

Adult Patient With Obstructive Sleep Apnea

Girish P. Joshi, MB BS, MD, FFARCSI
Professor of Anesthesiology and Pain Management
Director of Perioperative Medicine and Ambulatory Anesthesia
University of Texas Southwestern Medical Center, Dallas, Texas

Introduction

Obstructive sleep apnea (OSA) is an increasingly common sleep disorder, which is of particular concern to anesthesiologists as it is associated with increased perioperative morbidity and mortality. The prevalence of OSA is estimated to be 5-25%; however, with the US population aging and becoming obese, it is expected to increase significantly. Furthermore, the prevalence of OSA in the surgical population appears to be higher than that in the general population. With approximately 60-70% of all surgical procedures performed on an outpatient basis, it is inevitable anesthesiologists will encounter OSA patients in an ambulatory setting. However, suitability of ambulatory surgery in OSA patients remains controversial. Importantly, OSA is undiagnosed in an estimated 70-80% of patients. This review discusses the clinical presentation and diagnosis of OSA, appropriate patient and procedure selection, and optimal perioperative management of an adult OSA patient scheduled for ambulatory surgery.

Pathophysiology and Consequences of OSA

During rapid eye movement (REM) sleep there is loss of upper airway muscle tone, which can lead to increased pharyngeal resistance, generate negative pharyngeal pressures during inspiration, and cause upper airway collapse. The factors that contribute to upper airway narrowing and subsequent collapse during sleep include obesity, large neck circumference, upper airway abnormalities (e.g., anatomical or craniofacial abnormalities affecting the airway), and age. Hypoxemia and hypercarbia resulting from obstructive apnea lead to arousal from sleep followed by restoration of muscle tone and airflow. Resumption of airflow is usually followed by hyperventilation, which may cause hypocapnia and loss of respiratory drive, and further predispose to apnea. Frequent arousals result in sleep disruption and excessive daytime somnolence. In addition, oxygen desaturation, sympathetic hyperactivity, and systemic inflammatory response may contribute to cardiovascular co-morbidities including systemic hypertension, cardiac arrhythmias, myocardial ischemia, pulmonary hypertension, and heart failure.

Effects of Anesthesia and Surgery on Perioperative Sleep and Perioperative Complications

Sedative-hypnotics, opioids, and muscle relaxants impair neural input to the upper airway muscles and therefore may worsen or even induce upper airway obstruction and apnea. In addition, these drugs also decrease the ventilatory response to hypoxemia and hypercarbia further exaggerating OSA. In contrast to natural sleep, in which OSA patients arouse due to asphyxia, drug-induced airway obstruction and apnea lack the ability to arouse and respond adequately to asphyxia. This may have life-threatening consequences.

The surgical stress response also affects sleep patterns independent of anesthesia. Furthermore, postoperative anxiety, pain, and opioids might cause sleep deprivation and fragmentation, which may exacerbate sleep disorders. The reduced REM sleep in the immediate postoperative period is followed by a rebound REM sleep that can last for several days after surgery. Rebound REM sleep makes patients with OSA even more vulnerable to airway obstruction

and life-threatening apnea. Of note, postoperative sleep disturbances appear to be related to the location and invasiveness of the surgical procedure. Fewer sleep disturbances occur after mild-to-moderately invasive surgery, commonly performed on an outpatient basis than with major inpatient surgical procedures.

Clinical Presentation and Diagnosis of OSA

Because failure to recognize (or diagnose) OSA preoperatively is one of the major causes of perioperative complications, it is necessary that all patients be screened for OSA. Preoperative assessment includes comprehensive review of medical records (e.g., history of airway difficulty with prior anesthetics, medical comorbidities, and sleep studies, if available). Interview with the patient and/or family should include evaluation of symptoms of OSA and physical examination should include evaluation of signs of OSA.

A presumptive diagnosis of OSA may be derived based upon the presenting symptoms and signs. Recently, a shorter and convenient questionnaire has been shown to be as effective as the Berlin questionnaire. The questions for the new OSA screening tool include 1) Do you snore loudly (heard through closed doors); 2) Do you often feel tired, fatigued, or sleepy during day time despite adequate "sleep"; 3) Has anyone observed that you stop breathing during sleep; and 4) Do you have or are you being treated for high blood pressure. Combining this screening tool with physical examination may further improve the diagnosis of OSA.

Some suggest that if OSA is suspected during preoperative evaluation, it may be prudent to postpone the surgery and obtain a sleep study. However, it is unclear if routine sleep study would improve patient safety and outcome. In a recent survey of Canadian anesthesiologists (n=1063), 76% of the respondents stated that when faced with a patient scheduled for elective surgery with symptoms of OSA and no sleep studies, they would proceed with surgery treating the patient as if they had OSA. Nevertheless, it is important to have a high index of suspicion and treat these patients as if they have severe OSA.

