine, folate, zinc, iron, ferritin, selenium, beta-carotene, magnesium, and vitamins A, B-12, C and D [88-92]. Vitamin D levels are also affected by latitude and this should also be taken into consideration when screening and supplementing these deficiencies. It is imperative to evaluate and supplement all nutritional deficits prior to surgery to prevent deficiencies which can be significantly more difficult to correct in the postoperative period. These micronutrients should be supplemented in the preoperative setting and monitored to ensure normal values before surgery. All patients undergo postoperative monitoring to guide supplementation after bariatric surgery with frequent regularly scheduled blood tests.

As bariatric surgery becomes a safer, more popular, and more accepted form of weight loss amongst health professionals, it is clear that a thorough preoperative nutritional assessment and consistent preoperative follow-up with the dietitian is essential for the patient to lose an appropriate amount of weight, avoid malnutrition, and to maintain the weight loss hopefully for life [93-95]. Whether the dietitian has 6 weeks or 6 months to work with the patient preoperatively, the main focus should be to build the foundation for a healthier lifestyle and better eating habits.

10. Psychological

The fight against obesity has many fronts. Simply reducing the capacity or absorption of the gastrointestinal tract will not have long lasting effects on weight if the psychosocial aspects of the disease are not addressed. An essential part of the preoperative evaluation is a psychological clearance [96]. The psychosocial and behavioral evaluation is geared to confirm the patient's ability to incorporate nutritional and behavioral changes before and after bariatric surgery. The psychological investigation is also used to identify cognitive, environmental, or psychiatric contraindications prior to surgery and to offer treatment for any disorders identified [97]. The obese adult population in the United States has been found to have higher incidence of major depression, bipolar disorder, generalized anxiety and panic disorder [98]. Intervening in these disease processes can enhance postoperative weight reduction; however, no definitive significant improvement in weight loss has been shown [53].

The interview consists of a standard psychological evaluation, evaluation of the patient's appropriateness for surgery, an assessment of eating behavior, stress, coping mechanisms, and social support. It is also used to confirm that the patient has the ability to consent and evaluate all the potential risks and possible benefits to surgery [96]. The psychosocial evaluation should be performed by a credentialed expert in psychology and behavior modification for all patients. Screening for eating disorders can involve using standardized assessments, see table 2 [96].

Mental illnesses and eating disorders identified during the screening process are not necessarily contraindications to surgery [99]. Their optimization is key for a durable and satisfying outcome. The bariatric surgeon should be aware that the patient may exhibit impression management during the preoperative psychological evaluation. This is done by purposefully

• Eating Disorder Examination Questionnaire
• Cleveland Clinic Behavioral Rating System
• Millon Behavioral Medicine Diagnostic (MBMD) (Pearson, San Antonio, Texas, USA)
• Alcohol Use Disorder Identification Test – Consumption (AUDIT-C)
• Beck Depression Inventory – II (BDI-II)
• Beck Anxiety Inventory (BAI)
• Multidimensional Health Locus of Control Scale
• Overeater's questionnaire

Table 2. Mental health assessment tools prior to weight loss surgery

minimizing psychological symptoms to receive a recommendation to proceed with surgery from the mental health professional. It is recommended that mental health professionals use measures to assess for impression management, as this will allow for proper preoperative treatment and minimize postoperative surprises [97].

11. Education

The process towards obtaining successful results after bariatric surgery begins during the preoperative period. The algorithm of care is a multi step process and requires full participation of both the practitioners and the patient. The ability to follow the plan of care and manage lifestyle changes required for successful weight loss depends on how well the patients are prepared prior to surgery. High patient satisfaction rating has been demonstrated after instituting a preoperative class for their bariatric patients [100]. Their class covered the following content: presurgery appointments, preparing for surgery, postoperative procedures, pain management, activity levels, wound care, nutrition, lifestyle changes and discharge instructions.

The ASMBS recommends having educational objectives and assessments throughout the preoperative period. It is suggested that the materials provided to the patients be at a sixth to eighth grade reading level to maximize comprehension [53]. Multimedia tools are also useful, however patients should be cautioned against using the internet as an information source as there is a high degree of bias, conflicting statements and out of date information [100]. The main goal of preoperative education is to provide information needed for informed consent, prepare the patient for the required lifestyle change and to establish realistic expectations regarding potential weight loss and quality of life improvements.

