Curr Anesthesiol Rep (2014) 4:284–289
DOI 10.1007/s40140-014-0069-2

Patients with Obstructive Sleep Apnea for Ambulatory Surgery: Challenges and Management

Girish P. Joshi

Published online: 1 June 2014

Abstract Obstructive sleep apnea (OSA) is a common breathing disorder, which is of particular concern to anesthesiologists, as it is associated with increased perioperative complications. Although the suitability of ambulatory surgery in OSA patients remains controversial, patients with high burden of comorbidities, particularly those with poorly stabilized medical conditions are not suitable for ambulatory surgery. Risk reduction strategy would include routine preoperative screening for OSA as well as approaches to minimize reliance on opioids and achieve rapid clear-headed recovery from anesthesia. Developing and implementing protocols (clinical pathways) allow for uniform practice, which can improve safety and efficiency. This requires a multidisciplinary approach in which the anesthesiologist should take a lead in collaborating with the surgeons and perioperative nurses. This article will discuss the current evidence related to selection and management of OSA patients scheduled for surgery in an ambulatory setting.

Keywords Ambulatory surgery · Sleep-disordered breathing · Obstructive sleep apnea · Perioperative outcome · Patient safety · Opioids · Respiratory depression

Introduction

Obstructive sleep apnea (OSA) is a common breathing disorder, which is recognized as an independent risk factor for a range of clinical conditions, such as hypertension, stroke, depression, and diabetes. It is of particular concern to anesthesiologists, as it is associated with increased perioperative complications [1, 2••, 3]. With increase in prevalence of obesity and the aging population, the prevalence of OSA is expected to increase significantly [4]. Of note, the prevalence of OSA among surgical patients is higher than the general population and varies with different surgical populations [5]. Because approximately 60–65 % of all surgical procedures are being performed on an outpatient basis, it is inevitable that anesthesiologists will encounter OSA patients in an ambulatory setting [6••]. This article will discuss the current evidence related to selection and management of OSA patients scheduled for surgery in an ambulatory setting.

G. P. Joshi (✉)
University of Texas Southwestern Medical School, 5323 Harry Hines Blvd, Dallas, TX 75390-9068, USA
e-mail: girish.joshi@utsouthwestern.edu

Pathophysiology of OSA

The pathophysiology of OSA is complex, as depends on the interplay of mechanical factors, ventilatory control, and arousal thresholds [7, 8]. OSA is characterized by recurrent episodes of upper airway obstruction and apnea during sleep. Sleep is a vulnerable time for ventilation because there is loss of wakeful ventilatory drive and reduced muscle activation. This vulnerability is further exaggerated in patients with upper airway narrowing such as the obese and those with upper airway abnormalities.

Sedative-hypnotics, muscle relaxants, and opioids exaggerate OSA-related airway instability, and therefore, may worsen or even induce upper airway obstruction and apnea. In contrast to natural sleep during which hypoxemia, hypercapnia, arousal, and sensory feedback from inspiratory muscle effort increase the airway dilator muscle activity and allow resumption of breathing, drug-induced airway obstruction, and apnea suppress arousal, which may have life-threatening consequences.

In the postoperative period, there are significant disturbances in sleep architecture most likely due to surgical stress response [9–11]. In the immediate postoperative period, there is a significant reduction in the rapid eye movement (REM) sleep. The severity and duration of reduction in REM sleep depend on the degree of surgical stress response. When the inflammation and surgical stress response is resolved, there is a rebound increase in REM sleep, which increases apneic episodes. Thus, the patient can be at an increased risk of OSA-related complications for several days after surgery. These postoperative sleep pattern changes appear to be independent of type of anesthesia.

Pain and opioids may further exacerbate the sleep deprivation and fragmentation observed with OSA [12–14]. Sleep deprivation and fragmentation can result in hyperalgesia and increased sensitivity to painful stimuli. On the other hand, recurrent hypoxemia can enhance opioid analgesic potency. Overall, the predominance of either of these conditions determines pain behavior. For example, patients with severe hypoxemia but less severe sleep fragmentation may have enhanced opioid potency but no hyperalgesia.

