UC San Diego
SCHOOL OF MEDICINE

UNIVERSITY OF TORONTO

Perioperative Management of OSA Patients

Practical Solutions and Care Strategies

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Activity Description

Patients with obstructive sleep apnea may present significant problems in the perioperative period, including difficult airways, sensitivity to anesthetic agents, and postoperative adverse events. This 8-page monograph is an assimilation of material presented at the Challenges in the Perioperative Management of OSA Patients symposium, held in October 2010, and is designed to provide practical solutions and strategies for the perioperative care of patients with OSA. Additional contributions have been made by course faculty, and references to recent publications regarding OSA practice guidelines have been included.

Target Audience

This activity is designed for anesthesiologists, surgeons, physicians, nurse practitioners, certified nurse anesthetists, anesthesia assistants, respiratory therapists, and other healthcare providers interested in the perioperative care of patients with obstructive sleep apnea.

Method of Participation

The estimated time to complete this activity is 1.5 hours. To obtain credit, participants should register for the activity at http://cme.ucsd.edu/OSAonline, take the online pretest, read the monograph, answer the multiple choice posttest questions, and complete the evaluation form online to receive a certificate immediately upon completion. Adobe Reader is required to view this monograph.

Educational Objectives

Following completion of this educational activity, learners should be able to:

- Review the pathophysiology of OSA in the context of recent clinical research regarding perioperative care, sleep, and anesthesia.
- Determine the challenging link between comorbidities, including obesity, and their effects on airway management and ventilation.
- Formulate how to implement screening and treatment procedures for obstructive sleep apnea.
- Discuss the preoperative, intraoperative, and postoperative risks to patients with OSA, and apply strategies to mitigate these risks in support of positive patient outcomes.

Statement of Need

Obstructive sleep apnea (OSA) is the most prevalent sleep disorder in the adult population. Current estimates suggest that moderately severe OSA is present in approximately 11.4% of men and 4.7% of women. The prevalence of OSA is higher in patients presenting for surgery than in the general population, and a significant proportion of OSA patients remain undiagnosed when they present for surgery. This is of concern to the perioperative physician, as OSA has been associated with increased perioperative risk and postoperative complications.

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This activity was planned in collaboration with the University of Toronto.

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The CME staff, meeting planners, editorial staff, planning committee, and CME committee reviewers, other than listed above, do not have any relevant financial relationships to disclose.

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Cultural Competency

This activity is in compliance with California Assembly Bill 1195 which requires CME courses with patient care components to include curriculum in the subjects of cultural and linguistic competencies. Cultural competency is defined as a set of integrated attitudes, knowledge, and skills that enables health care professionals or organizations to care effectively for patients from diverse cultures, groups, and communities. Linguistic competency is defined as the ability of a physician or surgeon to provide patients who do not speak English or who have limited ability to speak English, direct communication in the patient's primary language. Cultural and Linguistic Competency was incorporated into the planning of this activity. Additional resources on cultural and linguistic competency and information about AB1195 can be found on the UC San Diego CME website at http://cme.ucsd.edu.

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Overview

This monograph is an assimilation of material presented at the Challenges in the Perioperative Management of OSA Patients symposium, held in October 2010. Additional contributions have been made by course faculty, and references to recent publications regarding OSA practice guidelines have been included.

Introduction

Obstructive sleep apnea (OSA) is the most prevalent sleep disorder in the adult population.[1-15] Current estimates suggest that moderately severe OSA is present in approximately 11.4% of men and 4.7% of women.[1,2] OSA is defined as the occurrence of at least five apneas/hypopneas (temporary cessation of breathing) in one hour. Symptoms typically associated with OSA include snoring, excessive daytime somnolence, and restless sleep.[14] Male gender, smoking and alcohol consumption, obesity and aging are known factors associated with a higher propensity for OSA.[6,16-18] According to Fietze and colleagues[19], over the course of 5 years, the incidence of moderate OSA increases by approximately 8%. OSA is associated with a number of medical comorbidities including hypertension, heart failure, myocardial infarction, diabetes mellitus, gastroesophageal reflux disease, and stroke (see Table 1).[20-22]

Comorbidities Associated with OSA		
Category	**Condition**	**Prevalence (%)**
Cardiac	Treatment-Resistant Hypertension	63-83
	Congestive Heart Failure	76
	Ischemic Heart Disease	38
	Atrial Fibrillation	49
	Dysrhythmias	58
Respiratory	Asthma	18
	Pulmonary Hypertension	77
Neurologic	First-Ever Stroke	71-90
Metabolic	Type II Diabetes Mellitus	36
	Metabolic Syndrome	50
	Hypothyroidism	45
	Morbid Obesity	50-90
Surgical	Bariatric Surgery	71
	Intracranial Tumor Surgery	64
	Epilepsy Surgery	33
Others	Gastroesophageal Reflux Disease	60
	Nocturia	48
	Alcoholism	17
	Primary Open-Angle Glaucoma	20
	Head and Neck Cancer	76

Table 1. Prevalence of comorbidities associated with OSA. Adapted from Seet E & Chung F. Anesthesiology Clin. 2010;28:199-215. Anesthesiology Clinics by Elsevier Health Science Journals. Reproduced with permission of Elsevier Health Science Journals in the format Copy via Copyright Clearance Center.