12. Functional status

A crucial component of the preoperative evaluation includes assessing the patient's ability to complete the activities of daily living. Bariatric patients have a high rate of comorbid conditions, some of which can cause physical limitation. Morbidly obese patients are also limited by their body habitus and weight related pain; this is especially true in the super morbidly obese patients. The limitations in mobility can impede on preoperative weight loss, cause psychological stress and limit access to care [101]. Preoperative functional status should be evaluated as it has been shown to be the strongest predictor for postoperative in hospital morbidity and mortality [102]. Our previously published data revealed that a completely dependent patient was 27 times more likely to experience mortality after bariatric surgery. The information gained from investigations into the patient's functional status is shared with the patient and risks, benefits and alternatives are discussed with the ability to offer a reasonable prognosis of the postoperative period.

Preoperative exercise has been found to reduce surgical complications, facilitate healing, achieve the mindset needed for positive behavior changes, and augment the rate of increased postoperative physical activity [103]. The ASMBS suggests exercise for 20 minutes, three to four days a week is sufficient to achieve these results [104]. Most bariatric surgery patients have sedentary lifestyles and low physical activity level. King and Bond describe a five step process to providing physical activity counseling to patients undergoing weight loss surgery [103].

The first step is to assess the patient's knowledge, beliefs and values regarding exercise along with prior and current levels of physical activity. The potential barriers successful implementation of a physical activity program should also be investigated at this point. Prior to beginning a physical activity program, the patients with current or a history of exercise intolerance should be referred to a cardiologist for proper exercise testing. Aside from cardiopulmonary restrictions to exercise, patients should be assessed for physical limitations such as sensory, balance and gait abnormalities – all of which can increase the risk of injury.

The second step is to advise the patient on the benefits of physical activity and develop realistic expectations. Strategies to increase safety and decrease barriers should be established. The patients should be taught how to gauge the level of intensity using the talk test or by measuring their own heart rate.

The thirds step is to come to a mutual agreement with the patient regarding their short, intermediate and long term physical activity goals. The goals should not be end results such as weight loss or maximal activity, but rather, specific goals regarding the frequency, duration and type of physical activity performed. It is recommended that the clinician set one goal that the patient has a high likelihood of achieving to boost confidence and encourage the patient to continue increasing their level of physical activity.

The fourth step is to assist the patient in achieving the goals by providing the patient printed materials and other resources that support self monitored physical activity. Such items include diaries, pedometers and a list of safe walking paths or fitness facilities. Patients who need a high level of encouragement or guidance, and those with significant barriers should be referred to professional personal trainers or other exercise professionals to achieve the best results.

The final step is to arrange for follow up and monitoring to answer questions and provide reinforcement. The patient and clinician should not be discouraged if the level of physical

http://dx.doi.org/10.5772/58605

activity is not immediately increased after one meeting. It may take many visits for the patients to overcome their barriers and begin a physical activity plan. The healthcare provider should remain vigilant and provide continual counseling to the patient.

13. Conclusions

The preoperative evaluation of the bariatric surgery patient requires a multidisciplinary approach, ultimately coordinated by the surgeon. There are many details to which attention must be paid including medical, nutritional and psychological aspects in an effort to fully evaluate the patient as a whole. This multi faceted approach is one of the factors which have allowed bariatric surgery to become a safe and effective method for weight loss and comorbidity amelioration. These evaluations may reveal problems which should be addressed before surgery to ensure safety and success in the postoperative period. These assessments offer the best way to prepare and counsel a patient for these life altering operations and provide a reasonable basis of expectation on the part of the surgeon and the patient. Many of the learning points incorporated into the preoperative evaluation of bariatric patients can potentially be applied to other disciplines.