Clinical Presentation and Diagnosis of OSA

Failure to recognize (or diagnose) OSA preoperatively is one of the major causes of perioperative complications. Therefore, screening for OSA before surgery is recommended as part of a pre-anesthesia and pre-surgical plan. Several screening questionnaires have been validated in identifying patients at high risk for OSA [15]. A large ($n = 14{,}962$) single center study found that 13 % of patients had a history of OSA. In addition, there was a high prevalence of undiagnosed patients at risk for OSA [5]. However, there was a significant variation (9.5–41.6 %) based on the screening tools utilized.

The STOP-BANG Questionnaire is probably the most commonly used screening tool in the perioperative period because of its ease of use [16]. Although this tool has a high sensitivity, it has a low specificity. Recent studies have reported that a STOP-BANG of 5–8 indicates a high probability of moderate-severe OSA [17, 18]. Therefore, it is recommended that 5 or more positive indicators should be used to determine presumptive diagnosis of OSA [6••]. In patients suspected of having OSA, the anesthesiologist may elect to proceed without obtaining a sleep study, as it is unclear if a sleep study would improve perioperative outcome [6••]. Nevertheless, it is important to have a high index of suspicion and treat these patients as if they have severe OSA [19••].

Polysomnography (PSG) is considered the gold standard for diagnosing OSA. It may be the preferred modality if the patient has significant comorbid medical conditions, or if the timing of surgery is not an important factor. Continuous positive airway pressure (CPAP) titration in the sleep laboratory allows for precise determination of settings. However, PSG is labor intensive and expensive. In addition, PSG may not be always available. Therefore, home sleep testing (HST) with single or multiple channels has gained widespread acceptance. It is easy to use and allow significant cost savings. However, its usefulness in patients at high risk of central sleep apnea and/or significant cardiac, pulmonary, or neurologic conditions remains controversial. Recently, some studies have reported that oxygen desaturation index (ODI) calculated from overnight oximetry is a sensitive and specific tool to detect sleep-disordered breathing in surgical patients [20]. However, oximetry is a screening tool, and does not establish a diagnosis of OSA for purposes of prescribing positive airway pressure therapy.

Positive airway pressure (PAP) devices such as CPAP, bi-level positive airway pressure (BiPAP), and automatic self-adjusting positive airway pressure (APAP) function as a mechanical stent (pneumatic splint) of the airway, stabilize the upper airway, reduce the number and the duration of apneic episodes, and improve oxygenation. Evidence suggests that using CPAP for longer than 6 h per night reduces daytime sleepiness, reduces systemic hypertension, and improves the symptoms of right heart failure as well as improves neurocognitive function and daily functioning [1, 7]. A 4–6 week CPAP therapy has been shown to decrease tongue volume and increase pharyngeal volume [1, 7]. The American Society of Anesthesiologists (ASA) guidelines for management of patients with OSA recommend that preoperative positive pressure devices, mandibular advancement devices, and/or oral appliances should be considered, particularly in patients with severe OSA [19••]. However, the compliance with PAP devices is less than 50 % [21]. It is not clear from the current literature if preoperative PAP therapy influences perioperative outcome.

Selection of Adult Obese Patients for Ambulatory Surgery

The scientific literature regarding the safety of ambulatory surgery in OSA patients is sparse and of limited quality. Therefore, the suitability of ambulatory surgery in OSA patients remains controversial [6••]. However, there is a general agreement that patients with high burden of comorbidities, particularly those with poorly stabilized medical conditions are not suitable for ambulatory surgery [6, 19••]. The ASA has recently published updated practice guidelines for management of surgical patients with OSA, including patient selection for ambulatory surgery [19••].