Chung and colleagues[9] note that the prevalence of OSA is higher in patients presenting for surgery than in the general population. A significant proportion of OSA patients remain undiagnosed when they present for surgery. This is of concern to the perioperative physician, as OSA has been associated with increased perioperative risk and postoperative complications. Patients with OSA have a higher propensity for perioperative complications following surgery under general anesthesia – Gupta and colleagues[23] found that patients with OSA undergoing hip or knee replacement were at an increased risk of developing perioperative complications (24% versus 9%, respectively). Proposed guidelines from the Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine[6] suggest that questions regarding OSA should be included in routine health screenings. Moreover, if OSA is suspected, a comprehensive sleep evaluation should be conducted. Similarly, the 2006 guidelines published by the American Society of Anesthesiologists[5] recommend collaboration between anesthesiologists and surgeons to develop an evaluation protocol prior to surgery. However, clinical practices pertaining to the perioperative management of OSA surgical patients are inconsistent. Recent increased attention in this area has revealed a lack of uniformity surrounding practice guidelines for the assessment and management of patients with OSA in the perioperative arena.[8,10,11]

Many OSA patients are undiagnosed when they present for surgery. Preoperative screening for OSA is a critical step in identifying patients at risk.

This monograph provides a brief overview of the pathophysiology of OSA with an emphasis on the potential perioperative adverse events facing OSA patients and measures that anesthesiologists can take to remain alert and proactive in support of positive patient outcomes.

Anatomy of OSA

Isono, Davidson

Aside from brachycephalic dogs, (e.g., Pug, Boston Terrier, etc.), man is the only mammal who suffers from OSA. According to Davidson[20], evolutionary changes to facilitate speech and language drove anatomical changes in the upper respiratory tract, which led to the development of OSA. Considered an anatomical illness and an undesired consequence of natural selection for speech and language, OSA appears to have its roots in the evolutionary development of man. Approximately 40,000 years ago, the acquisition of speech via anatomical changes in the supralaryngeal vocal tract allowed for the spoken word and language development.[20]

The current human supralaryngeal vocal tract reveals a short face with a narrowed pharynx, anterior rotation of the foramen magnum, posterior movement of the palate, shortened soft palate, loss of epiglottic-soft palate lock-up, and shifting of the tongue into the oropharynx from early Homo sapiens to form an improved outlet for speech and sound modulation, yet contributing to obstructing anatomy and potential development of OSA (see Figure 1). OSA appears to be a soft tissue phenomenon[20], whereby the respiration-obstructing soft tissue in the nose and pharynx predispose to night time airway obstruction.

Due in part to the evolutionary changes in the upper respiratory tract, humans now must face the potentially adverse outcome of obstructive sleep apnea.[21]

OSA occurs due to repetitive occlusion of the pharyngeal airway during sleep. OSA patients have structurally a more narrow and collapsible pharyngeal airway than non-OSA persons.[24] Understanding the mechanisms of the pharyngeal structural abnormalities is of great importance to develop new OSA treatments and for anesthesiologists to improve safety of perioperative airway management.[25] The pharynx is a multipurpose organ. Under supervision of neural and chemical controls, contraction of the pharyngeal muscles surrounding the pharyngeal airway modulates its size and stiffness according to purpose. For instance, the pharyngeal airway constricts to efficiently propel food into the esophagus during swallowing. The pharyngeal size and stiffness change dynamically during speech, partly determining the tone of the voice. By contrast, maintenance of a rigid and patent pharyngeal airway is mandatory for achieving adequate respiration. Thus, the inherent collapsibility of the pharynx predisposes to impaired respiration when the regulation of the pharyngeal muscles is depressed or impaired during sleep and anesthesia.[25] OSA patients have excessive soft tissue surrounding the pharyngeal airway for a given maxilla-mandible size.[26] The pharynx connects to the trachea, which is pulled caudally during large tidal inspiration. Pharyngeal airway patency is dependent on breathing.[27] In fact, an increase in lung volume decreases collapsibility of the pharyngeal airway and apnea-hypopnea index in OSA patients. Reduced lung volume in obese OSA patients possibly leads to decrease in longitudinal tension of the pharyngeal airway increasing collapsibility of the pharynx.[25,27] Anesthetic agents typically utilized during surgery decrease pharyngeal tone and depress ventilatory responses to hypoxia and hypercapnia; thus, it is essential that anesthesiologists identify potential anatomical abnormalities contributing to OSA development and restore the neural mechanisms compensating for the anatomical abnormalities after surgery.