Author details

Gurdeep S. Matharoo[1], Erika Renick[1], John N. Afthinos[1], Tracey Straker[2] and Karen E. Gibbs[1*]

*Address all correspondence to: dockegibbs@gmail.com

1 Department of Surgery, Division of Minimally Invasive and Bariatric Surgery, Staten Island University Hospital, State University of New York, Brooklyn, USA

2 Department of Anesthesiology, Montefiore Medical Center, Albert Einstein College of Medicine, New York, USA

References

[1] National Institutes of Health. Gastrointestinal Surgery for Severe Obesity. NIH Consensus Statement Online. http://consensus.nih.gov/1991/1991gisurgeryobesity084html.htm. Accessed: November 2, 2013.

[2] Yermilov I, McGory ML, Shekelle PW. Appropriateness criteria for bariatric surgery: beyond the NIH guidelines. Obesity. 2009;17:1521-27.

[3] Fried M, Yumuk V, Oppert J, et al. Interdisciplinary European guidelines on metabolic and bariatric surgery. Obes Fact. 2013;6:449-68.

[4] Snijder MB, van Dam RM, Visser M, et al. What aspect of body fat are particularly hazardous and how do we measure them? Int J Epidemiol. 2006;35(1)83-92.

[5] Kasama K, Mui W, Lee WJ, et al. IFSO-APC Consensus Statements 2011. Obes Surg. 2012;22:677-84.

[6] Zalesin KC, Franklin BA, Miller WM, et al. Impact of obesity on cardiovascular disease. Med Clin N Am. 2011;95:919-937.

[7] Fleisher LA, Beckman JA, Brown KA, et al. ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: executive summary: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Writing Committee to Revise the 2002 Guidelines on Perioperative Cardiovascular Evaluation for Noncardiac Surgery). Circulation. 2007;116:1971–1996.

[8] Mokdad, AH, Ford ES, Bowman BA, et al. Prevalence of obesity, diabetes and obesity-related health risk factors, 2001. JAMA. 2003;289;76-79.

[9] Padwal RS, Chang H, Klarenbach S, et al. Characteristic of the population eligible for and receiving publicly funded bariatric surgery in Canada. International Journal of Equity in Health. 2012; 11:54.

[10] DeMaria EJ, Portenier D, Wolfe L. Obesity surgery mortality risk score: proposal for a clnically useful score to predict mortality risk in patients undergoing gastric bypass. Surg Obes Relat Dis. 2007;3:134-40.

[11] Fleisher LA, Beckman JA, Brown KA, et al. 2009 ACCF/AHA focused update on perioperative beta blockade incorporated into the ACC/AHA 2007 guidelines on perioperative cardiovascular evaluation and care for noncardiac surgery: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. J Am Coll Cardiol. 2009;54:e13–118.

[12] Katkhouda N, Mason RJ, Wu B, et al. Evaluation and treatment of patients with cardiac disease undergoing bariatric surgery. Surg Obes Relat Dis. 2012;8:634-40.

[13] Hansen CL, Woodhouse s, Kramer M. Effect of patient obesity on the accuracy of thallium-201 myocardial perfusion imaging. Am J Cardiol 2000;85:749-52

[14] Fihn SD, Gardin JM, Abrams J, et al. 2012 ACCF/AHA/ACP/AATS/PCNA/SCAI/STS guideline for the diagnosis and management of patients with stable ischemic heart disease: a report of the American College of Cardiology Foundation/American Heart Association Task Force on, American Association for Thoracic Surgery, Preventive Cardiovascular Nurses Association, Society for Cardiovascular Angiography and Interventions, and Society of Thoracic Surgeons. J Am Coll Cardiol 2012;60:e44–164.

[15] Darvish-Kazem S, Gandhi M, Marcucci M, et al. Perioperative management of antiplatelet therapy in patients with a coronary stent who need non-cardiac surgery: a systematic review of clinical practice guidelines. Chest. 2013 Aug 8. Epub ahead of print

[16] Khan MF, Movahed MR. Obesity cardiomyopathy and systolic function: obesity is not independently associated withdilated cardiomyopathy. Heart Fail Rev. 2013;18:207-17.

[17] Allman-Farinelli MA. Obesity and venous thrombosis: a review. Semin Thromb Hemost 2011;37:903-7.

[18] Mertens I, Van Gaal LF. Obesity, haemostasis and the fibrinolytic system. Obes Rev 2002;3:85-101.

