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Management of Ambulatory Patients with Sleep Apnea: Application of Society of Anesthesia and Sleep Medicine Guidelines

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Learning Objectives

As a result of completing this activity, the participant should be able to:

- State whether a diagnosis of obstructive sleep apnea increases the risk for postoperative complications in ambulatory surgical patients
- Provide a comprehensive overview of the new Society of Anesthesia and Sleep Medicine Guidelines and their relevance to the preoperative screening and assessment of ambulatory surgical patients with sleep-disordered breathing
- Describe the best tools for screening obstructive sleep apnea in ambulatory patients

- Discuss the best perioperative practices for ambulatory surgical patients with suspected or known obstructive sleep apnea
- Summarize evidence on the effects of continuous positive airway pressure in ambulatory surgical patients

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Obstructive sleep apnea (OSA) syndrome is the most common type of sleep-disordered breathing and is characterized by recurrent apnea, hypopnea, or both lasting 10 seconds or longer during sleep despite ongoing efforts to breathe. Patients with OSA have increased depression of pharyngeal muscle tone during sleep, resulting in a recurrent pattern of partial or complete upper airway obstruction with impaired respiration.[1] The prevalence of mild OSA is 1 in 4 males and 1 in 10 females,[2,3] whereas moderate OSA occurs in 1 in 9 males and 1 in 20 females.[4,5] A significant number of OSA patients are undiagnosed when they come for elective surgery.[6] Approximately 10% to 20% of surgical patients, of whom 80% had not been previously diagnosed with OSA, were found to be at high risk for OSA based on preoperative screening.[7,8] An increase in the prevalence of OSA owing to the obesity epidemic as well as a greater number of operations performed as ambulatory procedures pose a practical challenge to the anesthesiologist.

The suitability of ambulatory surgery in OSA patients remains controversial because of concerns for increased perioperative complications, including death, following discharge. The effects of residual anesthetics, sedatives, and opioids on upper airway muscle tone and ventilator responsiveness, along with postoperative supine positioning, may worsen OSA in the early postoperative period. At present, evidence related to the safety of ambulatory surgery for OSA patients is limited. The American Society of Anesthesiologists (ASA)[9,10] and the Society for Ambulatory Anesthesia (SAMBA)[11] have published guidelines that emphasize the importance of proper patient selection and management of OSA patients for ambulatory surgery. In 2016, the Society of Anesthesia and Sleep Medicine (SASM) published guidelines on preoperative screening and assessment of patients with OSA.[12] In this Refresher Course, we review the current postoperative morbidity and mortality associated with OSA and screening tools to detect it, and we describe application of the SASM guidelines and best perioperative practices for ambulatory surgical patients with suspected or known OSA.

Summary of recommendations from the SASM Guidelines:[1]

- OSA patients undergoing procedures under anesthesia are at increased risk for perioperative complications compared with patients without the disease diagnosis. Identifying patients at high risk for OSA before surgery for targeted perioperative precautions and interventions may help to reduce perioperative patient complications.
- Screening tools help to risk stratify patients with suspected OSA with reasonable accuracy. Practice groups should consider making OSA screening part of standard preanesthetic evaluation.
- There is insufficient evidence in the current literature to support canceling or delaying surgery for a formal diagnosis (laboratory or home polysomnography) in patients with suspected OSA, unless there is evidence of an associated significant or uncontrolled systemic disease or additional problems with ventilation or gas exchange.
- The patient and the health care team should be aware that both diagnosed OSA (whether treated, partially treated, or untreated) and suspected OSA may be associated with increased postoperative morbidity.
- If available, consideration should be given to obtaining the results of the sleep study and, where applicable, the patient's recommended positive airway pressure (PAP) setting before surgery.
- If resources allow, facilities should consider having PAP equipment for perioperative use or have patients bring their own PAP equipment with them to the surgical facility.
- Additional evaluation to allow preoperative cardiopulmonary optimization should be considered in patients with diagnosed, partially treated/untreated, and suspected OSA where there is indication of an associated significant or uncontrolled systemic disease or additional problems with ventilation or gas exchange such as: (i) hypoventilation

[1] From: Chung F, Memtsoudis SG, Ramachandran SK, Nagappa M, Opperer M, *et al.*: Society of Anesthesia and Sleep Medicine guidelines on preoperative screening and assessment of patients with obstructive sleep apnea. *Anesth Analg* 2016; 123:452–73.

syndromes, (ii) severe pulmonary hypertension, and (iii) resting hypoxemia in the absence of other cardiopulmonary disease.

