CHEST

Perioperative Assessment and Management for Sleep Apnea in the Ambulatory Surgical Patient

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The overwhelming majority of surgical procedures performed in the United States are done on an outpatient basis. Patients with complicated medical problems are routinely scheduled for ambulatory procedures that have become progressively more complex. Appropriate patient selection is paramount to ensuring optimal perioperative outcomes, and the patient with known or suspected OSA presents unique challenges to the anesthesia care team regarding airway management, pain control, and postoperative monitoring requirements. Currently, a relative paucity of high-quality evidence exists on which to base guidelines or recommendations for the anesthetic care of these patients. It is generally agreed that early identification of those at risk for OSA allows for planning and implementation of strategies to help to reduce the risk of adverse perioperative events. Although various national societies have published consensus statements aimed at guiding the perioperative management of the patient at risk for OSA, more studies are needed to define the optimal approach to the perioperative care of this population.

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ABBREVIATIONS: AHI = apnea-hypopnea index; ASA = American Society of Anesthesiologists; $ETCO_2$ = end-tidal CO_2; HSAT = home sleep apnea test; PACU = postanesthesia care unit; PSG = polysomnogram; SAMBA = Society for Ambulatory Anesthesia; STOP-Bang = snoring, tiredness, observed apnea, high BP-BMI, age, neck circumference, and gender

Once reserved for the relatively healthy patient, ambulatory surgery is now offered to patients with increasingly complex medical histories and substantial comorbidities. In some hospitals, > 70% of all surgical procedures are performed on patients who are scheduled to be discharged on the day of the procedure.[1] Partially responsible are advances in surgical technology, including endoscopes, that have led to a decrease in the size of the incision required for many procedures. Simultaneously, developments in the pharmaceutical industry have made anesthetic medications with superior recovery profiles available.

Convenient and cost-effective, ambulatory surgery has long been considered a safe option for select patients, including those with well-controlled cardiovascular and pulmonary diseases.[2] Until recently, the perioperative care of patients with OSA was discussed only in the context of those who presented for surgery having already received a diagnosis of the disorder. It was not unusual for the patient with a formal diagnosis of OSA to routinely be transferred

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to an ICU for postoperative monitoring, regardless of the procedure. In the 1990s, Young et al[3] and Peppard et al[4] reported that undiagnosed sleep apnea was prevalent and that 82% of men and 93% of women with moderate to severe sleep apnea syndrome studied had not yet received a diagnosis. The subjects of this investigation were employed patients in the general population with no obvious barriers to either the diagnosis or treatment of sleep disorders. At the same time, Sabers et al[5] examined the impact of sleep apnea on perioperative complications, including unplanned admission, among an ambulatory surgical population undergoing nonotolaryngologic procedures in a tertiary medical center. They did not find OSA to be an independent risk factor for unanticipated admission or other perioperative adverse outcomes in patients with polysomnographic evidence of OSA.

Guidelines and Recommendations

In 2005, the American Society of Anesthesiologists (ASA) assembled a task force to review the available literature and make recommendations regarding the perioperative management of patients at risk for OSA. With a relative paucity of high-quality evidence upon which to establish recommendations, practice parameters based predominately on consensus of opinion were published in 2006.[6] The ASA checklist arose from this document and comprises questions for patients regarding signs and symptoms, which if present, according to the task force, suggest a presumptive clinical diagnosis of moderate OSA. Prior to this, a number of questionnaires to screen for the risk of OSA had been administered to patients presenting to sleep disorders clinics; however, the ASA's recommendation for use of questionnaires in the perioperative period represented a paradigm shift. Although the practice parameters contributed to the increased awareness of the possibility of undiagnosed OSA in patients presenting for surgery, they provided little guidance regarding recommendations for the extent and duration of postoperative monitoring. Additionally, the task force did not endorse ambulatory surgery for patients who screened positive for the risk of OSA, except for procedures performed under local anesthesia. This position was subsequently challenged in 2010 by data gathered in 2,193 patients undergoing ambulatory surgery at The Johns Hopkins Hospital Outpatient Center.[7] Prior to surgery, patients were given a self-administered questionnaire to determine their propensity for OSA, and adverse events were recorded. Patients with a high propensity for OSA were more challenging to intubate and required more medications for hemodynamic control; however, they did not have a higher rate of unplanned admission, reintubation, or other adverse events.