Polysomnography remains the gold standard in the diagnosis of OSA. Polysomnography consists of monitoring electroencephalogram (EEG), electrooculogram (EOG), and submental electromyogram (EMG) for staging sleep. In addition, oral and nasal airflow, respiratory efforts (inductance or impedance pneumography to monitor thoracoabdominal motion and/or diaphragmatic EMG), oximetry, and capnography are also monitored. Furthermore, body position, sound, arterial blood pressure, and ECG are monitored. Because polysomnography may not be always available, other home-based diagnostic devices with single or multiple channels have been explored.

The severity of OSA may be determined from a sleep study using the apnea-hypopnea index (AHI), which measures the frequency of apnea (cessation of breathing ≥ 10 seconds despite continuing ventilatory efforts) and hypopnea (more than 50% diminished airflow ≥ 10 seconds) events per hour, is used to characterize the severity of OSA. An AHI of 6-20 indicates mild OSA, AHI 21-40 indicates moderate OSA, and AHI >40 indicates severe OSA. Of note, sleep laboratories differ in their criteria for defining severity of OSA. If a sleep study is not available, patients should be treated as though they have moderate-to-severe OSA.

Ambulatory Surgery in OSA Patients

The scientific literature regarding the safety of ambulatory surgery in OSA patients is sparse and of limited quality [2]. Therefore, the suitability of ambulatory surgery in OSA patients remains controversial. The American Society of Anesthesiologists (ASA)-OSA practice guidelines provide recommendations regarding the optimal setting for the surgical procedure (e.g., ambulatory vs.

office-based); however, they are primarily based upon expert opinions rather than scientific evidence, which is lacking [3]. It is recommended that patient selection for ambulatory surgery should depend upon the severity of OSA, presence of coexisting comorbidities, invasiveness of surgery, type of anesthesia, anticipated postoperative opioid requirements, and adequacy of post-discharge observation. In addition, the ability of the facility to manage OSA patients should also be taken into consideration. The facility should have emergency difficult airway equipment and respiratory care equipment (e.g., nebulizers, CPAP devices, ventilators), as well as radiology capabilities (e.g., portable chest x-ray) and laboratory facilities (e.g., hemoglobin, blood gas and electrolyte analysis). Furthermore, transfer arrangements to an inpatient facility should be in place.

The ASA practice guidelines propose a scoring system that may be used to estimate whether an OSA patient is at increased perioperative risk of complications, and thus determine the suitability for ambulatory surgery (Table 1). It is recommended that patients who are at significantly increased risk of perioperative complications (score \geq 5) are not good candidates for ambulatory surgery. It must be emphasized that this scoring system is not yet validated and is meant only as a guide, and clinical judgment should be used to assess the risk of an individual patient. It is accepted that patients with mild OSA undergoing superficial or minor surgical procedures under local, regional or general anesthesia and expected to have minimal postoperative opioid requirement may undergo ambulatory surgery. On the other hand, ambulatory surgery is not recommended in patients undergoing airway surgery (e.g., UPPP surgery) or upper abdominal laparoscopic surgery.

Table 1: Scoring system to estimate perioperative risk (from ASA practice guidelines).

<p>A: Severity of sleep apnea based on sleep study (i.e., AHI) or clinical indicators if sleep study not available: None = 0; Mild OSA = 1; Moderate OSA = 2; Severe OSA = 3. Subtract a point in patients using CPAP or BiPAP preoperatively and postoperatively, and add a point in a patient with PaCO₂ >50 mmHg.</p>
<p>B: Invasiveness of surgery and anesthesia: Superficial surgery under local or peripheral nerve block anesthesia without sedation = 0 Superficial surgery with moderate sedation or general anesthesia or peripheral surgery under spinal or epidural anesthesia (with no more than moderate sedation) = 1 Peripheral surgery with general anesthesia or airway surgery with moderate sedation = 2 Major surgery or airway surgery under general anesthesia = 3</p>
<p>C: Requirement for postoperative opioid: None=0, Low dose oral opioids=1, High dose oral opioids or parenteral or neuraxial opioids=3</p>
<p>D: Estimation of perioperative risk: Overall score = score of A + greater score of either B or C: Patients with overall score of 4 or greater may be at increased perioperative risk from OSA. Patients with a score of 5 or greater may be at significantly increased perioperative risk from OSA.</p>

