ANESTHESIOLOGY™2014
OCTOBER 11-15 | NEW ORLEANS, LA

Session: L125
Session: L189

Can the Adult Patient With Morbid Obesity and Obstructive Sleep Apnea Safely Undergo Outpatient Surgery?

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Disclosures: This presenter has no financial relationships with commercial interests

Stem Case and Key Questions Content

A 52 year old, 45 kg/m2 body mass index (BMI) female with past medical history significant for hypertension and controlled gastroesophageal reflux (GERD) disease is scheduled for outpatient laparoscopic adjustable gastric band placement. The preoperative history reveals loud snoring while sleeping but is otherwise unremarkable. The patient can climb two flights of stairs without getting short of breath. The airway physical exam reveals a Mallampati class 2 airway, 4 cm thyromental distance, and a neck circumference of 45 cm. Chest x-ray (CXR) and electrocardiogram (ECG) are normal. Blood pressure is 123/71 and room air oxygen saturation is 95%.

Key Questions
1. How would one pre-procedurally screen a patient for suspected OSA? What selection criteria for suitability for ambulatory surgery should be used for patients with morbid obesity and OSA? What pre-procedural education should be provided to the patient and family?

2. What are the surgical considerations that impact anesthetic management for this case? What are the anesthetic/airway management considerations?

Case Continuation and Questions
Based on the preoperative evaluation, the decision is made to proceed with a general anesthetic in the outpatient setting.

3. What are the potential hazards/complications regarding the airway? Are there specific pre-induction safeguards one should implement? What airway device(s) should one have immediately available for backup purposes?

4. How should one manage the airway?

Case Continuation and Questions
After rapid sequence induction of anesthesia, direct laryngoscopy fails on two attempts. Mask ventilation remains easy between attempts.

5. What management options does the ASA DA algorithm recommend for a cannot intubate, can ventilate scenario?

6. What should one do if mask ventilation becomes inadequate? What management options does the ASA DA algorithm recommend for a cannot intubate, cannot ventilate scenario?

Case Continuation and Questions

The patient's trachea is intubated with a flexible fiberoptic intubating scope, and surgery proceeds uneventfully.

7. Are there special considerations for intraoperative management? Should nitrous oxide be used during the case? Are there special considerations for emergence or the end of the case?

8. Are there special considerations for postanesthesia care unit (PACU) management of this patient?

Model Discussion Content
Outpatient surgery for the morbidly obese patient with OSA is controversial but can be safely performed under certain conditions.

Morbid obesity (BMI > 40 kg/m2) is associated with multiple co-morbidities, including OSA.1 Super obesity (BMI > 50 kg/m2) may be associated with a higher risk of postoperative complications, particularly if these patients have OSA, obesity hypoventilation syndrome, poorly controlled systemic or pulmonary arterial hypertension, significant coronary artery disease (CAD), heart failure, bleeding disorder, or chronic renal failure requiring dialysis.2,3 In general, patient selection for ambulatory surgery should not be based solely on BMI.4 Recent large observational studies have assessed perioperative complications in the obese population and correlated adverse outcomes with patient and surgical factors.3,5-7Adverse outcomes are more likely in morbidly obese patients with poor functional status, poorly controlled medical conditions, history of deep venous thrombosis or pulmonary embolus, and history of bleeding disorder.3 Surgical considerations include the degree of invasiveness and experience of the surgeon. Criteria to determine suitability for outpatient surgery in this population should be based on functional status, the degree of medical optimization of systemic disease, and the invasiveness of the surgical procedure.3