- Where management of comorbid conditions has been optimized, patients with diagnosed, partially treated/untreated OSA, or suspected OSA may proceed to surgery provided strategies for mitigation of postoperative complications are implemented.
- The risks and benefits of the decision to proceed with surgery or delay surgery should include consultation and discussion with the surgeon and the patient.
- The use of PAP therapy in previously undiagnosed but suspected OSA patients should be considered case by case. Because of the lack of evidence from randomized controlled trials, we cannot recommend its routine use.
- Continued use of PAP therapy at previously prescribed settings is recommended during periods of sleep while hospitalized, both preoperatively and postoperatively. Adjustments may need to be made to the settings to account for perioperative changes such as facial swelling, upper airway edema, fluid shifts, pharmacotherapy, and respiratory function.

RISK FACTORS AND PATHOPHYSIOLOGY

Patients are predisposed to OSA by various pathophysiological, demographic, and lifestyle factors.[13] These include anatomical abnormalities that may cause mechanical changes in the airway lumen (*e.g.*, craniofacial deformities, retrognathia, macroglossia), connective tissue diseases (*e.g.*, Marfan syndrome), endocrine diseases (*e.g.*, hypothyroidism, Cushing disease), male gender, neck circumference greater than 40 cm, age above 50 years, and lifestyle factors including alcohol consumption and smoking. The prevalence of OSA may be up to 78% in morbidly obese patients scheduled for bariatric surgery.[14] Obesity causes enlargement of soft tissue structures around the airway as well as narrowing of the pharyngeal airway. Lung volumes are markedly reduced by an increase in the abdominal fat mass. Reduction of lung volume may decrease longitudinal traction forces on the trachea and pharyngeal wall tension, which causes narrowing of the airway. Visceral obesity is common in subjects with OSA.

OSA is associated with various comorbidities such as myocardial ischemia, heart failure, hypertension, arrhythmias, metabolic syndrome, cerebrovascular disease, insulin resistance, gastroesophageal reflux, and obesity. Sympathetic activation is increased by apneic episodes, which prevent the normal nocturnal decline in blood pressure. Sleep apnea associated with obesity leads to increased sympathetic tone, hypertension, left ventricular hypertrophy, chronic hypoxemia, and exaggerated swings in intrathoracic pressure during obstructive episodes. OSA also causes an increase in cavity size and wall thickness of the right ventricle. OSA is one of the common reasons for resistance hypertension.[15] Though OSA is not a component of metabolic syndrome (central obesity, hypertension, hyperlipidemia, and insulin resistance), experimental and clinical evidence demonstrates the relationship between OSA and cardiometabolic syndrome.[16] Anesthetic agents, including sedative-hypnotics, opioids, and muscle relaxants, exaggerate OSA-related airway instability and worsen the apnea. Surgical stress response during the postoperative period significantly changes sleep architecture.[17] These sequelae warrant a thorough understanding of the pathophysiology of OSA and the effects of anesthetics on patients with the disorder.