Preoperative Considerations

One of the considerations in the preoperative management of OSA patients is the use of positive airway pressure devices such as continuous positive airway pressure (CPAP), bi-level positive airway pressure (BiPAP), and automatic self-adjusting or auto-adjusting positive airway pressure (APAP), which function as mechanical stents (pneumatic splint) of the airway and increase in pharyngeal size. CPAP has been shown to reduce systemic hypertension and right heart failure as

well as reduce excessive daytime sleepiness and improve neurocognitive function [2]. A 4-6 week CPAP therapy has been shown to decrease tongue volume and increase pharyngeal volume. Because of numerous benefits, it is suggested that preoperative positive pressure devices should be considered, particularly in patients with severe OSA. However, the effects of preoperative CPAP therapy on perioperative outcome remain uncertain. Furthermore, the optimal duration of preoperative CPAP therapy before proceeding with elective surgical procedures is unknown. Patients who use CPAP devices at home should be advised to bring their device to the hospital for postoperative use. Other treatment modalities for OSA include mandibular advancement devices, oral appliances, and corrective surgery. Of note, a patient who has had corrective airway surgery should be assumed to remain at risk for OSA complications unless the symptoms and sleep studies have normalized.

Intraoperative Considerations

Although the type and extent of surgery and the need for postoperative opioids, rather than the choice of anesthetic technique appear to be more important determinants of postoperative complications in patients with OSA, local or regional anesthesia should be preferred whenever possible. Regional anesthesia obviates the need for airway manipulation and reduces the need for intraoperative sedatives and opioids. In addition, these techniques provide postoperative analgesia, and reduce postoperative opioid requirements. Therefore, it is recommended that for patients requiring moderate sedation, ventilation should be continuously monitored using capnography. Because CPAP has been shown to counteract sedation-induced airway closure, it should be considered during moderate sedation, particularly in patients using CPAP preoperatively. If deep sedation is required, general anesthesia (with a secure airway) may be preferable, particularly for procedures that might mechanically compromise the airway.

In patients requiring general anesthesia, there may be an increased risk of difficult mask ventilation and tracheal intubation. Although the predictors of difficult tracheal intubation remain controversial, high Mallampati score (III or IV), large neck circumference measured at the level of the thyroid cartilage (>17 inches for males and >16 inches for females) and limited mandibular protrusion are more reliable predictors of difficult laryngoscopy than BMI. If an "awake" tracheal intubation is planned, sedatives and opioids must be utilized judiciously. Of note, oropharyngeal and upper airway topicalization necessary for "awake" tracheal intubation may impair the upper airway protective reflexes and increase the frequency of OSA, which may lead to post-extubation airway obstruction. In addition, it is imperative that emergency airway equipment (e.g., video laryngoscopes, intubating LMA, fiberscope) and additional help is immediately available.

Because of alterations in pulmonary function, OSA patients may not tolerate even short periods of apnea. The techniques used to avoid post-induction hypoxemia include head-up (25° reverse Trendelenberg) positioning, preoxygenation with 100% O₂ and 10 cm H₂O CPAP for 3-5 minutes prior to induction of anesthesia. In addition, positioning of the patient in the head elevated laryngoscopy position (HELP), which can be achieved by "stacking" with blankets or a specially designed foam pillow, structurally improves maintenance of the passive pharyngeal airway and may be beneficial for mask ventilation as well as improve the success of tracheal intubation.

An ideal general anesthetic technique would promote early return of the patient's protective airway reflexes and allow maintenance of oxygenation. There is lack of evidence for superiority of a specific general anesthetic technique (e.g., inhalation vs. TIVA) in patients with OSA. Although clinical differences between desflurane and sevoflurane appear to be small, a recent study found that desflurane allowed an earlier return of protective airway reflexes. Of note, even a minor

degree of residual neuromuscular blockade (usually not appreciated clinically) can increase postoperative morbidity including inadequate ventilation, hypoxia, and the need for reintubation. Therefore, muscle relaxants should be used sparingly in this patient population. Because clinically unrecognized residual paralysis is common, and the use of neostigmine (in appropriate doses) does not increase the incidence of PONV, reversal drugs should be utilized without hesitation.

Because opioids may be associated with increased postoperative complications in OSA patients, they should be used judiciously. It is suggested that recurrent hypoxemia in patients with OSA may affect endogenous opioid mechanisms that may alter responsiveness to exogenous opioid administration. A recent study found that the opioid requirements of patients with preoperative hypoxemia were half that of those without preoperative hypoxemia suggesting an increased sensitivity to opioids in this patient population. Because lower opioid doses may be sufficient to achieve adequate analgesia, opioid therapy in OSA patients should be individualized and carefully titrated. These authors also recommend that assignment of OSA severity should be based upon oxygen desaturation.

