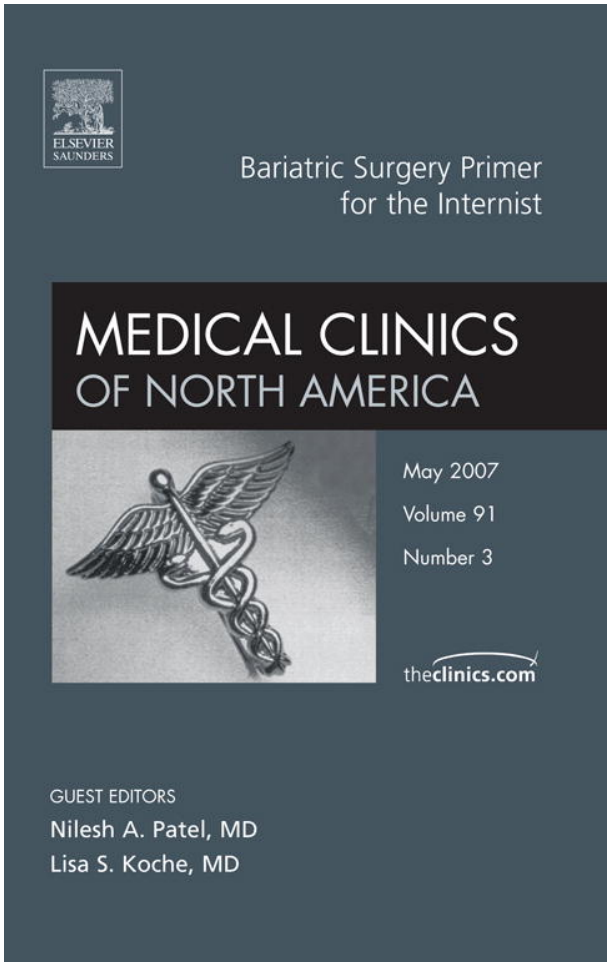

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Med Clin N Am 91 (2007) 339–351

THE MEDICAL
CLINICS
OF NORTH AMERICA

Preoperative Assessment and Perioperative Care of Patients Undergoing Bariatric Surgery

Rajesh Kuruba, MD[a,b], Lisa S. Koche, MD[b,c], Michel M. Murr, MD, FACS[a,b,*]

[a]*Department of Bariatric Surgery, University of South Florida, c/o Tampa General Hospital, P.O. Box 1289, Suite F-145, Tampa, FL 33601, USA*
[b]*Weight Management and Metabolic Health Center, P.O. Box 1289, Suite F-145, Tampa, FL 33601, USA*
[c]*Spectra Complete Healthcare, University of South Florida, 509 South Armenia Avenue, Suite #302, Tampa, FL 33609, USA*

The prevalence of morbid obesity in the United States and worldwide is increasing at an alarming rate. Between 1986 and 2000, the prevalence of adult Americans who have a body mass index (BMI) 40 kg/m^2 or greater quadrupled [1]. The recent National Health and Nutrition Examination Survey for 1999 through 2000 showed significant increases in the prevalence obesity (BMI $\geq$30 kg/m^2) from 23% to 31% and increases in extreme or morbid obesity (BMI $\geq$40 kg/m^2) from 2.9% to 4.7% compared with 1988 through 1994 [2]. The number of bariatric surgical procedures also has steadily increased during the past decade from 13,365 procedures in 1998 to 71,177 procedures in 2002 [3] and was expected to reach 140,000 in 2004 as a result of the increasing prevalence of morbid obesity, inconsistent weight loss with nonoperative therapy, and increasing evidence that bariatric procedures result in significant and durable weight loss, improve comorbid conditions, and reduce health care expenditure.

Although the overall mortality and morbidity rates of bariatric surgery are less than 1% and 15%, respectively [4,5], certain groups are at higher risk for complications [4,6] because of the high burden of comorbidities. There are three central questions to the suitability of patients for bariatric surgery: (1) Are patients ready and well equipped for lifelong changes?

* Corresponding author. Department of Bariatric Surgery, University of South Florida, c/o Tampa General Hospital, P.O. Box 1289 Suite F-145, Tampa, FL 33601.
E-mail address: mmurr@health.usf.edu (M.M. Murr).