In 2012, the Society for Ambulatory Anesthesia (SAMBA) declared that the previously published ASA practice guidelines were outdated and published its own consensus statement.[8] Citing new evidence, the SAMBA task force suggested that patients with known OSA and optimized comorbidities are acceptable candidates for ambulatory surgery if they are able to use a CPAP device in the postoperative period. Furthermore, patients with a presumptive diagnosis of OSA and optimized comorbidities should likewise be considered for surgery on an outpatient basis if their pain can be managed with minimal opioids. The SAMBA statement also recommended the use of the STOP-Bang (snoring, tiredness, observed apnea, high BP-BMI, age, neck circumference, and gender) questionnaire as a preoperative screening tool as opposed to the ASA checklist.[9] The STOP-Bang prediction tool is a series of questions that addresses signs, symptoms, and anthropometric measurements to identify a patient's risk of OSA. Although a score of ≥ 3 indicates that a patient is at risk for OSA, there are proponents in favor of using a higher cut point to decrease the number of patients who screen positive but do not have the disorder. Farney et al[10] showed that in a population of patients presenting to a sleep disorders clinic, progressively higher STOP-Bang scores were associated with an increased risk of OSA. Chung et al[11] found the same in a study of patients undergoing elective surgery. Controversy remains about the determination of an optimal cut point for assigning risk. The results of surveys administered to anesthesiologists to determine practice patterns in Canada and the United States indicated that the majority of respondents polled did not favor one screening tool over another.[12,13] Additionally, only a small fraction responded that they routinely screen surgical patients for OSA despite that the majority had provided care to at least one patient who had experienced a major adverse outcome secondary to respiratory depression.

Although the pervasive failure to screen preoperatively for OSA may be partially attributed to a deficit in knowledge, it may also be due to the lack of a reliable prediction tool with an acceptable receiver operating characteristic curve.[14] Furthermore, although the ASA and the Joint Commission recommend the screening of all surgical patients for the risk of OSA, no compelling data at present support whether screening for OSA risk leads to improved outcome.

Preoperative Testing

The gold standard for the detection of OSA is the polysomnogram (PSG), a test that is both costly and time consuming. Although patients identified as being at risk for OSA early in the preoperative evaluation process may have sufficient time to schedule an overnight sleep study, the value of this practice has not yet been determined. Likely more often, risk assessment for OSA frequently occurs on the day of the planned procedure. In addition, patients may not have convenient access to a facility that performs a PSG. Insufficient evidence supports case cancellation or delay to obtain a PSG before an ambulatory surgical procedure.[15-17] Likewise, the benefit of implementing preoperative CPAP in the patient receiving a new diagnosis of OSA before a procedure is unclear, and there is no agreement on the time period required to use CPAP prior to a procedure to achieve a decrease in perioperative risk.

A relative paucity of evidence links the value of the apnea-hypopnea index (AHI) with adverse outcomes, except in those with severe OSA.[18] Differences in scoring criteria among various laboratories as well as night-to-night variation in the patient's sleep architecture and impact of lateral and supine positions on sleep-disordered breathing may contribute to the lack of association between the AHI and perioperative adverse events.[19]

An option currently being explored as an alternative to preoperative in-laboratory PSG is a home sleep apnea test (HSAT). Patients identified as being at risk for OSA are sent home with a device that records only a portion of physiologic variables obtained during an attended PSG. Convenient and less expensive, HSAT may be more acceptable than an in-laboratory study to the patient who is preparing for a surgical procedure. Although data obtained from HSAT devices can be comparable to a PSG, there is a higher failure rate because the studies are unattended (10%-20%). Additionally, a negative HSAT study does not definitively rule out OSA. It is conceivable that preoperative diagnosis of OSA may confer overall health benefits to the patient who is subsequently compliant with treatment.[20] No evidence supports that short-term perioperative outcomes are altered in these patients.