Obesity hypoventilation syndrome (OHS) consists of the triad of obesity, daytime hypoventilation, and sleep-disordered breathing without an alternative neuromuscular, mechanical, or metabolic cause of hypoventilation.[18,19] OHS, which is often undiagnosed, has a prevalence of 10% to 20% in obese patients with OSA and 0.15% to 0.3% among the general adult population. Compared to eucapneic obese patients, OHS patients present with blunted central respiratory drive, severe upper airway obstruction, restrictive chest physiology, pulmonary hypertension, and increased mortality risk.[20] Compared with OSA patients, patients with OHS have a higher risk of perioperative complications including postoperative respiratory failure (odds ratio [OR] 10.9, 95% CI 3.7–32.3, $P < 0.0001$), postoperative heart failure (OR 5.4, 95% CI 1.9–15.7, $P = 0.002$), prolonged intubation (OR 3.1, 95% CI 0.6–15.3, $P = 0.2$), postoperative intensive care unit (ICU) transfer (OR 10.9, 95% CI 3.7–32.3, $P < 0.0001$), and longer ICU and hospital stay.[21] Patients with OHS are generally not suitable candidates for operations at ambulatory surgical centers.

DIAGNOSTIC CRITERIA FOR OSA

The gold standard for the diagnosis of OSA is the polysomnography or sleep study.[13] The apnea-hypopnea index (AHI), defined as the average number of abnormal breathing events per hour of sleep, is used to diagnose and assess the severity of OSA. Diagnostic criteria for OSA by the American Academy of Sleep Medicine (AASM) require either an AHI of 15 or above or AHI of 5 or higher with symptoms, such as daytime sleepiness, loud snoring, or observed obstruction during sleep.[22] OSA severity is considered mild for AHI of 5 to 15, moderate for AHI of 15 to 30, and severe for AHI above 30.[22]

PERIOPERATIVE COMPLICATIONS IN OSA PATIENTS UNDERGOING SURGERY

A systematic review by the SASM task force on preoperative preparation of patients with sleep-disordered breathing identified 52 studies that reported on the association of OSA with selected perioperative outcomes for operations under general or neuraxial anesthesia.[23] In total, the included studies reported on 413,576 OSA patients (diagnosed by ICD-9 coding, polysomnography, chart or clinical diagnoses, and screening questionnaires) and 8,557,044 control (non-OSA) patients.[23] The majority of the studies reported worse outcomes among patients with OSA compared to the control group.[23] In another recent meta-analysis, OSA patients had 33.3% higher odds of major adverse cardiac or cerebrovascular events up to 30 days after cardiac surgery and 18.1% higher odds of newly documented postoperative atrial fibrillation compared with non-OSA patients.[24]

Regarding mortality, three studies reported a lower death rate in the OSA group and one study reported increased deaths among OSA patients. The lower mortality rate might result from better monitoring and management of diagnosed OSA patients, a protective effect of ischemic preconditioning, and the obesity paradox (obesity is protective and associated with increased survival) in OSA patients. The only study reporting a higher death rate was a population-based database study that found an association between a diagnosis of OSA and increased mortality in patients undergoing revision knee or hip arthroplasties.[25]

OSA Patients Undergoing Ambulatory Surgery

Recent outcome studies on postoperative inpatients have clearly demonstrated serious cardiac and pulmonary complications in OSA patients, but evidence is limited regarding postoperative outcome in OSA patients undergoing ambulatory surgery. The systematic review conducted by SAMBA evaluated five prospective and two retrospective studies with various ambulatory surgical procedures including general surgery, orthopedic surgery, laparoscopic bariatric surgery, and upper airway surgery.[11] In that review, the postoperative outcomes of 1,491 patients with diagnosed or high-risk for OSA and 2,036 patients who were low-risk for OSA were compared with 2,095 non-OSA patients.[11] None of the included studies reported the need for a surgical airway, hypoxic brain injury, longer time to discharge, unanticipated hospital admission, death, or other clinically significant adverse outcomes. The systematic review also showed that OSA patients had a higher incidence of postoperative hypoxemia, but there was no increase in the need for ventilatory assistance or reintubation.[11] In a prospective cohort study, those patients with greater probability for OSA experienced more attempts at laryngoscopy, difficult laryngoscopic grade, and fiberoptic intubation.[8] Also, the use of intraoperative ephedrine, metoprolol, and labetalol was greater in OSA patients, but there was no difference in unanticipated hospital admissions.[8] A recent study on 404 ambulatory head and neck procedures in OSA patients showed no increase in either complications or readmissions.[26] A historical cohort study of 77,809 ambulatory surgical procedures did not identify any clinically significant increase in the rate of unplanned admissions related to a prior diagnosis of OSA in 674 OSA patients.[27] A recent systematic review and meta-analysis of the safety of conscious sedation for gastrointestinal endoscopy did not find a difference in cardiopulmonary complications in patients with OSA.[28] However, a recent retrospective review of the legal literature on perioperative complications in OSA reported on 2 patients undergoing minor ambulatory procedures who received intraoperative opioids.[29] Both patients had hypoxic arrests and required emergent transfer to hospital with 1 patient dying and the other suffering anoxic brain injury. The lack of increased postoperative complications in some of these studies may be attributable to careful selection of OSA patients for ambulatory surgery, use of continuous positive airway pressure (CPAP), and minimal use of opioids.