0025-7125/07/$ - see front matter © 2007 Published by Elsevier Inc.
doi:10.1016/j.mcna.2007.01.010

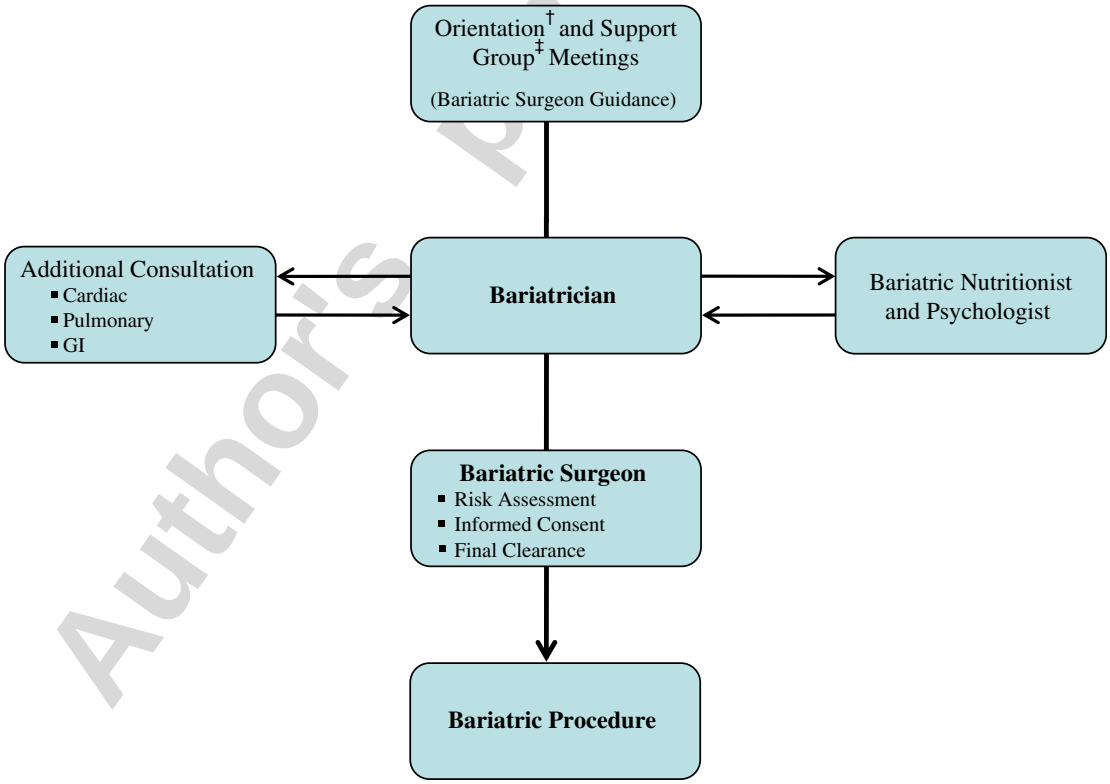
(2) What are the optimal methods to assess their operative risk? and (3) What is the best model for interdisciplinary care that these patients need? This article reviews the published literature and current practice trends for preoperative workup and assessment of patients undergoing bariatric surgery.

Preoperative assessment

Candidates for bariatric procedures should be selected carefully after evaluation by an interdisciplinary team with access to medical, surgical, psychiatric, and nutritional expertise (Fig. 1). The goals of preoperative assessment for bariatric surgery are listed in Box 1, and criteria for bariatric surgery are listed in Box 2.

Contraindications for bariatric procedures

There are a few absolute contraindications to bariatric surgery, such as mental/cognitive impairment, active cancer, advanced liver disease with



†Orientation meeting: Overview of the requirements (including third party payers) and process of weight loss surgery program.

‡Support group meeting: Candidates for bariatric surgery have the opportunity to talk to postoperative bariatric patients who can provide information relevant to pre- and postoperative issues.

Fig. 1. Our algorithm for evaluation and preoperative assessment of bariatric patients.

Box 1. Goals of preoperative assessment for bariatric surgery

Assess indications and contraindications to operative treatment.
Perform comprehensive and interdisciplinary medical, psychological, and dietary evaluations.
Treat and optimize medical comorbidities before surgical intervention.
Educate the patients and their support system about options of treatment and risk and set realistic expectations.

portal hypertension, unstable coronary artery disease, and uncontrolled severe obstructive sleep apnea with pulmonary hypertension (pulmonary systolic pressure >50 mm Hg). Age is no longer considered an absolute contraindication to bariatric surgery [9,10].