[19] Kuruba R, Koche LS, Murr MM. Preoperative assessment and perioperative care of patients undergoing bariatric surgery. Med Clin N Am. 2007;339-51.

[20] The American Society for Metabolic and Bariatric Surgery Clinical Issues Committee. ASMBS updated position statement on prophylactic measures to reduce the risk of venous thromboembolism in bariatric surgery patients. Surg Obes Relat Dis. 2013;9:493-97

[21] Zierler BK. Ultrasonography and diagnosis of venous thromboembolism. Circulation. 2004;109:I9-I14.

[22] Prystowsky JB, Morasch MD, Eskandari, MK, et al. Prospective analysis of the incidence of deep venous thrombosis in bariatric surgery patients. Surgery. 2005;138:759-65.

[23] Westling A, Bergqvist D, Bostrom A. Incidence of deep venous thrombosis in patients undergoing obesity surgery. World J Surg. 2002;26:470-3.

[24] Gargiulo NJ 3rd, Veith FJ, Lipsitz EC, et al. The incidence of pulmonary embolism in open versus laparoscopic gastric bypass. Ann Vasc Surg. 2007;21:556-9.

[25] Gargiulo NJ 3rd, O'Connor DJ, Veith FJ, et al. Long-term outcome of inferior vena cava filter placement in patients undergoing gastric bypass. Ann Vasc Surg. 2010;24:946-9.

[26] Birkmeyer NJO, Share D, Baser O, et al. Preoperative placement of inferior vena cava filters and outcomes after gastric bypass surgery. Ann Surg. 2010;252:313-8.

[27] U.S. Food and Drug Administration. Removing retrievable inferior vena cava filters: initial communication. August 9, 2010. Available at: http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm221676.htm. Accessed November 2, 2013.

[28] Birkmeyer NJ, Finks JF, English WJ, et al. Risk and benefits of prophylactic inferior vena cava filters in patients undergoing bariatric surgery. Journal of Hospital Medicine. 2013;8:173-77.

[29] Hsu P, Basu CB, Venturi M, et al. Venous thromboembolism prophylaxis. Semin Plast Surg. 2006;20(4):225-32.

[30] Becattini C, Agnelli G, Manina G, et al. Venous thromboembolism after laparoscopic bariatric surgery for morbid obesity: clinical burden and preventions. Surg Obes Relat Dis 2012;8:108-15

[31] Kemkes-Matthes B. Hirudin for prophylaxis and treatment of deep vein thrombosis. Semin Thromb Hemost. 2002;28(5):455-8.

[32] Mosen DM, Schatz M, Magid DJ, et al. The relationship between obesity and asthma severity and control in adults. J Allergy Clin Immunol. 2008;122:507-11. e6.

[33] Beuther DA, Sutherland ER. Overweight, obesity and incident asthma: a meta-analysis of prospective epidemiologic studies. Am J Respir Crit Care Med. 2007;175:661-6

[34] Hamoui N, Anthone G, Crookes PF. The value of pulmonary function testing prior to bariatric surgery. Obes Surg. 2006;16:1570-73

[35] van Huisstede A, Biter LU, Luitwieler R, et al. Pulmonary function testing and complications of laparoscopic bariatric surgery. Obes Surg. 2013;23:1596-1603.

[36] Masoomi H, Reavis KM, Smith BR, et al. Risk factors for acutre respiratory failure in bariatric surgery: data from the Nationwide Inpatient Sample, 2006 – 2008. Surg Obes Relat Dis. 2013;9:277-83.

[37] Marchini JFM, Souza FLN, Schmidt A, et al. Low educational status, smoking, and multidisciplinary team experience predict hospital length of stay after bariatric surgery. Nutr Metab Insights. 2012;5:71-6.

[38] Azagury DE, Abu Dayyeh BK, Greenwalt IT, et al. Marginal ulceration after roux-en-y gastric bypass surgery: characteristics, risk factors, treatment, and outcomes. Endoscopy. 2011;43:950-4.

[39] Fawcett A, Shembekar M, Church JS, et al. Smoking, hypertension, and colonic anastomotic healing; a combinded clinical and histopathological study. Gut. 1996;38:714-8.