PREOPERATIVE CONSIDERATIONS

Preoperative Assessment for OSA

Routine preoperative screening for OSA in patients presenting for surgery may identify the majority of OSA patients and may provide opportunities for heightened awareness and potential risk reduction by implementing appropriate preoperative, intraoperative, and postoperative interventions (Table 1).[12] Although the ultimate goal is to minimize the risk of postoperative complications as much as feasible by ensuring that every patient with *suspected* OSA is identified, clearly such an approach will result in a challenging logistical, economic, and clinical burden for healthcare providers.[12] Hence, a balance has to be struck between the desire to minimize postoperative complications and the responsible use of resources. The realistic goal is to stratify those at particular risk, and suggest methods to prevent or treat problems, without creating undue economic burden on the healthcare system.[12]

Screening tools such as STOP-Bang,[30-33] the perioperative sleep apnea prediction (P-SAP) score,[34] the Berlin questionnaire,[35] and the ASA Checklist[35] can be used as preoperative screening tools to identify patients with suspected OSA.[12] These tools have been validated in the surgical population. The characteristics of each tool are shown in Table 2.[12] The STOP-Bang questionnaire was initially developed for the surgical population but has been validated in various patient populations.[36] Patients with a STOP-Bang score of 0 to 2 are considered at low risk, 3 to 4 at intermediate risk, and 5 to 8 at high risk for OSA.[37-39] The STOP-Bang questionnaire has the highest methodological validity and accuracy in predicting a diagnosis of OSA.[40,41] ~~A STOP-Bang score of 5 to 8 identifies patients with a high possibility of moderate to severe OSA.[37-39]~~ The addition of a serum bicarbonate level 28 mmol/L or higher to a STOP-Bang score of 3 or above increases the specificity for a preoperative diagnosis of OSA.[42] For obese or morbidly obese patients, a STOP-Bang score of 4 or greater can be used as a cut-off to disqualify the patient for ambulatory surgery.[43] The STOP-Bang score can be used to risk stratify patients who are at high risk for OSA.[44] High-risk OSA patients (STOP-Bang score ≥3) had a longer hospital stay and almost 4-fold higher risk of postoperative complications compared with low-risk OSA patients.[44]

Also, the oxygen desaturation index (ODI) from a high-resolution oximeter is sensitive and specific to identify undiagnosed sleep-disordered breathing in surgical patients.[45] ODI is a good predictor of AHI. An ODI of 10 or higher has demonstrated a high sensitivity (93%) and reasonable specificity (75%) to detect moderate and severe OSA. Patients with preoperative mean overnight oxygen saturation below 93% or ODI higher than 29 events per hour were recently shown to be at higher risk for postoperative complications.[46]

SASM guidelines indicate that additional evaluation for preoperative cardiopulmonary optimization should be considered in patients with a high probability of having OSA *and* in whom there is indication of uncontrolled systemic conditions or additional problems with ventilation or gas exchange. These conditions include, but may not be limited to: (1) hypoventilation syndromes, (2) severe pulmonary hypertension, and (3) resting hypoxemia not attributable to other cardiopulmonary disease.[12]