OSA is associated with obesity, GERD, hypertension, metabolic syndrome, insulin resistance, arrhythmias, myocardial ischemia, heart failure, and cerebrovascular disease.8 OSA is characterized by recurrent episodic cessation of breathing lasting ≥ 10 seconds during sleep.8, Exaggerated depression of pharyngeal muscle tone results in a cyclical pattern of partial or complete upper airway obstruction and impaired respiration.8,9 This manifests clinically as repeated nocturnal arousals with increased sympathetic output leading to daytime hypersomnolence, memory loss, and executive dysfunction.8,10 The gold standard for definitive diagnosis of OSA is overnight polysomnography or sleep study.8 The apnea hypopnea index (AHI), defined as the average number of abnormal breathing events per hour of sleep, is used to determine the presence and severity of OSA. An apneic event refers to cessation of airflow for 10 seconds, and hypopnea occurs when reduced airflow leads to oxygen desaturation ≥ 4%.8,11 OSA severity is mild for AHI ≥ 6 to 20, moderate for AHI 21 to 40, and severe for AHI > 40 with symptoms, such as daytime sleepiness, loud snoring, or observed obstruction during

sleep.8,18 The prevalence of OSA was 78% in morbidly obese patients scheduled for bariatric surgery.8,13 Current guidelines recommend that patients with moderate to severe OSA treated with positive airway pressure (PAP) maintain its use prior to surgery.8,14 Patients with diagnosed moderate to severe OSA who are unable or unwilling to use PAP after discharge may not be appropriate candidates for ambulatory surgery.3

A significant number of patients with OSA are undiagnosed when they present for elective surgery.8,15 Approximately 24% of surgical patients were found to be at high risk for OSA by question-based screening, 81% of whom had not been previously diagnosed.8,16,17 The ASA suggests that positive sleep studies or clinical indicators, such as question-based criteria, be considered during pre-procedural screening,3,18,19 together with

a. the level of invasiveness of surgery and anesthesia
b. the potential need for post-procedure opioids.

The Society for Ambulatory Anesthesia recommends using STOP-Bang, a question-based screening tool, along with evaluation of patient co-morbidities.19 The STOP-Bang questionnaire is useful in the preoperative setting to predict OSA severity, triage patients for further confirmatory testing, and exclude those without disease.8,20 Patients with STOP-Bang scores 0-2 may be considered low risk, 3-4 intermediate risk, and 5-8 high risk of OSA.8,21 Patients with suspected OSA can be considered for ambulatory surgery if their co-morbid conditions are optimized, and if postoperative pain relief can be provided predominantly with non-opioid analgesics.

Recent observational case series report that laparoscopic adjustable gastric banding can be performed safely on an outpatient basis.3,22,23 Systematic review of studies found no differences between ambulatory surgery OSA and non-OSA patients for anesthesia-related complications and unanticipated hospital admission.3,19 Of note, these studies used protocol-based care which optimized perioperative management. There was emphasis on limiting opioid dose and exercising caution in patients who developed recurrent respiratory events postoperatively.3 The predictors for surgical morbidity and mortality in outpatient OSA patients include age > 50 years, male gender, poorly controlled co-existing medical conditions, invasiveness of the surgical procedure, surgeon experience, and postoperative opioid dose.3 OSA patients with inadequately treated co-morbid conditions are not suitable for ambulatory surgery.

Preoperative tests should be based on clinical indications and the invasiveness of the surgical procedure. The American College of Cardiology and American Heart Association proposed recommendations for perioperative care of morbidly obese patients undergoing surgery.3,24 Recommendations include an ECG in patients with at least one risk factor for CAD and/or poor exercise tolerance. ECG signs of right ventricular hypertrophy including right-axis deviation and right bundle branch block suggest pulmonary artery hypertension, and a left bundle branch block may suggest occult CAD.3,24 In addition, a CXR should be obtained on all morbidly obese patients as it may reveal undiagnosed heart failure, cardiac chamber enlargement, or abnormal pulmonary vascularity suggestive of pulmonary hypertension, all warranting further cardiovascular investigation.3,24 Further testing, such as exercise and/or pharmacological stress echocardiography, may be indicated in the presence of three or more of the following risk factors:3,24

a. history of CAD
b. history of congestive heart failure
c. history of cerebrovascular disease
d. preoperative treatment with insulin
e. preoperative serum creatinine levels > 2 mg/dL

If it is determined that the morbidly obese patient with OSA is suitable for outpatient surgery, pre-procedure patient and family education should be provided. Education19 consists of

a. advising continued use of PAP postoperatively for patients with diagnosed OSA
b. recommending the semi-upright position while sleeping postoperatively
c. warning about the inherent dangers of opiate use
d. discussing the possibility of transfer to an inpatient facility for continued monitoring should it be warranted.