Figure 1. Note the large, fat-filled globular tongue and its position in the oropharynx. Note the neck fat is predominantly subcutaneous. Airway anatomy MRI. Image courtesy of Terence Davidson, MD, FACS.

Perioperative Risks Associated with OSA

Chung, Eikermann, Gay

Current diagnostic guidelines define mild OSA as 5 – 15 apnea hypopnea index (AHI), moderate 15 – 30, and severe OSA as ≥ 30 AHI.[6] The AHI is an index used to assess the severity of sleep apnea based on the total number of complete cessation (apnea) and partial obstructions (hypopnea) of breathing occurring per hour of sleep.[8] Both anesthesia and postoperative analgesic measures can negatively affect OSA outcomes. The effects of anesthesia, sedation, and analgesics may work similarly, increasing the risk of detrimental effects to patients with OSA.

During wakefulness, upper airway dilator muscle activity is high in patients with OSA. These protective reflexes are diminished during the transition from wakefulness to sleep[28], leading to collapse of the pharyngeal airway in anatomically predisposed individuals.[29] Evidence suggests that the consequences of sleep and anesthesia-induced unconsciousness are related; anesthetized patients who needed positive pressure to maintain airway patency had more severe sleep-disordered breathing than did those whose airways remained patent at or below atmospheric pressure.[30] Similar to sleep, during the transition from wakefulness to propofol-induced loss-of consciousness, decreases in genioglossus electromyogram activity and increases in pharyngeal critical closing pressure were observed proximate to loss of consciousness, suggesting that particular vulnerability exists after transition from conscious to unconscious sedation.[31] Surprisingly, recent data suggest that certain anesthetics including barbiturates[32,33] and isoflurane[34] dose-dependently augment genioglossus activity with increasing depth of anesthesia; they nonetheless decrease genioglossus activity during the wake-unconsciousness transition, putting the airway at risk at least transiently.

Patients with OSA may present significant problems in the perioperative period, including difficult airways, sensitivity to anesthetic agents, and postoperative adverse events.

The potential perioperative risks to OSA patients include increased morbidity and mortality, as well as difficult intubation and postoperative respiratory distress/obstruction.[16,23,24,35] For the anesthesiologist, review of the best practice guidelines can help ameliorate the potential for an increased risk of OSA in the perioperative patient. The guidelines were developed in an effort to improve perioperative care of patients with OSA, and include recommendations such as working with surgeons to develop screening and safety protocols for patients with known or suspected OSA, preoperative initiation of CPAP (continuous positive airway pressure), and specific intraoperative precautions to ensure patient safety.[5,6,15,16,36] While current literature lacks a definitive stance on evidence-based guidelines surrounding preoperative, intraoperative, and postoperative management of patients with OSA, there is a plethora of information available supporting a myriad of physician experiences closely involved in the perioperative care of patients with OSA.[35-38]

Preoperative Risks and Solutions for Patients with OSA

Chung, Davidson

Proper screening and OSA diagnosis prior to surgery is key to reducing risks associated with this condition. Since a significant number of patients arrive for surgery lacking a formal diagnosis, the preoperative role of the anesthesiologist may be to begin incorporating the use of available OSA screening tools.[5,13,39] Concerns associated with anesthesia preoperatively include OSA risk stratification and evaluation, and sedative premedication.[15] According to the American Society of Anesthesiologists[5], a formal preoperative review for OSA should include review of the medical records, physical examination, sleep studies, and preoperative x-rays in select cases. A sufficient amount of time prior to surgery is necessary to carry out this initial patient review to ensure adequate surgical preparation.[5]

Obesity, waist and neck circumference, gender, and age have all been attributed to increased propensity for OSA. The STOP and STOP-Bang questionnaires[9], when the questions are asked specifically as stated, provide a self-explanatory diagnostic tool to screen for OSA, with strong sensitivity levels in patients with moderate and severe OSA (74% and 93%, respectively; see Tables 2 and 3).[9] However, specificity levels are generally not up to par (53% and 43%, respectively), resulting in a high number of false positives and an increased need for anesthesiologists to be alert to any patient presenting with predisposing factors.[9,36] In yet unpublished data, Minokadeh and Davidson screened patients for OSA using the STOP questionnaire in a UC San Diego Anesthesia Pre-op Clinic. Those who screened positive were administered a home sleep test prior to leaving clinic (T. Davidson, MD; written communication; October 2010). Those who scored positive on the sleep test were placed on an auto-titrating positive airway pressure machine (APAP), with the expectation that they would learn to use it in the days prior to surgery, and continue to use it for the first postoperative week. The preliminary conclusion is that patients with obstructive sleep apnea can be screened, tested, and successfully placed on APAP for the first postoperative week.