The phenotype of the patient who will suffer adverse perioperative outcomes due to OSA has not been elucidated. Isolated OSA in the otherwise healthy patient should not preclude the patient from having ambulatory surgery. The presence of significant pulmonary comorbidities has been associated with a higher incidence of postoperative adverse outcomes.[21] However, it is unclear whether OSA, concomitant systemic disease, or the combination of both is what places the patient at greater risk.

Patients with systemic disease should be optimized before any elective surgical procedure, regardless of postoperative disposition. However, certain patient conditions, although potentially optimized, that present a risk for surgery in an ambulatory venue are considered prohibitive and include severe cardiac valvular disease (critical aortic stenosis), poor cardiac function (ejection fraction $< 30\%$), chronic hypoxemia requiring supplemental oxygen, and pulmonary hypertension. Such patients are better served through triage to an inpatient venue.[22-24] Additionally, careful consideration should also be given to patients with OSA and respiratory disease (overlap syndrome) and those with cardiovascular abnormalities (eg, atrial fibrillation) that are potentially caused or exacerbated by repetitive episodes of hypercarbia or hypoxemia.[8] These patients may benefit from having their procedures scheduled in an inpatient facility.

Management

Anesthetic management of ambulatory surgical patients with known or suspected OSA is directed at maintaining a patent airway and avoiding CNS depressants. Data support the opinion that patients with OSA may be difficult to ventilate with a mask and more challenging to intubate than their counterparts without OSA.[25,26] Equipment and resources required to secure a difficult airway should be available and a plan formulated and in place before induction of anesthesia for the patient who may not be able to be ventilated or intubated without specialized equipment. Although routine equipment in accredited ambulatory surgical centers and office-based practices may be comparable to that seen in a hospital operating room, difficult airway adjuncts, such as jet ventilation and bronchoscopy equipment, depend on the facility. Additionally, personnel skilled in the use of this equipment as well as those adept in obtaining a surgical airway also vary depending on the venue.

Early studies examining perioperative complications associated with sleep surgery in patients with severe OSA reported occurrences of acute upper-airway obstruction after minimal sedation and during induction of anesthesia, failed intubation, negative pressure pulmonary edema, arrhythmias, and death secondary to hypoxic cardiopulmonary arrest.[27,28] Technological advances in equipment to facilitate tracheal intubation in the patient with a difficult airway have substantially reduced complications

related to the induction of anesthesia; however, routine use of these instruments and airway maneuvers may not be a part of all ambulatory surgical practices.

Patients with OSA have an increased risk of gastroesophageal reflux; therefore, aspiration prophylaxis has been recommended before the induction of general anesthesia.[29,30] Although no singular anesthetic medication or technique has been shown to produce superior outcomes in ambulatory surgical patients with OSA, general principles can guide risk mitigation in this population. Local field blocks, short-acting anesthetic medications with rapid recovery profiles, and drugs that can be reversed with an antidote are beneficial in minimizing the risk of respiratory depression. Additionally, use of multimodal analgesia and regional anesthesia may help by reducing perioperative opioid requirements, although, all CNS depressants should be avoided, if possible. Antihistamines, benzodiazepines, and phenothiazines also contribute to respiratory depression, and their use in patients with OSA is discouraged in the perioperative period. Dexmedetomidine, a centrally acting α_2-agonist similar to clonidine, has been discussed as an option for use in providing sedation with minimal respiratory depression.[31,32] Originally approved by the US Food and Drug Administration in 1999 for patients on mechanical ventilation, indications for use were expanded in 2009 to include procedural sedation in patients who are not intubated. Although generally effective for sedation alone, dexmedetomidine may not be the optimal medication to use for procedural sedation secondary to limitations associated with the inability to bolus the drug for quick onset, slow titration requirements for escalating dose, and bradycardia and hypotension resulting from rapid administration.[33] Additionally, the medication has only mild analgesic properties. One study showed that when used for sedation in patients undergoing colonoscopy, approximately one-half of the subjects required a second agent to achieve a satisfactory level of analgesia, and their recovery was prolonged. The authors closed the study before the target enrollment was achieved, concluding that the use of the medication for colonoscopy was limited by pronounced hemodynamic side effects and a complicated administration regimen.[34]