Patients with suspected OSA based on the STOP-Bang screening questionnaire should be advised to follow-up with their primary physician for possible sleep study.19
The anesthetic/airway management considerations for the morbidly obese patient with suspected OSA include risk of hypoxemia, pulmonary aspiration of gastric contents, increased likelihood of encountering a DA,25-27 difficulty obtaining emergency invasive airway access, and loss of the airway. Deleterious respiratory physiologic changes in the morbidly obese include increases in airway resistance, oxygen consumption, and minute ventilation.1 Conversely, lung volumes, pulmonary compliance, chest wall compliance and gas flows are reduced. Decreased expiratory reserve volume and functional residual capacity (FRC) decline significantly following induction of anesthesia.1

Several factors increase aspiration risk in the morbidly obese patient. First, elevated BMI is consistently associated with higher rates of GERD, particularly in females with elevated estrogen levels.28 Secondly, morbidly obese patients have higher gastric volumes than the non-obese. Third, barrier pressure (lower esophageal pressure minus gastric pressure) is significantly lower in the morbidly obese, although it remains positive.29 Recent literature suggests that gastric emptying is not impaired in the obese and is not a primary factor in aspiration risk.30 Measures to decrease the risk of gastric acid aspiration should be considered, including preoperative proton pump inhibitors, antacids, and rapid sequence induction with cricoid pressure.8 Cricoid pressure may impede mask ventilation and tracheal intubation.8, 31 Pharyngeal obstruction, resulting from anatomical mismatch between the craniofacial bony enclosures and the amount of soft tissue32 or physical obstruction from lingual tonsil hyperplasia33 can increase the likelihood of experiencing a DA in the obese patient. Face mask ventilation, laryngoscopy and emergency invasive airway access may prove challenging in morbidly obese patients as well. If difficulty with basic airway management is likely, the updated ASA DA algorithm25 recommends considering the relative merits and feasibility of

a. awake intubation vs. intubation after induction of general anesthesia
b. non-invasive techniques vs. invasive techniques for the initial approach to intubation
c. video laryngoscopy (VL) as the initial approach to intubation
d. preservation vs. ablation of spontaneous ventilation.

Airway management should begin with a thorough preoperative history, airway assessment, and physical exam. This assessment25 should include the likelihood and clinical impact of difficulty with

a. patient cooperation or consent
b. mask ventilation
c. supraglottic airway placement
d. laryngoscopy
e. intubation
f. surgical airway access.

If the patient has multiple nonreassuring DA predictors, the practitioner should consider awake intubation since alternative airway management plans will likely fail. A history of OSA may be associated with difficult mask ventilation.34,35 The patient with OSA is eight times more likely to be a difficult intubation.36 It is recommended that backup airway management equipment be prepared and readily available. Proper positioning and preoxygenation, minimizing laryngoscopies, and early use of alternate airway devices may mitigate these risks.
To improve oxygenation, ventilation and laryngoscopic view, the patient should be placed in the head-elevated laryngoscopy position (HELP), placing the external auditory meatus at the level of the sternal notch.37 Preoxygenation with 100% oxygen is recommended until end tidal oxygen fraction reaches 90%. FRC can be further augmented with the application of 5-10 cm H2O PAP during this process.37 Morbidly obese patients with OSA require special attention during preoxygenation as this population has increased oxygen consumption and greatly reduced FRC.1