Additional questionnaires frequently utilized to screen for OSA include the American Society of Anesthesiologists' (ASA) 14-item checklist broken down by physical characteristics, history of obstruction during sleep, and somnolence complaints; Epworth Sleepiness Scale; Stanford Sleepiness Scale; the Berlin questionnaire – an 11-question test validated in the primary care setting and organized into three categories (snoring, excessive daytime sleepiness, and hypertension); the Wisconsin questionnaire examining snoring habits; Haraldsson's 5-item questionnaire; and Flemons criteria, a "clinical prediction formula" examining neck circumference, hypertension history, and clinical symptom complaints, resulting in a clinical sleep apnea score.[3,5,7,8,35-37,39,40] The ASA checklist has produced a sensitivity of 79% at an AHI cutoff of 15. The Berlin questionnaire has been found to have a sensitivity of 69% and specificity of 56% in surgical patients with an AHI

Continued on next page

S	Snoring: Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?	Y	N
T	Tired: Do you often feel tired, fatigued or sleepy during the daytime?	Y	N
O	Observed: Has anyone observed you stop breathing during your sleep?	Y	N
P	Blood pressure: Do you have or are you being treated for high blood pressure?	Y	N

Table 2. STOP questionnaire. High risk of OSA = answering yes to 2 or more questions. Adapted from Chung F, et al. Anesthesiology. 2008;108:812-21. Reprinted with permission from Wolters Kluwer Health.

S	Snoring: Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?	Y	N
T	Tired: Do you often feel tired, fatigued or sleepy during the daytime?	Y	N
O	Observed: Has anyone observed you stop breathing during your sleep?	Y	N
P	Blood pressure: Do you have or are you being treated for high blood pressure?	Y	N
B	BMI: BMI more than 35 kg/m^2	Y	N
A	Age: Age over 50 years	Y	N
N	Neck circumference: Neck circumference greater than 40 cm	Y	N
G	Gender: Male	Y	N

Table 3. STOP-Bang scoring model. High risk of OSA = answering yes to 3 or more items. Adapted from Chung F, et al. Anesthesiology. 2008;108:812-21. Reprinted with permission from Wolters Kluwer Health.

cutoff of 15.[36] The literature has not shown any one questionnaire to be better at evaluation of OSA than any other, though recent studies suggest that the STOP-Bang is the most user-friendly with a sensitivity of 93% and a specificity of 43% at AHI cutoff of 15.[9]

In addition to proper screening measures, preoperative preparation can include the use of home sleep tests as a diagnostic tool for OSA. While the diagnostic gold standard remains polysomnography (PSG) carried out overnight in a sleep clinic, oftentimes this is an expensive, time-consuming option. Moreover, there frequently is not enough time from the date of scheduled surgery to obtain necessary authorizations and appointments for a PSG, resulting in the need for alternative diagnostic methods.[21] For the anesthesiologist who first suspects sleep apnea in a preoperative clinic for surgery scheduled several days in the future, polysomnography is not an option. Were it required, the patient's surgery would have to be cancelled and rescheduled pending the PSG and appropriate treatment. Pulse oximetry as a single metric of sleep apnea lacks the sensitivity and specificity of PSG and multi-channel home sleep testing. However, if the goal is only to cipher out those with an apnea hypopnea index of 15 or 20 or more, pulse oximetry can be considered.

According to Davidson (T. Davidson, MD; written communication; October 2010), a number of home sleep tests have been developed over the last 15 years to measure OSA using similar equipment as laboratory-based PSG. The validity of home sleep testing is a contentious issue. One of the best reviews was performed in a national coverage determination in 2009 by the Centers for Medicare and Medicaid Services, with the final decision supporting equally effective testing utilizing PSG and home sleep tests, as measured by outcomes and patient compliance.[41]

Utilizing a short questionnaire with a simple portable device may be a cost effective way to discover patients with high probability of OSA. Combining this preoperative screening information with observations in the post-anesthesia care unit may provide enough information to assist in proper postoperative patient care.[8]

While patients with mild OSA may not require preoperative PAP therapy, patients with moderate and severe OSA who have been on PAP therapy should continue treatment in the preoperative period (see Figure 2). According to Liao and colleagues[40], patients who have been noncompliant with instructions for CPAP use prior to surgery and are in need of CPAP post-surgery, pose the highest risk of potential complications. However, Kaw and colleagues[12] found that CPAP use prior to surgery did not affect postoperative outcome. This patient diversity results in the need to be especially attentive to intraoperative solutions to improve patient outcomes.