Role of the bariatric surgeon

The bariatric surgeon should be the key person to coordinate an interdisciplinary team and supervise preoperative evaluation along with a bariatrician. A decision for bariatric surgery should be reached, preferably along with family members, only after assessment of the probability that the patient will be able to tolerate surgery without excessive risk and will comply with the postoperative regimen and life-long medical surveillance.

Role of the bariatric nutritionist

The purpose of dietary counseling is not to induce weight loss preoperatively but to assess the patient's nutritional status and aid in patient education. Registered dietitians are best qualified to provide nutritional care, including preoperative assessment and postoperative education, counseling, follow-up [11,12], and education to patients about self-monitoring, meal planning, assessing nutritional deficiencies, and nutritional

Box 2. Criteria for bariatric surgery

As per the NIH consensus conference, eligibility for bariatric surgery is summarized as follows [7,8]:
BMI $\geq$40 kg/m^2 or $\geq$35 kg/m^2 with comorbid conditions
Failure of nonoperative weight loss efforts
Absence of contraindications (medical and psychological)
Well informed, compliant, and motivated patient

supplementation. Postoperatively, patients are required to take life-long nutritional supplements and to undergo life-long medical monitoring. Dedicated dietitians with specialty training in nutritional medicine are instrumental in the preoperative education of patients on new dietary requirements and stipulations and adjustment to those requirements after weight loss surgery.

Role of the bariatric psychologist/psychiatrist

Bariatric patients have a high prevalence of depression, anxiety, binge eating, night eating syndrome, post-traumatic stress disorder, and body dysmorphic disorders; approximately half of bariatric patients are taking psychotropic medications [13]. A preoperative evaluation should aim to assess a patient's psychological well-being, ability to make informed decisions, and willingness to participate actively in postoperative treatment [14]. In a systematic review of 29 studies, serious psychiatric disorders that required inpatient hospitalization and personality disorders were found to predict suboptimal weight loss after surgery [15].

Although there is no standardized protocol for the psychiatric and psychological evaluation of patients undergoing bariatric surgery, many centers use a structured interview, such as the Boston interview for gastric bypass [14], guidelines from Montefiore Medial Center/Albert Einstein College of Medicine [16], and the Weight and Lifestyle Inventory from the University of Pennsylvania [17]. Additionally, many clinicians use the Beck Depression Inventory or the Minnesota Multiphasic Personality Inventory for psychological testing [18].

We use brief motivational interviewing to assess the patients' readiness for change and to set realistic expectations of weight loss. In a survey of 230 women and 54 men, we found that patients' "dream weight" was 89% ± 8% excess body weight loss and that 67% ± 10% and 49% ± 14% excess body weight loss are "acceptable" and "disappointing" weights, respectively. These unrealistic weight loss expectations should be addressed to avoid regressive behavior postoperatively [19].

Role of the bariatrician

An internist or primary care provider with strong interest and training in bariatrics should ensure proper preoperative evaluation and treatment of comorbidities before and after bariatric surgery. A detailed history of nutrition, weight loss or gain, and physical activity should be obtained, and secondary causes of obesity (eg, Cushing syndrome, hypothyroidism) should be assessed and ruled out when clinically suspected. Although routine laboratory studies in the absence of physical findings are controversial [20], a list of commonly recommended tests is detailed in Table 1. Additional diagnostic

Table 1
Recommended preoperative testing

Test	Indication
Complete blood count	
Comprehensive metabolic panel, liver function tests	Renal failure, congestive heart failure, diuretic use, NASH
Creatinine	Age >50 yr, diuretic use
PT/PTT	Malnutrition (revisional bariatric surgery)
Glucose, Hb A1c	Obesity or DM
Electrocardiogram	Men >40 yr, women >50 yr, known coronary artery disease, hypertension, diabetes
Chest radiograph	Age >50 yr, known or suspected cardiac or pulmonary disease

Abbreviations: DM, diabetes mellitus; NASH, nonalcoholic steatosis; PT/PTT, prothrombin time/partial thromboplastin time.

testing and expert consultations (eg, with cardiologists, pulmonologists, and gastroenterologists) should be obtained when clinically indicated. Another goal of preoperative evaluation is to provide patients with guidelines and goals to increase their physical activity. Specifically, the bariatrician should assess preoperative patients as follows.

Endocrine

Strict glycemic control during the perioperative period to maintain serum glucose below 150 mg/dL or HBA1C <7 is essential to reduce adverse events. Routine screening for secondary causes of obesity, such as Cushing syndrome or hypothyroidism, has not been proven to be beneficial because of the rarity of these disorders compared with the epidemic of exogenous obesity in this context.