These guidelines propose a scoring system based on the severity of OSA, the invasiveness of the surgery, the type of anesthetic technique, and the need for postoperative opioids [19••]. However, clinical utility of this scoring system is questionable, as it has not yet been validated. It is recommended that a patient who has had corrective airway surgery should be assumed to remain at risk for OSA complications unless the sleep studies and symptoms have normalized [19••].

A systematic review of the published literature assessing perioperative complications in patients with OSA undergoing ambulatory surgery revealed that OSA patients with inadequately treated comorbid conditions are not suitable for ambulatory surgery [6••]. Patients with a diagnosis of OSA (who are typically prescribed CPAP preoperatively) may be considered for ambulatory surgery if their comorbid medical conditions are optimized and they agree to use a CPAP device in the postoperative period. It appears that postoperative CPAP use may be protective against opioid-induced respiratory depression. Patients with a clinical diagnosis of OSA based on screening questionnaire can be considered for ambulatory surgery if their comorbid conditions are optimized and if postoperative opioid usage can be curtailed. Of note, no guidance could be provided for OSA patients undergoing upper airway surgery due to limited evidence [6••].

Clearly, identifying a patient suitable for an ambulatory procedure is a dynamic process that depends on the complex interplay between patient characteristics, invasiveness of the procedure, and anesthetic technique (e.g., local/regional versus general anesthesia) as well as post-discharge factors such as ability to manage postoperative pain with non-opioid analgesics and availability of a responsible caregiver. In addition, it is necessary to consider the ambulatory setting (i.e., office-based, free-standing ambulatory surgery center, hospital-based ambulatory surgery center, or short-stay), as it will influence the ability to manage complex patients based on the availabilities of personnel and equipment. Although it may be difficult to quantify, appropriateness of patient selection may also depend on the experience and skill of the surgeon and the anesthesiologist.

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, local or regional anesthesia should be preferred whenever possible [19••].

Patients with OSA are at an increased risk of difficult mask ventilation and tracheal intubation [1]. Therefore, planning for difficult airway management during induction of general anesthesia is important. Because of alterations in pulmonary function, the OSA patients may not tolerate even short periods of apnea. The techniques used to avoid post-induction hypoxemia include preoxygenation with patient in the head-up position and use of CPAP, if it can be tolerated. In addition, positioning in the head elevated laryngoscopy position (HELP) 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 optimal general anesthetic technique would consistently achieve rapid clear-headed recovery and promote early return of the patient's protective airway reflexes and maintenance of oxygenation. To achieve rapid recovery, it is necessary to use anesthetic, analgesic, and muscle relaxant agents judiciously. There is lack of evidence for superiority of a specific general anesthetic technique in patients with OSA. Nevertheless, nitrous oxide (N_2O) is beneficial because it can reduce the requirements of inhaled anesthetics and opioids [22•]. This allows for rapid emergence from anesthesia [23] and avoidance of opioid-induced respiratory complications. Although many avoid N_2O due to concerns of increased incidence of postoperative nausea and vomiting (PONV) and pressure effects through expansion of closed spaces, the clinical significance of these side effects in modern anesthetic practice has been questioned [24]. Importantly, 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 [25, 26]. Therefore, muscle relaxants should be used sparingly and reversal drugs should be utilized in appropriate doses. Respiratory strategies for optimal intraoperative ventilation would include use of lung protective ventilation. It is important to avoid hyperventilation as metabolic alkalosis can result in postoperative hypoventilation, which is undesirable in the OSA patients.

Postoperative Nausea, Vomiting, and Pain Prophylaxis

Prophylactic multimodal antiemetic therapy consisting of dexamethasone 4–8 mg, IV and ondansetron 4 mg should be utilized in all ambulatory surgical patients [27••]. High PONV risk patients could receive additional antiemetics such as transdermal scopolamine patch and/or total intravenous anesthesia. Promethazine 6.25 mg, IV or dimenhydrinate 1 mg/kg can be used for treatment of PONV in the recovery room.