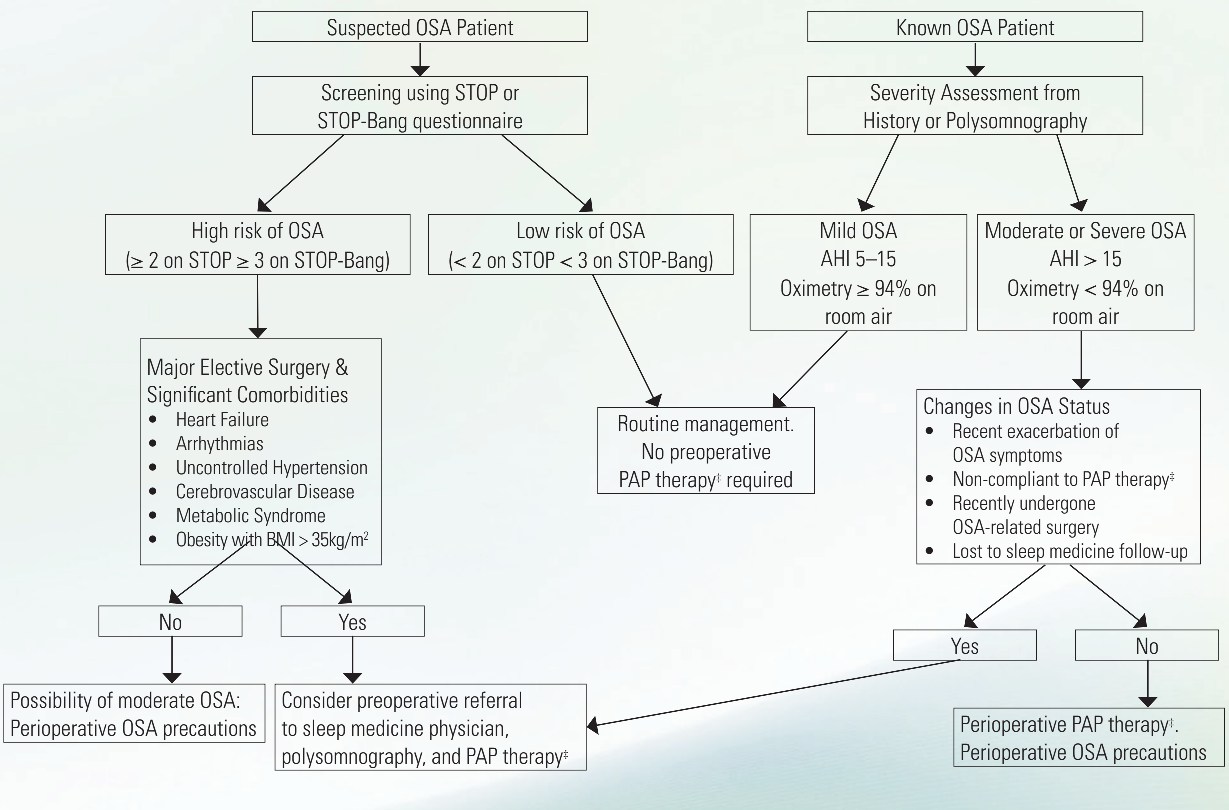


Figure 2. Preoperative evaluation of the patient of known or suspected obstructive sleep apnea in the anesthesia clinic. ‡ Positive airway pressure (PAP) therapy – including continuous PAP, bilevel PAP, or autotitrating PAP. Adapted from Seet E, & Chung F. Management of sleep apnea in adults – functional algorithms for the perioperative period: continuing professional development. Can J Anesth. 2010;57:849-65. Reprinted with permission from Springer.

Intraoperative Risks and Solutions for Patients with OSA

Several issues can arise intraoperatively in the OSA patient, including difficult intubation, opioid-related respiratory depression, and excessive sedation; Table 4 (see below) provides an overview of potential anesthetic concerns with the OSA patient, including management strategies to lower these potential risks.[15] Two important correlates of difficult intubation are a higher Mallampati score ≥ 3, neck circumference > 40 cm, or waist circumference > 105 cm (42 inches; same for both genders).

Proper positioning should include supporting the obese patient behind the upper back and head to achieve an anatomical position where a horizontal plane between the sternal notch and the external auditory meatus is established. In patients with OSA, the sitting posture decreases the frequency of airway obstruction compared to supine, and the benefits from upright positioning are enhanced in the obese patient. Ramping or placing patients into a sitting position for preoxygenation and anesthetic induction should be considered.[39]

Additionally, the obese patient has a reduced functional residual capacity, and tidal volume often falls below the closing capacity of the small airways, leading to atelectasis, increased intrapulmonary shunting, and impaired oxygenation. Functional residual capacity is further reduced after induction of anesthesia, when the weight of the anterior chest compresses the thorax. At least three minutes of breathing 100% oxygen or five vital capacity breaths of 100% oxygen are essential.[42]