The non-emergent pathway of the ASA DA management algorithm25 should be followed in a cannot intubate, can ventilate situation. One could attempt VL, and if unsuccessful, place an intubating laryngeal mask airway (ILMA). VL has a high likelihood of success even in obese patients.38 ILMA placement is often successful since internal adipose tissue aligns the device along the midline with the glottis.39 Upon confirmation of adequate oxygenation and ventilation with an ILMA, a flexible fiberoptic scope can be used to place an ETT in the trachea.40 If an ILMA, such as the LMA Fastrach™, is used, a flexible fiberoptic scope may not be necessary as this device was designed to be used as a blind technique. If unsuccessful, a flexible fiberscope can be utilized. If unable to succeed with these alternative techniques, one should awaken the patient.

In a cannot intubate, cannot ventilate scenario, the practitioner should call for help. Emergency noninvasive airway ventilation via a supraglottic device or emergency invasive airway access is recommended.25 Emergency invasive airway access includes jet ventilation and percutaneous or surgical airway. Difficulty in performing invasive techniques in morbidly obese patients is more likely than in non-obese patients if neck circumference is increased. It is important for the practitioner to oxygenate the patient in between intubation attempts and actively pursue opportunities to deliver supplemental oxygen throughout the process of DA management.25
With the airway safely and uneventfully secured in the morbidly obese patient with OSA, intraoperative risk reduction strategies should be employed. Increased susceptibility to airway collapse, chronic sleep deprivation, and blunted responses to hypercarbia and hypoxia manifest as elevated sensitivity to the respiratory depressant effects of anesthetic drugs.8 Preoperative

sedative premedication should therefore be avoided.8 Short acting agents such as propofol, remifentanil and desflurane are preferred.8 Use of nitrous oxide may be considered given its analgesic properties, reducing intraoperative opiate requirements, and the second gas effect, facilitating emergence from volatile anesthetics.3 Morbid obesity is associated with deleterious changes in pulmonary function that intraoperative lung protective strategies may mitigate. These strategies consist of 6-8 ml/kg ideal body weight tidal volumes, 5-10 cm H2O positive end expiratory pressure, and intraoperative lung recruitment maneuvers.3,41 It is advisable to avoid hyperventilation as compensatory metabolic alkalosis can lead to postoperative hypoventilation.3 Mild hypercapnea has the additional benefit of shifting the oxyhemoglobin dissociation curve to the right, increasing tissue oxygenation.3,42
Perioperative OSA risk reduction strategies include a multimodal, opioid-sparing approach to analgesia including8

a. NSAIDs and COX-2 inhibitors, acetaminophen, tramadol and tapentadol
b. NMDA receptor antagonist ketamine
c. adjuvants such as pregabalin and gabapentin
d. alpha 2 agonists clonidine and dexmedetomidine
e. local and regional anesthesia.

Studies show that oxygen desaturation is 12 to 14 times more common in patients with OSA who receive postoperative opioids.43

General and airway risk factors may render airway patency and oxygenation uncertain in this patient population, resulting in an increased risk of extubation failure.44 The practitioner should ensure that airway reflexes are intact and that the patient is awake, responsive, and fully recovered from neuromuscular blockade prior to extubation. Small amounts of residual neuromuscular blockade can result in postoperative morbidity from airway obstruction, hypoventilation, hypoxia, gastric content aspiration and reintubation.8,45

The patient should be placed in HELP and provided 100% oxygen before extubation. A staged extubation should be considered if intubation was performed using a supraglottic airway (SGA), leaving the SGA in as a bridge to extubation. Another bridging option is placement of an airway exchange catheter that allows for reversible extubation and reintubation. The patient should remain positioned semiupright/nonsupine after extubation. Known OSA patients already on PAP devices should continue PAP therapy postoperatively.8,18 Supplemental oxygen should be administered to OSA patients with caution since it may reduce hypoxic respiratory drive and increase the incidence and duration of apneic episodes.8 Because obese patients may have unrecognized OSA, recurrent hypoxemia may respond to PAP combined with oxygen.8
Prior to discharge from a non-stimulating PACU environment, the room air oxygen saturation should return to baseline without evidence of hypoxia or airway incompetence. Most significant postoperative complications in OSA patients occur within two hours of surgery. Some authors propose extending PACU observation an additional 30 to 60 minutes after modified Aldrete criteria for discharge have been met.8,47