Patients with OSA benefit from a multimodal analgesia technique using non-opioid analgesics including regional/local analgesia, acetaminophen, non-steroidal anti-inflammatory drugs or cyclooxygenase-2 specific inhibitors, and

dexamethasone. Because opioids may be associated with increased postoperative complications in the OSA patients, they should be used judiciously. Use of procedure specific pain management strategy should allow improved pain control with minimal use of opioid and opioid-induced respiratory complications [28].

Emergence from General Anesthesia

Toward the end of surgery, it is common practice to reduce the respiratory rate in an effort to build up end-tidal carbon dioxide (CO_2) levels and facilitate respiration [29]. However, such practice can delay emergence from anesthesia as the washout of the inhaled anesthetic would be delayed. Patients with OSA are at a high risk of airway obstruction after tracheal extubation and are frequently associated with difficult airway management [30]. Therefore, planning for tracheal extubation is a critical component of a successful general anesthetic technique. In patients with a difficult intraoperative course, prophylactic placement of a nasal airway prior to tracheal extubation may facilitate management of extubation failure.

Postoperative Considerations

In the postoperative period, OSA patients are particularly vulnerable to upper airway obstruction and the need for reintubation as well as systemic hypertension and cardiac dysrhythmias. The severity of OSA, the presence of comorbid conditions, and use of opioids are predictors of perioperative complications. Once in the recovery room, patients should be maintained in a semi-upright (30° head-up) position, if possible. Patients should be observed for recurrent episodes of desaturation and apnea and increasing need for supplemental oxygen. Patients who easily obstruct their airway when drowsy should receive extra vigilance. In addition, sedation-analgesic mismatch with opioids is a good predictor of potential complications. Avoid systemic opioids, if possible and if necessary titrate small amounts of short-acting drugs.

Role of Supplemental Oxygen in the Postoperative Period

Although supplemental oxygen is beneficial for most patients, it should be administered with caution as it may reduce respiratory drive and increase the incidence and duration of apneic episodes. A recent study reported that although arterial oxygen saturation was maintained during administration of supplemental oxygen, minute ventilation was reduced significantly [31]. Supplemental oxygen may mask the development of hypercarbia, which may lead to life-threatening respiratory complications, particularly in patients with OSA. Therefore, recurrent hypoxemia may be better treated with PAP along with oxygen rather than oxygen alone.

Role of Positive Airway Pressure Therapy in the Postoperative Period

Use of PAP may reduce the risk of airway obstruction and respiratory complications. It is necessary that anesthesiologists familiarize themselves with PAP devices. Patients with known OSA on therapy should be placed on PAP therapy in the postoperative period as soon as possible.

Prophylactic CPAP for 24–48 h after extubation has been reported to improve pulmonary function and reduce major complications despite unrestricted opioid use. However, determination of optimal PAP setting and timing of initiating the PAP therapy may be difficult in patients who have not previously used the device. A recent study reported that empiric use of CPAP in the postoperative period did not improve outcome [32]. In another study, perioperative APAP treatment decreased the severity of OSA (based on AHI) and improved postoperative oxygen saturation. No difference in complication rate was observed [33]. It is possible that use of self-adjusting or APAP devices may be more effective in the postoperative period.

Home Discharge

The previous recommendations by the ASA Practice Guidelines suggest that OSA patients be monitored for a median of 3 h longer than their non-OSA counterparts and the need to monitor for a median of 7 h after the last episode of airway obstruction or hypoxemia, while breathing room air in an unstimulated environment has been eliminated in the updated version [19••]. The recommendation for longer postoperative stays had no scientific basis.

Post-discharge instructions to the patients and their families (caregivers) are critical in improving outcome [6••]. Patients on PAP therapy preoperatively should use their PAP therapy whenever sleeping. Patients should be asked to avoid opioids. Patients suspected of having OSA based on clinical criteria should be encouraged to follow up with their primary care or sleep medicine physicians.