Best Preoperative Practices in Patients Who Are Diagnosed with OSA, Are Nonadherent with Prescribed Therapy, or Have a High Pretest Probability for OSA

Because OSA remains undiagnosed in the majority of patients presenting for surgery, many will be identified as having a high probability for OSA for the first time during the preoperative screening process or on the day of surgery.[12] In addition, many patients with an established diagnosis of OSA either refuse to use, or are poorly adherent with, their prescribed therapy. The optimal benefit of CPAP may require 4 to 6 weeks of treatment for upper airway edema to decrease.[47] There are limited data to suggest that preoperative PAP therapy in the form of CPAP, autotitrated positive airway pressure (APAP), or bilevel positive airway pressure (BPAP) may improve perioperative outcomes.[48-51] The limited benefit of CPAP in surgical patients was shown in a recent meta-analysis.[48] A diagnosis of OSA and the use of CPAP were associated with a reduction in postoperative complications, especially cardiac arrest and shock.[50] Another study found that OSA patients treated with CPAP have fewer cardiorespiratory complications than those without CPAP therapy.[51] All this evidence gives preliminary confirmation that patients with OSA may safely undergo ambulatory surgery if they are cautiously selected and receive focused perioperative care (Table 3).

Patient Selection for Ambulatory Surgery

In 2006 and 2014, the ASA published practice guidelines on the perioperative management of OSA patients[9,10] based on the severity of sleep apnea, invasiveness of the procedure, type of anesthesia, and the need for postoperative opioids. Using a systematic review of recent evidence, SAMBA published a consensus statement on the preoperative selection of patients with OSA for ambulatory surgery.[11] According to SAMBA guidelines, patients who have a diagnosis of OSA, are compliant with CPAP, have optimized comorbid conditions, and have minimal postoperative opioid requirements can be considered for ambulatory surgery (Figure 1).[11] However, patients who are noncompliant with CPAP may not be appropriate for ambulatory surgery. At the same time, patients with a presumed diagnosis of OSA, based on the screening tool, and optimized comorbid conditions may be considered for ambulatory surgery if postoperative pain relief can be managed predominantly with nonopioid analgesic techniques. In contrast to the ASA OSA guidelines, laparoscopic upper abdominal surgeries such as gastric banding may be safely performed on a day surgery basis provided the perioperative precautions are followed. Because of limited evidence, no guidance was provided for OSA patients undergoing upper airway surgery. A recent systematic review on selection of obese patients for ambulatory surgery showed that the literature lacks enough information to make recommendations regarding the selection of these patients and whether there is a cut-off of body mass index (BMI) for ambulatory surgery.[53] Super-obese patients with BMI greater than 50 kg/m^2 are at increased risk for perioperative complications, while patients with lower BMI do not present any elevated risk as long as comorbidities are optimized before surgery.[52]

INTRAOPERATIVE MANAGEMENT

Monitored anesthesia care with local or regional anesthesia techniques should be considered where appropriate.[53] Intraoperative capnography should be utilized to monitor ventilation to avoid oversedation during monitored anesthesia care.[13] Difficult intubation equipment should be available in anticipation of difficulty intubating a patient with OSA. Preoperative sedatives should be avoided.[53] Recently, gabapentin was shown to be associated with increased risk for respiratory depression among patients undergoing major laparoscopic procedures. The dose of perioperative opioids should be reduced if gabapentin is administered.[54] Application of CPAP during bag and mask ventilation may be helpful to minimize upper airway obstruction during induction and immediately after extubation.[55] Short-acting agents such as propofol, desflurane, or sevoflurane and remifentanil should be utilized to ensure rapid recovery.[56] Nonopioid analgesic agents such as nonsteroidal antiinflammatory drugs (NSAIDs) and local anesthesia infiltration should be administered to reduce postoperative opioid requirements. At the end of surgery, adequate reversal of neuromuscular blockade should be confirmed, and the patient should be extubated in the semiupright position when fully awake and recovered.[56]