[40] ASMBS Clinical Issues Committee et al. Perioperative management of obstructive sleep apnea. Surg Obes Relat Dis. 2012;8:e27-e32.

[41] Berry RB; Budhiraja R; Gottlieb DJ; et al. Rules for scoring respiratory events in sleep: update of the 2007 AASM Manual for the Scoring of Sleep and Associated Events. J Clin Sleep Med 2012;8(5):597-619.

[42] Ramirez A, Lalor PF, Szomstein S, et al. Continuous positive airway pressure in immediate postoperative period after laparoscopic roux-en-y gastric bypass: is it safe? Surg Obes Relat Dis. 2009;5:544-6.

[43] Chau EHL, Lam D, Wong J, et al. Obesity hypoventilation syndrome a review of epidemiology, pathophysiology, and perioperative considerations. Anesthesiology. 2012;117:118-205

[44] Khan A, King WB, Patterson EJ, et al. Assessment of obstructive sleep apnea in adults undergoing bariatric surgery in the Longitudinal Assessment of Bariatric Surgery-2 (LABS-2) study. J Clin Sleep Med. 2013;9(1):21-9.

[45] Ogunnaike B, Jones SB, Jones DB, et al. Anesthetic considerations for bariatric surgery. Anesth Analg. 2002;95:1793-1805.

[46] Kheterpal S, Han R, Tremper KK, et al. Incidence and predictors of difficult mask ventilation. Anesthesiology 2006;105(5):885-891.

[47] Neligan PJ, Porter s, Max B, et al. Obstructive sleep apnea is not a risk factor for difficult intubation in morbidly obese patients. Anesth Analg. 2009;109(4):1182-6.

[48] Lebowitz PW, Shay H, Straker T,et al. Shoulder and head elevation improves laryngoscopic view for tracheal intubation in non obese as well as obese individuals. J Clin Anesth. 2012;24(2):104-8.

[49] Brodsky JB, Lemmens JM, Brock-Utne JG, et al. Morbid obesity and tracheal intubation. Anesth Analg. 2002;94(3):732-736.

[50] Vaugh RW, Bauer S, Wise L. Volume and pH of gastric juice in obese patients. Anesthesiology 1975;43(6):686-689.

[51] Apfelbaum JL, Hagberg CA, Caplan RA, et al. Practice guidelines for management of the difficult airway: an updated report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway. Anesthesiology. 2013;118(2): 251-70

[52] Anesthesiology News – Guide to Airway Management. Airway management in the patient undergoing bariatric surgery. Available at http://www.anesthesiology-news.com/download/Bariatric_ANGAM09_WM.pdf. Accesibility verified: November 4, 2013.

[53] 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. Surg Obes Relat Dis. 2013;9:159-91.

[54] Jankovic D, Wolf P, Anderwald C, et al. Prevalence of endocrine disorders in morbidly obese patients and the effects of bariatric surgery on endocrine and metabolic parameters. Obes Surg. 2012;22:62-69.

[55] Perna M, Romagnuolo J, Morgan K et al. Preoperative hemoglobin A1c and postoperative glucose control in outcomes after gastric bypass for obesity. Surg Obes Relat Dis. 2012;6:686-90.

[56] National Institutes of Health. The Practical Guide: Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. http://www.nhlbi.nih.gov/guidelines/obesity/prctgd_b.pdf. Accessed 10/26/2013.

[57] Hampel H, Abraham NS, El-Serag HB. Meta-analysis: obesity and the risk for gastroesophageal reflux disease and its complications. Ann Intern Med. 2005;143(3): 199-211.

[58] Greenwald D. Preoperative gastrointestinal assessment before bariatric surgery. Gastroenterol Clin N Am. 2010;19;81-6.

[59] Verma S, Sharma D, Kanwar P, et al. Prevalence of Helicobacter pylori infection in bariatric patients: a histologic assessment. Surg Obes Relat Dis. 2013;9(5):679-85.

[60] Rawlins L, Rawlins MP, Brown CC, Schumacher DL. Effect of Helicobacter pylori on marginal ulcer and stomal stenosis after roux-en-y gastric bypass. Surg Obes Relat Dis. 2013;9:760-4.