Anesthesia reversal can present problems with airway obstruction and desaturation. The upper airway collapses frequently during sleep and anesthesia. Upper airway patency depends on the balance between airway collapsing and dilating forces. Most current evidence suggests that patients who are prone to airway collapse have an anatomical predisposition to pharyngeal collapse on a biomechanical basis, which is associated with an increased propensity of the supraglottic airway to collapse during inspiration. In fact, during contraction of the respiratory pump muscles (diaphragm and intercostal muscles), a negative airway pressure is being generated and the collapsible upper airway segment surrounded by soft tissues would collapse in the absence of its dilating forces. Variables that promote airway stability include upper airway dilator muscle activation, low extraluminal pressure, posture, respiratory timing, and high lung volume. Postoperative residual curarization is common after administration of neuromuscular blocking agents. There is a growing body of evidence that residual neuromuscular blockade places patients at increased risk.[43-46]

Therefore, suggested practices include verification of full neuromuscular blockade recovery, ensuring the patient is fully conscious prior to extubation[47], and placing the patient in a semi-upright recovery position.[15,17] The intraoperative anesthesia team should be alerted in advance, and perioperative OSA precautions should be taken. Some of these measures would include anticipating possible difficult airways, use of short-acting anesthetic agents, opioid minimization, reversal prior to extubation, and extubation in a non-supine position.[4,5,15,17,47,48] Future studies in humans need to show which combinations of anesthetics and opioids are optimal to achieve a persistently patent airway. It is possible that drugs that increase respiratory drive such as CO_2 or ampakins protect against fentanyl-induced respiratory depression and lethal apnea in rats, and may be helpful to improve safety.[49]

Anesthetic Concern	Principles of Management
Sedative premedication	Avoid sedating premedication
	Alpha-2 adrenergic agonist (clonidine, dexmedetomidine) may reduce intraoperative anesthetic requirements and have an opioid-sparing effect
Possible difficult airway	Ramp from scapula to head if patient is obese
	Adequate preoxygenation
	ASA Difficult Airway Algorithm
Gastroesophageal reflux disease	Consider proton pump inhibitors, antacids, rapid sequence induction with cricoid pressure
Opioid-related respiratory depression	Minimize use of opioids for analgesia
	Use of short-acting agents (remifentanil)
	Regional and multimodal analgesia (NSAIDs, acetaminophen, tramadol, ketamine, gabapentin, pregabalin, dexmedetomidine, dexamethasone)
Carry-over sedation effects from longer-acting intravenous sedatives and inhaled anesthetic agents	Use of propofol/remifentanil for maintenance of anesthesia
	Use of insoluble potent anesthetic agents (desflurane, sevoflurane)
	Use of regional blocks as a sole anesthetic technique
Excessive sedation in monitored anesthetic care	Use of intraoperative capnography for monitoring of respiration
Post-extubation airway obstruction	Verification of full reversal of neuromuscular blockade
	Ensure patient fully conscious and cooperative prior to extubation
	Non-supine posture for extubation and recovery
	Resume use of positive airway pressure device

ASA=American Society of Anesthesiologists; NSAIDs=non-steroidal anti-inflammatory drugs

Table 4. Intraoperative anesthetic management of the patient with obstructive sleep apnea. Adapted from Seet E & Chung F. Can J Anesth. 2010;57:849-64. Reprinted with permission from Springer.

Postoperative Risks and Solutions for Patients with OSA

Patients who are at high risk of OSA on the screening questionnaires, and have recurrent post anesthesia care unit (PACU) respiratory events, are associated with higher postoperative respiratory complication (see Figure 3 below).

Known OSA patients previously on PAP therapy should be encouraged to be compliant with PAP therapy postoperatively. Also, it may be prudent to monitor patients with OSA with oximetry or telemetry monitoring.

In regard to length of hospital stay following surgery, Gupta and colleagues[23] found that OSA patients remained in the hospital significantly longer than control patients. Moreover, OSA patients undergoing cardiac surgery had longer stays in ICU than control patients. Night time can be a particularly vulnerable time for patients with OSA, as sleep and sedation from critical respiratory depression appear very similar. In order to ensure patient safety, close monitoring when narcotics are required may be necessary throughout the night. Moreover, by monitoring patients with known OSA for a longer time period postoperatively, adverse outcomes such as postoperative airway problems, respiratory failure, ischemia, delirium, and death may be avoided.[50,51]