POSTOPERATIVE DISPOSITION AND UNPLANNED ADMISSION AFTER AMBULATORY SURGERY

The majority of cases of opioid-induced respiratory depression have been reported within 24 hours, mostly within the first 6 hours postoperatively.[57] Up to 50% of patients who died within 24 hours postoperatively from critical respiratory events had OSA.[58] In a closed claims analysis, OSA or suspected OSA was present in 24% of the patients with respiratory depression.[59] A significant association of postoperative opioid-induced respiratory depression exists in patients with underlying cardiac or pulmonary disease.[58,60] Among patients with postoperative opioid-induced respiratory depression, 34% had preexisting cardiac disease and 25% had pulmonary disease.[60]

Patients with diagnosed or suspected OSA who are receiving general anesthesia should have extended monitoring after they have met the modified Aldrete criteria for discharge.[10] Recurrent respiratory events (episodes of apnea ≥10 sec, bradypnea <8 breaths/min, pain–sedation mismatch, or repeated oxygen desaturation <90%) in the postanesthesia care unit are an indication for continuous postoperative monitoring.[61] OSA patients with recurrent respiratory events have an increased risk of postoperative respiratory complications.[61] These patients may require postoperative PAP therapy with monitoring.[12]

Ambulatory surgical centers that handle OSA patients should have the ability to manage postoperative complications related to OSA and an agreement with an appropriate inpatient facility. Postoperative complications may result from an imbalance between enhanced pain processes and increased sensitivity to anesthetics, opioids, or both in patients with some specific OSA phenotypes.[62,63] In a recent systematic review of 60 deaths or near-deaths in surgical patients with OSA, 81% of the patients reported to be on opioid therapy were receiving relatively small doses of opioids with a morphine equivalent daily dose less than 10 mg; only 20% received a relatively higher dosage of opioids.[64] Further analysis of the dosage of intravenous opioids showed a clear dose–response pattern in the death or near-death group, *i.e.*, increased odds of death or near-death with increasing opioid doses (OR of 1.0, 1.5, and 3.0 respectively at opioid doses of <10 mg, 10–25 mg, and >25 mg; *P* for trend <0.005).[64]

Worsening of sleep-disordered breathing may occur in the first postoperative nights at home.[17,65] The use of opioids in unmonitored settings by patients with OSA increases the risk of complications. The anesthesiologist and surgeon should agree on postoperative analgesic medication, and patients should be advised to use acetaminophen, NSAIDs, and cyclo-oxygenase type 2 inhibitors rather than opioids. To reduce the risk of postoperative respiratory depression, the dose of opioids prescribed for discharge should be reduced if the patient was already taking gabapentinoids prior to surgery.[54] Patients should be educated to sleep in a semiupright position and to apply their PAP devices when sleeping, even during the daytime. It is necessary to educate surgeons, patients, and patients' families regarding the need for increased vigilance after discharge home. Brief information in the form of pamphlets can be given to patients to educate them about OSA.[66] At present, there are practice variations in the way anesthesiologists manage patients with OSA.[67] Depending on the facilities and the types of surgery, it is essential that each ambulatory surgical facility establish an individualized policy and protocol for the management of surgical ambulatory patients with OSA.[68] More studies are needed to determine the optimal approach to the perioperative management of ambulatory surgical patients with OSA.

CONCLUSION

In recent years, there is a better understanding about the effect of anesthetics and opioids on postoperative sleep architecture in OSA patients. Careful selection of patients for ambulatory surgery using specific protocols and risk mitigation strategies are imperative to avoid cancellations and complications. Educating patients and the healthcare team will improve the perioperative outcome. With appropriate screening, careful patient selection, limited use of opioids, and algorithm-based management, the majority of ambulatory surgical procedures may be done safely in patients with OSA.

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