[61] World Health Organization. Global Burden of Disease – 2004 Update. Geneva, Switzerland. WHO Press; 2008

[62] Che F, Nguyen B, Cohen A, et al. Prevalence of hiatal hernia in the morbidly obese. Surg Obes Relat Dis. 2013 Apr 19. Epub ahead of print

[63] Fris RJ. Preoperative low energy diet diminishes liver size. Obesity Surg. 2004;14:1165-70.

[64] Edholm D, Kullberg J, Haenni A, et al. Preoperative 4-week low-calorie diet reduces liver volume and intrahepatic fat and facilitates laparoscopic gastric bypass in morbidly obese. Obes Surg. 2011;21:345-50.

[65] Guadalajara H, Sanz Boro R, Pascual I, et al. Is prophylactic cholecystectomy useful in obese patients undergoing gastric bypass? Obes Surg. 2006;16(7):883-5.

[66] Liem RK, Niloff PH. Prophylactic Cholecystectomy with open gastric bypass operation. Obes Surg. 2004;14:763-5.

[67] Hamad GG, Ikramuddin S, Gourash WF, et al. Elective cholecystectomy during laparoscopic gastric bypass: is it worth the wait? Obesity Surg. 2003;13:76-81.

[68] D'Hondt M, Sergeant G, Deylgat B, et al. Prophylactic cholecystectomy, a mandatory step in morbidly obese patients undergoing laparoscopic Roux-en-Y gastric bypass? J Gastrointest Surg. 2011;15:1532-36.

[69] Biesemeier CK, Garland J, eds. ADA Pocket Guide to Bariatric Surgery. Chicago, IL: American Dietetic Association; 2009.

[70] Aills L, Blankenship J, Buffington C, et al. ASMBS allied health nutritional guidelines for the surgical weight loss patient. Surg Obes Relat Dis. 2008;4(5 Suppl):S73-S108.

[71] National Eating Disorders Association. Factors that may contribute to eating disorders page. Accessibility verified: http://www.nationaleatingdisorders.org/contributing-factors-prevention. Accessed November 1, 2013.

[72] Beckman LM, Beckman TR, Earthman CP. Changes in gastrointestinal hormones and leptin after Roux-en-Y gastric bypass procedure: a review. J Am diet Assoc. 2010;110(4):571-84.

[73] Karpyn A, Young C, Weiss S. Reestablishing healthy food retail: changing the landscape of food deserts. Child Obes. 2012;8(1):28-30.

[74] Herichova I. Changes of physiological functions induced by shift work. Endocr Regul. 2013;47(3):159-70.

[75] Geliebter A, Gluck ME, Tanowitz M, et al. Work-shift period and weight change. Nutrition. 2000;16(1):27-29.

[76] McAlpine DE, Frisch MJ, Romes ES, et al. Bariatric surgery: a primer for eating disorder professionals. Eur Eat Disord Rev. 2010;18(4):304-17.

[77] Sandberg RM, Dahl JK, Vedul-Kjelsas E, et al. Health-related quality of life in obese presurgery patients with and without binge eating disorder, and subdiagnostic binge eating disorders. J Obes. 2013;2013:878310.

[78] Snyder, AG. Psychological assessment of the patient undergoing bariatric surgery. Oschner J. 2009;9(3):144-8.

[79] Kinzl JF, Schrattenecker M, Traweger C, et al. Psychosocial predictors of weight loss after bariatric surgery. Obes Surg. 2006;16(12):1609-14.

[80] Chesler BE. Emotional eating: a virtually untreated risk factor for outcome following bariatric surgery. ScienteificWorldJournal. 2012;2012:365961.

[81] Thomas J, Gizis F, Marcus E. Food selections of Roux-en-Y gastric bypass patients up to 2.5 years postsurgery. J Am Diet Assoc. 2010;110(4):608-12.

[82] Timlin MT, Pereira MA. Breakfast frequency and quality in the etiology of obesity and chronic diseases. Nutr Rev. 2007;65(6 Pt 1): 268-81.