While current monitoring practices support continuous monitoring in the PACU and frequent monitoring into postoperative day (POD) 1, patients with OSA may still have hypoxia for the first few postoperative days. Electronic monitoring is one possible solution, though false and undetected alarms on a med/surg floor are much higher than electronic monitoring systems used at home because the sensors cannot account for patients that move, eat, talk, and ambulate to the bathroom; furthermore, patients are often behind closed doors. The high false positive alarm rate is disruptive to work flow, and intolerable to the patients, causing poor compliance. Ultimately, the monitoring system used must be un-encumbering. Transducers must be small and preferably wireless. Home OSA screening manufacturers have made great advances in miniaturizing technology, which may be portable to the med/surg floor.[50-52] It is imperative that monitoring of at-risk patients requiring narcotics continue for several days following surgery. By engaging in preoperative screening, it is less likely that patients with undiagnosed OSA will suffer complications postoperatively (see Figure 4).[53]

Regarding ambulatory surgery, short-acting anesthetic agents and non-invasive surgery typically makes this a safer option for patients with OSA.[54] However, severe untreated or undiagnosed OSA requiring postoperative narcotics after ambulatory surgery may be unsafe.

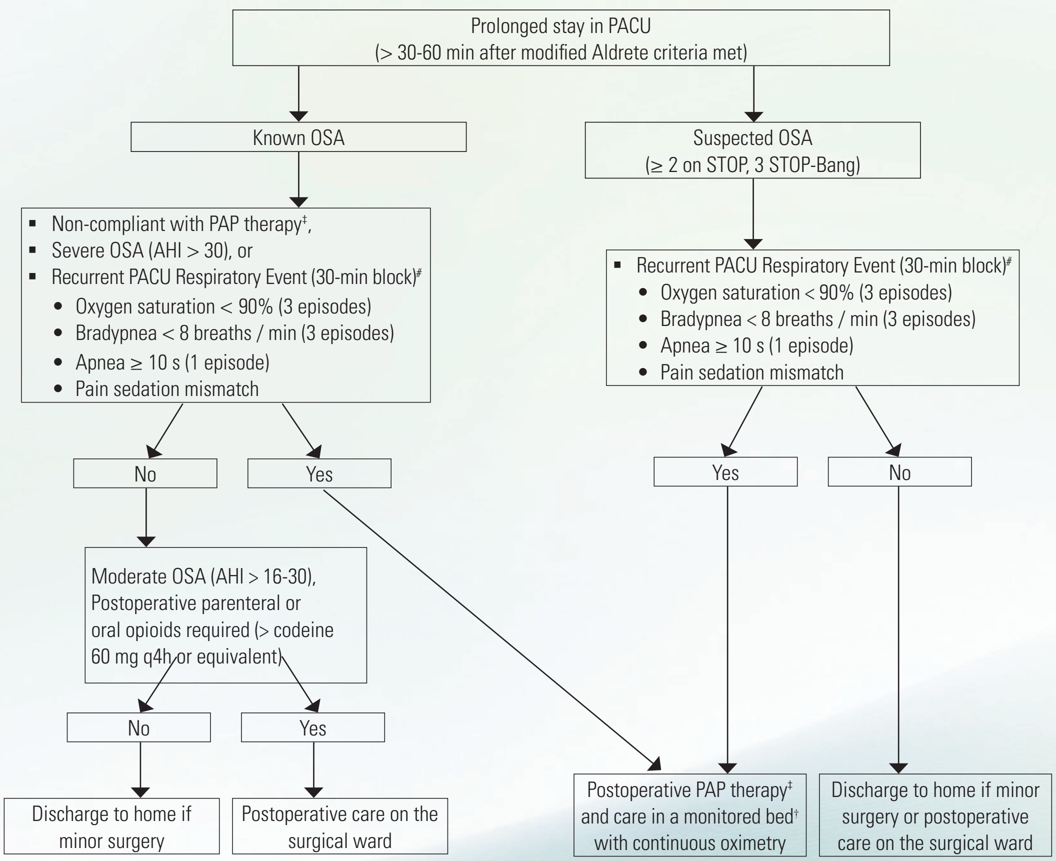
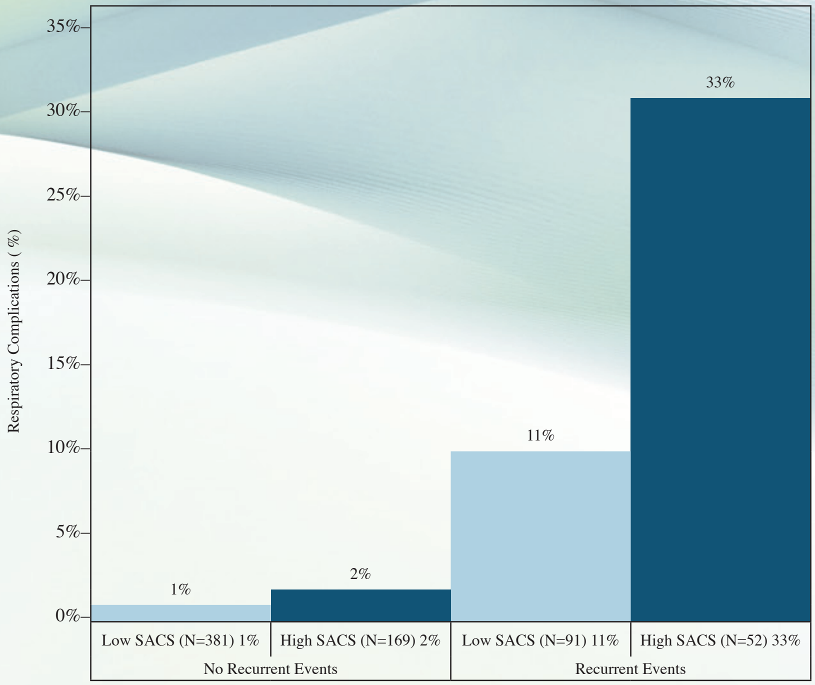