Summary and Conclusions

Patients with OSA are at a high risk of perioperative complications for several days after surgery. Clearly, patients with OSA may benefit from advance planning. Although the suitability of ambulatory surgery in OSA patients remains controversial, patients with a high burden

of comorbidities, particularly those with poorly stabilized medical conditions are not suitable for ambulatory surgery. Since a large proportion of OSA patients remain clinically undiagnosed, there is growing consensus that screening for OSA should be a part of standard preoperative evaluation. Anesthesiologists could potentially impact a significant public health burden and reduce the percentage of undiagnosed OSA. High index of suspicion allows for perioperative planning including use of anesthetic technique that would allow rapid clear-headed recovery and promote early return of the patient's protective airway reflexes and maintenance of oxygenation as well as minimizing reliance on opioids and appropriate monitoring. OSA patients who develop sedation-analgesic mismatch with opioids, oxygen desaturation, and apneic episodes should be monitored closely. Developing and implementing protocols (clinical pathways) allow for uniform practice, which can improve safety and efficiency. This requires a multidisciplinary approach in which the anesthesiologist should take a lead in collaborating with the surgeons and perioperative nurses.

Compliance with Ethics Guidelines

Conflict of Interest Girish P. Joshi has received honoraria from Pacira, Pfizer, Cadence, Baxter, and Mylan Pharmaceuticals.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

1. Adesanya AO, Lee W, Greilich NB, Joshi GP. Perioperative management of obstructive sleep apnea. Chest. 2010;138:1489–98.
2. •• Memtsoudis SG, Melanie C. Besculides MC, Mazumdar M. A rude awakening—the perioperative sleep apnea epidemic. N Eng J Med 2013; 368: 2352–3. *This is an excellent overview of concerns in surgical patients with sleep apnea.*
3. Chung F, Mokhlesi B. Postoperative complications associated with obstructive sleep apnea: time to wake up! Anesth Analg. 2014;118:251–3.
4. Peppard PE, Young T, Barnet JH, et al. Increased prevalence of sleep-disordered breathing in adults. Am J Epidemiol. 2013;177(1006–14):9.
5. Lockhart EM, Willingham MD, Abdallah AB, et al. Obstructive sleep apnea screening and postoperative mortality in a large surgical cohort. Sleep Med. 2013;14:407–15.
6. •• Joshi GP, Ankichetty S, Chung F, Gan TJ. 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. *This article provides recommendations for appropriate selection of patients with OSA for ambulatory surgery.*
7. Eastwood PR, Malhotra A, Palmer LJ, et al. Obstructive sleep apnoea: from pathogenesis to treatment: current controversies and future directions. Respirology. 2010;15(587–95):5.
8. Isono S. Obesity and obstructive sleep apnoea: mechanisms for increased collapsibility of the passive pharyngeal airway. Respirology. 2012;17:32–42.
9. Knill RL, Moote CA, Skinner MI, Rose EA. Anesthesia with abdominal surgery leads to intense REM sleep during the first postoperative week. Anesthesiology. 1990;73:52–61.
10. Dette F, Cassel W, Urban F, et al. Occurrence of rapid eye movement sleep deprivation after surgery under regional anesthesia. Anesth Analg. 2013;116:939–43.
11. Chung F, Liao P, Yegneswaran B, et al. Postoperative changes in sleep-disordered breathing and sleep architecture in patients with obstructive sleep apnea. Anesthesiology. 2014;120:287–98.
12. Doufas AG, Tian L, Davies MF, Warby SC. Nocturnal intermittent hypoxia is independently associated with pain in subjects suffering from sleep-disordered breathing. Anesthesiology. 2013;119:1149–62.
13. Doufas AG, Tian L, Padrez KA, et al. Experimental pain and opioid analgesia in volunteers at high risk for obstructive sleep apnea. PLoS One. 2013;8:e54807.
14. Doufas AG. Obstructive sleep apnea, pain, and opioid analgesia in the postoperative patient. Curr Anesthesiol Rep 2014; 4:1–9. *Overview of interactions between opioid analgesia and sleep apnea.*
15. Ramachandran SK, Josephs LA. A meta-analysis of clinical screening tests for obstructive sleep apnea. Anesthesiology. 2009;110:928–39.
16. Chung F, Yegneswaran B, Liao P, et al. STOP questionnaire: a tool to screen patients for obstructive sleep apnea. Anesthesiology. 2008;108:812–21.
17. 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.
18. 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):10.
19. •• Gross JB, Apfelbaum JL, Caplan RA, et al. 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. *This article provides the updated guidelines for perioperative management of patients with sleep apnea.*
20. Chung F, Liao P, Elsaid H, et al. Oxygen desaturation index from nocturnal oximetry: a sensitive and specific tool to detect sleep-disordered breathing in surgical patients. Anesth Analg. 2012;114:993–1000.
21. Weaver TE, Grunstein RR. Adherence to continuous positive airway pressure therapy: the challenge to effective treatment. Proc Am Thorac Soc. 2008;5:173–8.
22. • de Vasconcellos K, Sneyd JR. Nitrous oxide: are we still in equipoise? a qualitative review of current controversies. Br J Anaesth 2013; 111: 877–85. *This is an excellent overview of current controversies surrounding the use of nitrous oxide. The authors emphasize that there is no scientific reason for routinely avoiding nitrous oxide.*
23. Peyton PJ, Chao I, Weinberg L, et al. Nitrous oxide diffusion and the second gas effect on emergence from anesthesia. Anesthesiology. 2011;114:596–602.
24. Fernandez-Guisasola J, Gomez-Arnau JI, Cabrera Y, Garcıa del Valle S. Association between nitrous oxide and the incidence of