Cardiac

Patients should be assessed for cardiac risk according to the American Heart Association guidelines [21]. Patients should be assessed for risk based on history and physical and functional capacity. Intermediate- or high-risk patients require further cardiac evaluation; a reliable clinical predictor is the patient's ability to perform activities requiring at least four metabolic equivalents (eg, climbing a flight of stairs or walking up a hill).

Full evaluation may not be feasible because of body habitus and weight limitations of diagnostic equipment. The accuracy of thallium-201 scanning can be significantly diminished in patients who have a BMI greater than 30 kg/m^2 [22]. Transesophageal dobutamine stress echocardiography may be superior to the other types of stress echocardiography testing for obese patients [23]. Beta-blockers may decrease the risk of perioperative ischemia,

infarction, or dysrhythmia in patients who have coronary artery disease [21], but its role is not defined in bariatric surgery.

We screen asymptomatic patients for coronary disease if they have at least one of the following: age greater than 50 years with at least two of the following: metabolic syndrome, diabetes, hypertension, smoking, dyslipidemia, or family history of coronary disease; an abnormal baseline electrocardiogram; or prior history of coronary artery disease/valvular disease.

Using this protocol, we screen 25% to 35% of patients who are asymptomatic and 10% of patients who have known coronary artery disease. Nuclear imaging detects abnormalities in 5% of the told cohort that require further intervention. We treat high-risk patients or patients who have coronary artery disease with perioperative beta-blockers starting 1 week preoperatively and up to 2 weeks postoperatively.

Pulmonary

Obstructive sleep apnea (OSA) is characterized by periodic, partial, or complete obstruction of the upper airway during sleep. The prevalence of OSA in large series of bariatric surgical patients is 39% to 71% [24,25]. The American Society of Anesthesiologists practice parameters are useful for the perioperative assessment and management of patients who have OSA [26]. Preoperative initiation and perioperative use of continuous positive airway pressure (CPAP) or bilevel positive airway pressure (BiPAP) can reduce hypercarbia, hypoxemia, and pulmonary artery vasoconstriction.

We screen patients by history, neck examination, and the Epworth Sleepiness Scale (Table 2) and refer them to polysomnography if they score 6 or higher on the Epworth Sleepiness Scale and if they snore [27,28]. Using these criteria, we refer 75% of all bariatric patients for polysomnography, the majority of whom (82%) are diagnosed with OSA. We require at least 4 weeks of treatment with CPAP/BiPAP before the proposed operation to minimize

Table 2
Epworth sleepiness scale

Situation	Chance of dozing[a]
Sitting and reading	
Watching TV	
Sitting, inactive in a public place (eg, a theater or a meeting)	
As a passenger in a car for an hour without a break	
Lying down to rest in the afternoon when circumstances permit	
Sitting and talking to someone	
Sitting quietly after a lunch without alcohol	
Ina car, while stopped for a few minutes in the traffic	
Total	
Do you snore while sleeping?	☐Yes—☐No
Does your bed partner say that you snore?	☐Yes—☐No

[a] 0 = none; 1 = slight; 2 = moderate; 3 = high.

alveolar hypoventilation. Additionally, we reinstitute CPAP/BiPAP treatment in the recovery room and during day- and night-time sleep in the immediate postoperative period. With this approach, the incidence of postoperative primary respiratory failure in our cohort is 1% [29]. Occasionally, we require pulmonary function tests and spirometry in patients who have known reactive airways disease and chronic obstructive pulmonary disease.

Hypercoagulability

Obesity is an independent risk factor for venothromboembolic events (VTE). This risk is accentuated by pneumoperitoneum during surgery and perioperative hypercoagulability through increased levels of fibrinogen, factor VIII, and von Willebrand factor. The incidence of VTE in patients receiving routine perioperative prophylaxis ranges from 0.2% to 3.5% [30,31]. Although 95% of bariatric surgeons use some form of thromboprophylaxis routinely [32], clear dosing guidelines for prophylaxis of VTE in bariatric patients have not been developed because of the elusive relationship of body weight and dosing regimens and because many of the studies that compared different regimens and doses were underpowered [33,34]. However, VTE prophylaxis and early ambulation should be pursued in all patients.