Because most sedative agents cause some element of CNS depression, attempts at conscious sedation may be unsuccessful secondary to inadequate ventilation. Because mask ventilation and intubation can be difficult, consideration should be given to securing the airway in a controlled manner first to avoid the rapid and potentially unpredictable sequence of events required to rescue the patient from unanticipated respiratory insufficiency.

Extubation of patients with OSA is, like intubation, associated with an increased incidence of oxyhemoglobin desaturation and failure to ventilate. Therefore, before extubation, the patient should be fully awake and following commands, with complete recovery of neuromuscular blockade. The head of the bed should be elevated to 30° and the patient extubated while inspiring 100% oxygen followed by application of 1 to 2 min of CPAP at 10 cm H_2O pressure while in the operating room.[35]

Patients should be transferred to the postanesthesia care unit (PACU) with supplemental oxygen. On arrival to the PACU, the patient should remain positioned with the head of the bed elevated to at least 30° with continual assessment of ventilation. Although monitoring of respiratory rate and pulse oximetry is considered standard of care after administration of an anesthetic in the United States, objective measures of adequacy of ventilation have been recommended but not yet required by any regulatory or accrediting agency.[36-38] Capnometry has long been the standard for evaluating ventilation during general anesthesia. However, the use of this technology in a non-operating room environment to date has been subject to institutional availability. Surgical patients are routinely transferred from the operating room to the PACU in the supine position with residual effects of medications that affect both tidal volume and respiratory drive. Capnometry can identify respiratory depression before other standard physiologic measures and clinical observation. Bradypneic hypoventilation, commonly associated with opioids, is characterized by a decreased respiratory rate, normal tidal volume, increased $PaCO_2$, and increased end-tidal CO_2 ($ETCO_2$); however, hypopneic hypoventilation is associated with a normal respiratory rate, decreased tidal volume, increased $PaCO_2$, and normal or decreased $ETCO_2$ secondary to a disproportionate airway dead space in relation to tidal volume.[39,40] These changes can signify substantial changes in the quality of ventilation that potentially requires intervention but may be accompanied by stable measurements of oxygen saturation, especially in the patient receiving supplemental oxygen. Apnea and upper-airway obstruction can result in decreased tidal volume and respiratory drive. This combined with atelectasis can result in increased airway resistance and hypoxemia. Increases and decreases in $ETCO_2$ may represent different mechanisms of hypoventilation; however, these changes may identify respiratory insufficiency

prior to changes in pulse oximetry on room air in patients who have received CNS depressants.