postoperative nausea and vomiting in adults: a systematic review and meta-analysis. Anaesthesia. 2010;65:379–87.
25. Murphy GS, Brull SJ. Residual neuromuscular block: lessons unlearned. Part I: definitions, incidence, and adverse physiologic effects of residual neuromuscular block. Anesth Analg. 2010;111:120–8.
26. Brull SJ, Murphy GS. Residual neuromuscular block: lessons unlearned. Part II: methods to reduce the risk of residual weakness. Anesth Analg. 2010;111:129–40.
27. •• Gan TJ, Diemunch P, Habib AA et al. Consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg 2014;118:85–113. *This is a comprehensive review of recent literature related to postoperative and post-discharge nausea and vomiting. Also, several approaches to PONV prophylaxis are provided.*
28. Joshi GP, Kehlet H: Procedure-specific pain management: the road to improve postsurgical pain management? Anesthesiology 2013;118:780–2. *Overview of procedure specific pain management.*
29. Joshi GP. The role of carbon dioxide in facilitating emergence from inhalation anesthesia: then & now. Anesth Analg. 2012;114(933–4):11.
30. Cavallone LF, Vannucci A. Extubation of the difficult airway and extubation failure. Anesth Analg. 2013;116:368–83.
31. Niesters M, Mahajan RP, Aarts L, Dahan A. High-inspired oxygen concentration further impairs opioid-induced respiratory depression. Br J Anaesth. 2013;110:837–41.
32. O'Gorman SM, Gay PC, Morgenthaler TI. Does autotitrating positive airway pressure therapy improve postoperative outcome in patients at risk for obstructive sleep apnea? a randomized controlled clinical trial. Chest. 2013;144:72–8.
33. Liao P, Luo Q, Elsaid H, et al. Perioperative auto-titrated continuous positive airway pressure treatment in surgical patients with obstructive sleep apnea: a randomized controlled trial. Anesthesiology. 2013;119:837–47.