One should discharge a patient with diagnosed moderate to severe OSA to a monitored environment if the patient is noncompliant with PAP therapy, receives parenteral opioids, or has recurrent PACU respiratory events.8 PACU respiratory events, occurring repeatedly in separate 30 minute intervals, are defined8 as

a. episode of apnea ≥ 10 seconds
b. bradypnea < 8 breaths per minute
c. pain analgesia mismatch
d. oxygen saturation < 90%.

Monitoring with continuous oximetry is recommended if parenteral opioids are given due to possible drug-induced respiratory depression.48 Patients with diagnosed moderate to severe OSA requiring high-dose oral opioids should be admitted to a monitored unit with continuous oximetry and/or PAP therapy regardless of the presence or absence of PACU respiratory events. The Anesthesia Patient Safety Foundation advises capnography for detection of opioid-induced hypoventilation when opiates and supplemental oxygen are given.48 Caution should be exercised if suspected moderate to severe OSA patients require postoperative parenteral opiates or exhibit repeated respiratory events in the postoperative period. These patients are at increased risk of postoperative respiratory complications49-51 and should be transferred to an inpatient facility for continuous oximetry monitoring and/or PAP therapy.8

References

1. Cullen A, Ferguson A. Perioperative management of the severely obese patient: a selective pathophysiological review. Can J Anaesth 2012; 59:974-96.
2. Kakarla VR, et al. Are laparoscopic bariatric procedures safe in superobese (BMI ≥50 kg/m2) patients? An NSQIP data analysis. Surg Obes Relat Dis 2011; 7:452-8.
3. Joshi, GP. The adult patient morbid obesity and/or obstructive sleep apnea for ambulatory surgery: an update. Refresher course lectures, American Society of Anesthesiologists 2013.
4. Verma R, et al. Day case and short stay surgery. Anaesthesia 2011; 66:417-34.
5. Elliott JA, et al. Fast-track laparoscopic bariatric surgery: a systematic review. Updates Surg. 2013.
6. Memtsoudis SG, et al. Factors influencing unexpected disposition after orthopedic ambulatory surgery. J Clin Anesth 2012; 24:89-95.
7. Nandipati K, et al. Factors predicting the increased risk for return to the operating room in bariatric patients: a NSQIP database study. Surg Endosc. 2013; 27:1172-7.
8. Chung F, Obstructive sleep apnea-What an anesthesiologist should know. Refresher course lectures, American Society of Anesthesiologists 2013.
9. Isono S. Obstructive sleep apnea of obese adults: Pathophysiology and perioperative airway management. Anesthesiology 2009; 110:908-21.
10. Beebe DW, Gozal D. Obstructive sleep apnea and the prefrontal cortex: Towards a comprehensive model linking nocturnal upper airway obstruction to daytime cognitive and behavioral deficits. J Sleep
Res 2002; 11:1-16.
11. Iber C, Ancoli-Israel S, Cheeson A et al. The AASM Manual for the Scoring of Sleep and Associated Events, Rules, Terminology and Technical Specifications. Westchester, Illinois, American Academy of Sleep Medicine, 2007.
12. Epstein LJ, Kristo D, Strollo PJ et al. Clinical guideline for the evaluation, management and long-term
care of obstructive sleep apnea in adults. J Clin Sleep Med 2009; 5:263-76.
13. Lopez PP, Stefan B, Schulman CI et al. Prevalence of sleep apnea in morbidly obese patients who presented for weight loss surgery evaluation: more evidence for routine screening