Once the patient is stable on room air for 1 h, it would be extremely unusual for him or her to experience a recrudescence of medication-induced respiratory depression in the absence of antagonism of long-acting opioids or benzodiazepines. However, the 2006 ASA guidelines recommend that patients with known or suspected OSA should be observed in the PACU 3 h longer than their counterparts without OSA and at least 7 h after their last episode of obstruction. With these recommendations in mind, our institution developed guidelines for the perioperative management of patients with known or suspected OSA (Fig 1). Patients with OSA and those given a presumptive diagnosis of OSA are scheduled to have surgery as the first case of the day to allow sufficient time for postoperative surveillance of respiratory depression before discharge to an unmonitored environment or home. The duration of monitoring required to capture all perioperative complications is unknown. A 5-year retrospective review of patients with OSA undergoing sleep surgery examined complications in 345 patients treated by 10 different surgeons for uvulopalatopharyngoplasty with or with septoplasty between 1999 and 2005.[41] Two hundred forty-eight of these patients were monitored overnight, whereas 97 were discharged home on the same day as the procedure. The incidence of all postoperative complications was 28.1%, but no deaths occurred within the 2 weeks immediately following the procedures. Major complications occurred in three patients, all of which within 2 h of the conclusion of the procedure, and included laryngospasm during tracheal extubation, which resulted in negative pressure pulmonary edema requiring treatment with diuresis, and bradycardia in two patients, which resolved without treatment. All bleeding complications in outpatients occurred at least 3 days after discharge from the facility, and three inpatients required intervention to control posttonsillectomy bleeds. No statistical differences were found in patients with respect to age, AHI, or presence of comorbidities. Although many of these patients with OSA were safely discharged home, more studies are required to determine which patients may benefit from overnight observation in a monitored environment.

Conclusions

Historically, ambulatory surgery has been considered a safe and efficient option for appropriately selected patients. Patients with OSA can safely undergo surgical procedures on an outpatient basis if their comorbidities are optimized and their recovery in the PACU uneventful. More studies are required to determine the phenotype of the patient with OSA who may benefit from prolonged postoperative monitoring.

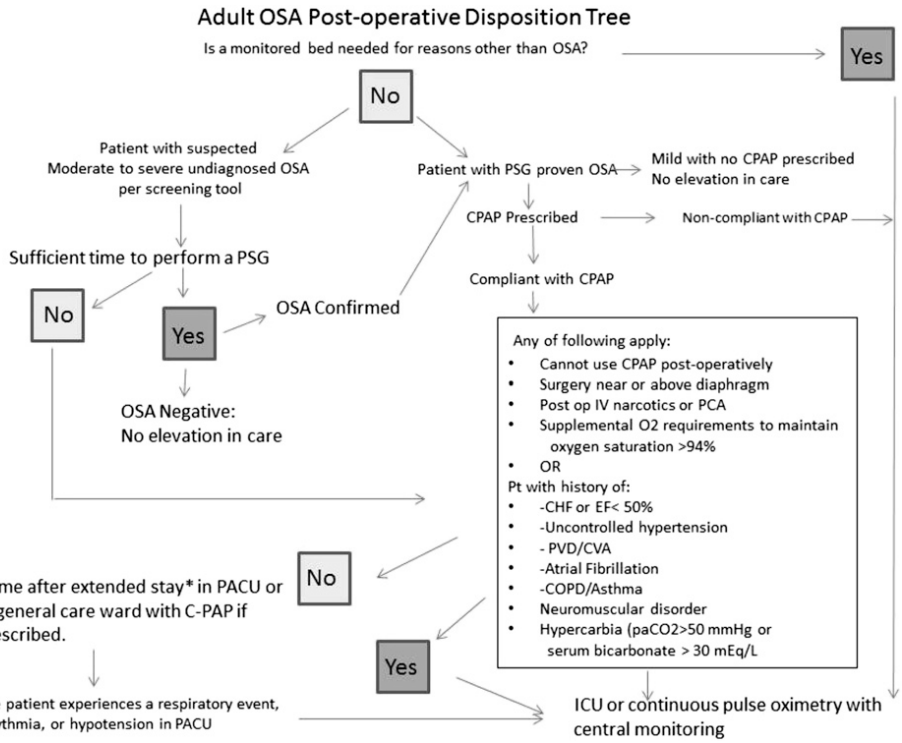

Figure 1 – *Adult OSA postoperative disposition tree. CHF = congestive heart failure; CVA = cerebrovascular accident; EF = ejection fraction; O_2 = oxygen; PACU = postanesthesia care unit; PCA = patient-controlled analgesia; PSG = polysomnogram; Pt = patient; PVD = peripheral vascular disease.*

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