[83] Pereira MA, Erickson E, McKee P. Breakfast frequency and quality may affect glycemia in adults and children. J Nutr. 2011;141(1):163-8.

[84] Goldstone AP, Prechtl de Hernandez CG, Beaver JD, et al. Fasting biases brain reward systems towards high-calorie foods. Eur J Neurosci. 2009;30(8):1625-35.

[85] National Weight Control Registry. NWCR facts page. Available at: http://www.nwcr.ws/Research/default.htm. Accessibility verified: November 1, 2013.

[86] Centers for Disease Control. Overcoming barriers to physical activity page. Available at: http://www.cdc.gov/physicalactivity/everyone/getactive/barriers.html. Accessibility verified: November 1, 2013.

[87] Nicoletti CF, Lima TP, Donadelli SP, et al. New look at nutritional care for obese patient candidates for bariatric surgery. Surg Obes Relat Dis. 2013;9:520-5.

[88] Schweiger C, Weiss R, Berry E, Keidar A. Nutritional deficiencies in bariatric surgery candidates. Obes Surg. 2010;20:193-7.

[89] Germmel K, Santry HP, Prachand VN, Alverdy JC. Vitamin D deficiency in perioperative bariatric surgery patients. Surg Obes Relat Dis. 2009;5:54-9.

[90] Hoeft B, Weber P, Eggerdorfer M. Micronutrient – a global perspective on intake, health benefits and economics. Int J Nutr Res. 2012;82(5):312-20.

[91] Kaidar-Person O, Person B, Szomstein S, et al. Nutritional deficiencies in morbidly obese patients: a new form of malnutrition? Part A: vitamins. Obes Surg. 2008;18(7): 870-6

[92] Kaidar-Person O, Person B, Szomstein S, et al. Nutritional deficiencies in morbidly obese patients: a new form of malnutrition? Part B: minerals. Obes Surg. 2008;18(8): 1028-34.

[93] Kulick D, Hark L, Deen D. The bariatric surgery patient: a growing role for registered dietitians. J Am Diet Assoc. 2010;110(4):593-9.

[94] Kushner RF, Neff LM. Bariatric surgery: a key role for registered dietitians. J Am Diet Assoc. 2010;110(4):524-6.

[95] Van Horn, L. The registered dietitian's role in treating bariatric surgery patients. J AM Diet Assoc. 2010;110(4):497.

[96] Heinberg LJ, Ashton K, Windover A. Moving beyond dichotomous psychological evaluation: the Cleveland Clinic Behavioral Rating System for weight loss surgery. Surg Obes Relat Dis. 2010;6:185-90.

[97] Ambwani S, Boeka AG, Brown JD, et al. Socially desirable responding by bariatric surgery candidates during psychological assessment. Surg Obes Relat Dis. 2013;9:300-5.

[98] Simon GE, Von Korff M, Saunders K, et al. Association between obesity and psychiatric disorders in the US adult population. Arch Gen Psychiatry. 2006;63:824-30.

[99] Greenberg I, Sogg S, Perna FM. Behavioral and psychological care in weight loss surgery: Best practice update. Obesity. 2009;17:880-4.

[100] Goldstein N, Hadidi N. Impact of bariatric preoperative education on patient knowledge and satisfaction with overall hospital experience. Bariatr Nurs Surg Patient Care. 2010;5:137-44.

[101] Kalarchian MA, Marcus MD, Levine MD, et al. Psychiatric disorders among bariatric surgery candidates: relationship to obesity and functional health status. Am j Psychiatry 2007; 164:328-34.

[102] Khan MA, Grinberg R, Johnson S, et al. Perioperative risk factors for 30-day mortality after bariatric surgery: is functional status important? Surg Endosc. 2013;27:1772-7.

[103] King WC, Bond DS. The importance of preoperative and postoperative physical activity counseling in bariatric surgery. Exerc Sport Sci Rev. 2013;41(1):26-35.

[104] American Society for Metabolic and Bariatric Surgery. ASMBS Public and Professional Education Committee. Bariatric Surgery: Postoperative Concerns. http://s3.amazonaws.com/publicASMBS/GuidelinesStatements/Guidelines/asbs_bspc.pdf. Accessed 10/28/2013.