The role of routine duplex ultrasonography in detecting deep venous thrombosis is not clear and cannot be justified in bariatric patients. Prophylactic inferior vena cava filter placement may be beneficial for bariatric patients at high risk for postoperative VTE (eg, patients who have venous stasis disease, BMI $\geq$60 kg/m^2, truncal obesity, prior VTE, and known hypercoagulable state) [31,35,36]. Extended prophylaxis (postdischarge) with low-molecular-weight heparin may be necessary for these high-risk patients.

We use 7500 units of unfractionated heparin subcutaneously on call to the operating room and use enoxaparin 40 mg subcutaneously daily for patients who have a BMI 50 kg/m^2 or greater and 30 mg subcutaneously twice daily for patients who have a BMI greater than 50 kg/m^2 until discharged from the hospital. We use extended prophylaxis with enoxaparin 60 mg subcutaneously daily for 10 days after discharge from the hospital for patients who have a BMI 60 kg/m^2 or greater, relative immobility, or previous history of VTE.

Gastrointestinal

The recent European guideline that strongly recommends upper endoscopy or contrast studies before gastric bypass [37] is based on a single study that showed significant upper gastrointestinal tract lesions in 62% of patients [38]. Potential drawbacks for screening asymptomatic patients include low impact of endoscopy on surgical management and the secondary unnecessary work-up prompted by endoscopic findings and its attendant increased costs [39–41]. The recommendations to screen for *Helicobacter pylori* in asymptomatic bariatric patients are not well founded.

Obesity is a risk factor for cholelithiasis. Gallstone formation is common after bariatric surgery due to rapid weight loss and occurs in 32% of patients within 6 months of gastric bypass [42]. For these reasons and because of the impracticality of screening all patients preoperatively, we undertake a routine cholecystectomy at the time of gastric bypass [43]. Other clinicians prefer a selective approach and remove only gallbladders that contain stones; if cholecystectomy is not performed at the time of surgery, ursodiol 600 mg daily for 6 months may reduce the incidence of new stone formation [42].

In summary, we do not routinely screen for gallstones, hiatal hernias, or *H pylori* in asymptomatic patients.

Liver

Nonalcoholic fatty liver disease (NAFLD) is a clinicopathologic condition characterized by significant lipid deposition in hepatocytes that may induce a wide spectrum of liver damage ranging from simple fatty infiltration to cirrhosis. When inflammatory changes occur with or without fibrosis, the term "nonalcoholic steatohepatitis" (NASH) is more appropriate.

In a review of 12 observational studies including 1620 patients, the prevalence of steatosis was 91% (range, 85%–98%), the prevalence of NASH was 37% (range, 24%–98%), and the prevalence of unexpected cirrhosis was 1.7% (range, 1%–7%) [44]. Patients older than 45 years and those who were obese or diabetic are at greatest risk for advanced fibrosis [45,46].

Preoperative assessment for bariatric patients should include comprehensive liver function panel, lipid profile, and, when indicated, viral markers for hepatitis. Because clinical and radiologic parameters of the presence or severity of NAFLD/NASH are unreliable and preoperative liver biopsies are impractical, we routinely obtain a liver biopsy during the bariatric surgical procedure to diagnose and stage NAFLD/NASH [47,48]. Earlier bariatric surgical procedures, such as the jejunoileal bypass [49], with too rapid a weight loss along with the attendant malnutrition had adverse effect on liver function. Contemporary surgical procedures, such as gastric bypass with more controlled weight loss, have shown to improve NASH, including fibrosis [50,51]. Patients who have known cirrhosis and impairment of hepatic reserve (eg, Childs-Pugh class B or C) or the presence of portal hypertension or ascites are at prohibitive risk for complications.

Recommendations for preoperative diets that reduce liver size are not founded in rigorous scientific data and warrant further studies.

Dysfertility

At least 50% of patients who have polycystic ovary syndrome (PCOS) are obese [52]. PCOS is diagnosed by the presence of at least two of the

following criteria: oligo- or anovulation, clinical or biochemical signs of hyperandrogenism, and polycystic ovaries [53].

The endocrine abnormalities of PCOS include increased serum androgens, increased luteinizing hormone level, increased luteinizing hormone/follicle-stimulating hormone ratio, and hyperinsulinemia. Weight loss and very-low-calorie diets lead to normalization of insulin resistance, menstrual dysfunction, and oligo-ovulation. Because diet-based and pharmacologic therapies do not lead to sustained weight loss, interest in bariatric surgery for amelioration of PCOS has risen. In a series of 24 patients who had PCOS and mean BMI of 50 ± 8 kg/m^2, gastric bypass resulted in significant improvement of manifestations related to PCOS [54].