for obstructive sleep apnea before weight loss surgery. Am Surg 2008; 74:834-8.
14. Gross JB, Bachenberg KL, Benumof JL et al. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: A report by the ASA Task Force on perioperative management of patients with obstructive sleep apnea. Anesthesiology 2006; 104:1081-93.
15. Singh M, Liao P, Kobah S et al. Proportion of surgical patients with undiagnosed obstructive sleep apnoea. Br J Anaesth 2013; 110:629-636.
16. Finkel KJ, Searleman AC, Tymkew H et al. Prevalence of undiagnosed obstructive sleep apnea among adult surgical patients in an academic medical center. Sleep Med 2009; 10:753-8.
17. Stierer TL, Wright C, George A et al. Risk assessment of obstructive sleep apnea in a population of
patients undergoing ambulatory surgery. J Clin Sleep Med 2010; 6:467-72.
18. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: an updated report by the American Society of Anesthesiologists task force on perioperative management of patients with obstructive sleep apnea. Anesthesiology 2014; 120:268-86.
19. Joshi GP, et al. Society for Ambulatory Anesthesia (SAMBA) consensus statement on preoperative selection of patients with obstructive sleep apnea scheduled for ambulatory surgery. Anesth Analg 2012; 115:1060-8.
20. Farney RJ, Walker BS, Farney RM et al. The STOP-Bang equivalent model and prediction of severity of obstructive sleep apnea: relation to polysomnographic measurements of the apnea/hypopnea index. J Clin Sleep Med 2011; 7:459-65.
21. Chung F, Subramanyam R, Liao P et al. High STOP-Bang score indicates a high probability of
obstructive sleep apnoea. Br J Anaesth 2012; 108: 768-75.
22. Lockhart EM, et al. Obstructive sleep apnea screening and postoperative mortality in a large surgical cohort. Sleep Medicine; 2013; 14:407-15.
23. American Society for Metabolic and Bariatric Surgery (ASMBS). Peri-operative management of obstructive sleep apnea ASMBS Clinical Issues Committee. Surgery for Obesity and Related Diseases 2012; 8:e27-32.
24. Poirier P, Alpert MA, Fleisher LA, et al: Cardiovascular evaluation and management of severely obese patients undergoing surgery: a science advisory from the American Heart Association. Circulation 2009; 120:86-95.
25. 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.
26. Brodsky JB, Lemmens HJ, Brock-Utne JG, Vierra M, Saidman LJ. Morbid obesity and tracheal intubation. Anesth Analg 2002; 94:732-6.
27. Gonzalez H, Minville V, Delanoue K, Mazerolles M, Concina D, Fourcade O. The importance of increased neck circumference to intubation difficulties in obese patients. Anesth Analg 2008; 106:1132-6.
28. Lagergren J. Influence of obesity on the risk of esophageal disorders. Nat Rev Gastroenterol Hepatol 2011; 8:340-7.
29. de Leon A, Thorn SE, Wattwil M. High-resolution solid-state manometry of the upper and lower esophageal sphincters during anesthesia induction: a comparison between obese and non-obese patients. Anesth Analg 2010; 111:149-53.
30. Buchholz V, Berkenstadt H, Goitein D, Dickman R, Bernstine H, Rubin M. Gastric emptying is not prolonged in obese patients. Surg Obes Relat Dis 2013; 9(5):714-7.