Importantly, patients with OSA benefit from a multimodal analgesia technique using non-opioid analgesics including regional/local analgesia, acetaminophen, NSAIDs/COX-2 specific inhibitors, corticosteroids (dexamethasone 4-8 mg), and NMDA antagonists (e.g., ketamine). Dexmedetomidine is an α_2 -adrenergic agonist with hypnotic, sedative, sympatholytic, and analgesic properties that reduces anesthetic and opioid requirements. Because dexmedetomidine does not cause respiratory depression, and patients can be easily aroused, it may be used for sedation and analgesia for various procedures including awake tracheal intubation and even after tracheal extubation. However, its role in the intraoperative period is yet to be established.

Respiratory strategies for optimal intraoperative ventilation (i.e., maintain PaO_2 and PaCO_2) would include use of appropriate ventilatory mode and pattern (e.g., pressure controlled ventilation and positive end-expiratory pressure). It is important to avoid hyperventilation as patients are usually hypercarbic and metabolic alkalosis from hyperventilation may lead to postoperative hypoventilation and airway obstruction. Use of pressure support ventilation at the end of surgery during recovery from anesthesia and muscle relaxants should reduce postoperative pulmonary atelectasis and hypoxemia, as well as allow washout of inhaled anesthetics and early emergence.

One of the major concerns in patients with OSA is the risk of airway obstruction after tracheal extubation. Thus, prior to tracheal extubation the patient must be fully awake, alert, and following commands, and complete reversal of neuromuscular blockade should be established in addition to achieving standard extubation criteria. Extubation should be performed in a semi-upright (30° head-up) position, when possible. Importantly, coughing, reflex movements of the hand moving towards the tracheal tube and patient sitting up should not be confused as purposeful movements.

Postoperative Considerations

Postoperative complications are more frequent in patients with OSA. These include airway obstruction, oxygen desaturation, and the need for reintubation as well as systemic hypertension, cardiac dysrhythmias, and need for admission. The severity of OSA, degree of hypoxemia, and perioperative use of opioids are predictors of perioperative complications.

Once in the PACU, patients should be maintained in a semi-upright (30° head-up) position, if possible. Although supplemental oxygen is beneficial for most patients, it should be administered with caution as it may reduce hypoxic respiratory drive and increase the incidence and duration of apneic episodes. Recurrent hypoxemia may be better treated with CPAP along with oxygen rather than oxygen alone. Use of CPAP may reduce the risk of airway obstruction and respiratory

depression. It is recommended that patients who use CPAP preoperatively should wear their CPAP masks postoperatively. Prophylactic CPAP for 24-48 h after extubation has been reported to reduce major complications despite unrestricted opioid use.

Prior to discharge from the PACU the oxygen saturation on room air should return to baseline and the patient should not become hypoxic or develop airway obstruction when left undisturbed in the recovery area. Most significant postoperative complications in OSA patients usually occur within 2 hours after surgery. Discharge home might be considered if the patient can maintain baseline oxygen saturation on room air, and the propensity to develop airway compromise and respiratory depression no longer exists. The ASA Practice Guidelines suggest that OSA patients be monitored for a median of 3 hours longer than their non-OSA counterparts before discharge from the facility. In addition, the monitoring should continue for a median of 7 hours after the last episode of airway obstruction or hypoxemia while breathing room air in an unstimulated environment. Unfortunately, the recommendation for longer postoperative stays are not based upon any scientific evidence, and may be the major limitation of performing surgical procedures in an ambulatory setting. Because there is a possibility that OSA patients may not always meet criteria for safe home discharge, the option of admission should be discussed with the patient prior to surgery. It is important that the post-discharge instructions emphasize the potential for aggravation of OSA and the need to use opioids judiciously.

Summary

Patients with OSA are at a high risk of perioperative complications and pose several challenges to the anesthesiologist including difficult tracheal intubation and increased postoperative complications (e.g., respiratory obstruction after extubation or respiratory depression after opioid administration). There is uncertainty regarding scheduling and management of OSA patients for outpatient surgery. With limited understanding of their postoperative course, any recommendations remain speculative. Prudent perioperative management should be guided by the awareness of the potential complications based on the severity of OSA, invasiveness of diagnostic or therapeutic procedure, and requirement of postoperative opioids. Development of protocols for adequate preoperative evaluation including use of questionnaires may help to identify patients with OSA. In addition, protocols for acceptable outpatient surgery candidates that take into consideration the special problems and risks of OSA are crucial for improved postoperative outcome.

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