Preoperative risk scoring

The overall mortality of bariatric surgery is less than 1% [4,55]. Recently, higher mortality rates have been reported among Medicare beneficiaries and patients older than 65 years of age [6]. Male gender, older age, high BMI, and surgeon's experience have been identified as predictors of adverse events by multivariate analysis [4,6,56]. The Obesity Surgery Mortality Risk Score, which was developed by DeMaria and colleagues (Eric DeMaria, MD, FACS, personal communication, 2006), uses five patient characteristics. Age 45 years or greater, hypertension, BMI 50 kg/m^2 or greater, male gender, and risk of pulmonary embolism (history of VTE, pulmonary hypertension, and obesity hypoventilation) have been proposed to predict perioperative mortality of bariatric surgery. In a multicenter study of 4433 patients, including our cohort, to validate the OSMRS, patients who had 0 to 1, 2 to 3, or 4 to 5 risk factors had mortality rates of 0.37%, 1.21% and 2.4%, respectively. This risk stratification may help in surgical decision making and in obtaining informed consent and may allow standardization of outcome comparisons between different centers.

Anesthetic considerations

Preoperative evaluation

Attention should focus on issues unique to the obese patient, particularly cardiorespiratory status and the airway. With severe pulmonary hypertension, pulmonary artery catheterization and monitoring may be necessary. Preoperative arterial blood gas can identify carbon dioxide retention, provide guidelines for perioperative oxygen requirements, and aid in setting guidelines for weaning from the ventilator during the postoperative period.

It is recommended that the patient's usual medications, except insulin, diuretics, and oral hypoglycemics, be continued until the time of surgery. Antibiotic prophylaxis is important because of the increased risk of postoperative wound infection.

Intraoperative care

Operating room beds with a high weight capacity are required. The patient should be well secured because of the risk for falling during table position changes. Particular care should be paid to protect pressure areas during positioning because pressure sores and neural injuries are more common in obese patients.

Endotracheal intubation and airway management in the obese patient can be challenging, and a number of clinical factors can predict ventilation and tracheal intubation difficulty: primarily neck circumference [57], visualization of oropharyngeal structures (Mallampati score), thyromental distance, and dental configuration. Brodsky and colleagues [57], in a study of 100 morbidly obese patients, found that neither obesity nor BMI predicted difficult intubation, whereas a high Mallampati score (≥ 3) and large neck circumference increased the potential for difficult laryngoscopy and intubation. Towels or a shoulder roll can be used to extend the neck. Optimal positioning of the patient and consideration of an algorithm for difficult airway management, such as the American Society of Anesthesiologists' Practice Guidelines for Management of the Difficult Airway, help to achieve safe and rapid airway management [26].

Blood pressure cuffs should span a minimum of 75% of the patient's upper arm circumference for reliable measurements. Invasive arterial monitoring should be used for the "super" obese (BMI ≥ 60 kg/m^2), for patients who have severe cardiopulmonary disease, or for patients in whom the noninvasive blood pressure cuff reading is unreliable. Central venous catheters should be used in cases of difficult peripheral venous access or when postoperative access may be difficult. Highly lipophilic substances, such as barbiturates and benzodiazepines [58], show significant increases in the volume of distribution for obese individuals relative to normal-weight individuals, and these drugs must be administered in higher doses. Desflurane has been suggested as the inhaled anesthetic of choice in this patient population because of its more rapid and consistent recovery profile. Complete muscular relaxation is crucial during laparoscopic bariatric procedures to facilitate ventilation and to maintain an adequate working space for visualization and safe manipulation of laparoscopic instruments. Collapse of the pneumoperitoneum may be an early indication that muscle relaxation is inadequate.

Postoperative considerations

Patients who have significant cardiac disease, male gender, BMI 60 kg/m^2 or greater, diabetes, OSA, and intraoperative complications are the risk factors predictive of postoperative ICU admission [59]. We manage all of our patients in a specialized nursing unit for bariatric patients; routine admissions to the ICU are $<1\%$. Patients who need intravenous beta-blockers are monitored by telemetry.

Summary

The field of bariatric surgery has changed dramatically since the NIH Consensus Conference statement in 1991. As bariatric surgeons continue to improve procedures for weight loss, successful outcomes after bariatric surgery depend not only on the technical expertise of the surgeon but also on careful preoperative assessment, screening, and minimization of preoperative risk. Further research is needed for formulating evidence based on the guidelines for many aspects of the perioperative care of bariatric patients.

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