31. Ovassapian A, Salem MR. Sellick's maneuver: To do or not do. Anesth Analg 2009; 109:1360-2.
32. Bein B, Scholz J. Anaesthesia for adults undergoing non-bariatric surgery. Best Pract Res Clin Anaesthesiol 2011; 25:37-51.
33. Ovassapian A, Glassenberg R, Randel GI, Klock A, Mesnick PS, Klafta JM. The unexpected difficult airway and lingual tonsil hyperplasia. Anesthesiology 2002; 97:124-32.
34. Kheterpal S, Martin L, Shanks AM et al. Prediction and outcomes of impossible mask ventilation: a
review of 50,000 anesthetics. Anesthesiology 2009; 110:891-7.
35. Siyam MA, Benhamou D. Difficult endotracheal intubation in patients with sleep apnea syndrome.
Anesth Analg 2002; 95:1098-102.
36. Langeron O, Masso E, Huraux C, Guggiari M, Bianchi A, Coriat P, Riou B. Prediction of difficult mask ventilation. Anesthesiology 2000; 92:1229-36.
37. Brodsky JB. Physiological and anesthetic considerations in morbidly obese patients. Curr Rev Clin Anesth 2006; 26(18):237-48.
38. Cattano D, Corso RM, Altamirano AV, Patil CB, Meese MM, Seitan C, Hagberg CA. Clinical evaluation of the C-MAC D-Blade video laryngoscope in severely obese patients: a pilot study. Br J Anaesth 2012; 109(4):647-8.
39. Arslan ZI, Ozdamar D, Yildiz TS, Solak ZM, Toker K. Tracheal intubation in morbidly obese patients: a comparison of the intubating laryngeal mask airway and laryngeal mask airway CTrach. Anaesthesia 2012; 67:261-265.
40. Matioc AA, Genzwuerker HV. Why go blind when you can see? J Emerg Med 2012; 42:702-3.
41. Aldenkortt M, et al. Ventilation strategies in obese patients undergoing surgery: a quantitative systematic review and meta-analysis. Br J Anaesth 2012; 109:493-502.
42. Joshi GP. The role of carbon dioxide in facilitating emergence from inhalation anesthesia: then & now. Anesth Analg 2012; 114: 933-4.
43. Bolden N, Smith CE, Auckley D et al. Perioperative complications during use of an obstructive sleep
apnea protocol following surgery and anesthesia. Anesth Analg 2008; 105:1869-70.
44. Cavallone LF, Vannucci A. Extubation of the difficult airway and extubation failure. Anesth Analg 2013; 116(2):368-83.
45. Murphy GS, Brull SJ. Residual neuromuscular block: Lessons unlearned part 1: Definitions, incidence,
and adverse physiologic effects of residual neuromuscular block. Anesth Analg 2010; 111:120-8.
46. Neligan PJ, Malhotra G, Fraser M, Williams N, Greenblatt EP, Cereda M, Ochroch EA. Continuous positive airway pressure via the Boussignac system immediately after extubation improves lung function in morbidly obese patients with obstructive sleep apnea undergoing laparoscopic bariatric surgery. Anesthesiology 2009; 110(4):878-84.
47. Seet E, Chung F. Management of sleep apnea in adults - Functional algorithms for the perioperative period: Continuing Professional Development. Can J Anesth 2010; 57:849-64.
48. Weinger MB, Lee LA. "No patient shall be harmed by opioid-induced respiratory depression". In:
Proceedings of "Essential monitoring strategies to detect clinically significant drug-induced respiratorydepression in the postoperative period" conference. APSF Newsletter 2011; 26(2):21,26-28.

49. Gali B, Whalen FX, Schroeder D et al. Identification of patients at risk for postoperative respiratory complications using a preoperative obstructive sleep apnea screening tool and postanesthesia care
assessment. Anesthesiology 2009; 110:869-77.
50. Chung F, Yegneswaran B, Liao P et al. Validation of the Berlin questionnaire and American Society of Anesthesiologists checklist as screening tools for obstructive sleep apnea in surgical patients. Anesthesiology 2008; 108:822-30.
51. Vasu TS, Doghramji K, Cavallazzi R et al. Obstructive sleep apnea syndrome and postoperative complications: Clinical use of the STOP-Bang questionnaire. Arch Otolaryngol Head Neck Surg 2010; 136:1020-4.