Figure 3: Postoperative management of the known or suspected obstructive sleep apnea patient after general anesthesia. #Recurrent postanesthesia care unit (PACU) respiratory event- any event occurring more than once in each 30-min evaluation period (not necessary to be the same event). ‡ Positive airway pressure (PAP) therapy – including continuous PAP, bilevel PAP, or autotitrating PAP. †Monitored bed- environment with continuous oximetry and the possibility of early nursing intervention (eg, intensive care unit, step-down unit, or remote pulse oximetry with telemetry in surgical ward). Pain-sedation mismatch=simultaneous occurrence of high pain scores and high sedation levels. Adapted from Seet E, & Chung F. Management of sleep apnea in adults – functional algorithms for the perioperative period: continuing professional development. Can J Anesth. 2010;57:849-65. Reprinted with permission from Springer.

Likelihood of Postoperative Respiratory Events with High Sleep Apnea Clinical Score (SACS)



The likelihood of postoperative respiratory events was significantly associated with high SACS (OR=3.5, p=0.001) and recurrent PACU events (OR=21.0, p<0.001).

Figure 4. Gali B, Whalen FX, Schroeder DR, et al. Identification of patients at risk for postoperative respiratory complications using a preoperative obstructive sleep apnea screening tool and postanesthesia care assessment. Anesthesiology. 2009;110:869-77. Reprinted with permission from Wolters Kluwer Health.

Respiratory Arrest in the Hospital

Davis

While the perioperative patient represents a unique opportunity to diagnose and treat OSA prior to hospital admission, this group represents only a small percentage of apneic/hypopneic arrests in the inpatient setting. Data from the UC San Diego Medical Centers reveal that over 90% of inpatient arrests are brady-asystolic, with the vast majority of these involving known respiratory or cardiovascular insufficiency prior to loss of vital signs. Approximately half of non-ICU arrests involve acute and unexpected respiratory insufficiency, most of which have an identifiable risk factor for apnea. These risk factors include a decrease in level of consciousness combined with a process leading to mechanical obstruction. Level of consciousness may be modified by medications (sedatives/narcotics), encephalopathy, anesthetics, or even sleep itself. Mechanical obstruction may be related to obesity, airway swelling/masses, or placement in the supine position. The challenge is to identify patients at risk for inpatient apnea/hypopnea with enough sensitivity to prevent arrests and enough specificity to avoid occupying monitored beds unnecessarily.[55]

Preliminary data from UC San Diego Medical Centers attempts to address these challenges in several ways. First, the STOP-Bang questionnaire is applied in the preoperative clinic, with positive screens leading to multi-channel home sleep testing. Once a diagnosis of OSA is made, patients undergo a longer period of observation in the PACU followed by admission to a designated inpatient bed with capnometry, continuous pulse oximetry, and ECG monitoring. Staff has been trained to identify the early warning signs of an apneic event, using a “progressive” paradigm. This model suggests that snoring and “snorking” (obstructive snoring) precedes self-correcting apneas, which in turn precede problematic apneic events.[55]

OSA and Malpractice

Benumof

Adverse outcomes can occur due to intubation difficulties (due to increased oropharyngeal classification, decreased atlanto-occipital extension, thick neck and occasionally micrognathia and retrognathia) and extubation difficulties (due to loss of optimal airway management position, monitors off the patient, patients not fully awake, no oropharyngeal airway), and together constitute approximately 30% of the malpractice OSA cases. However, the prototypical OSA malpractice case, constituting approximately 70% of the cases, is finding a postoperative patient dead in bed. The clinical components of the prototypical OSA malpractice "dead in bed" case are: (1) severe OSA, (2) morbid obesity, (3) patient in an isolated ward room, (4) has no monitoring, (5) is receiving narcotics, (6) has a painful incision, (7) is off oxygen and (8) is off his or her CPAP device.[56] Primary care doctors, sleep doctors, surgeons and anesthesiologists must have ready access to all OSA - related information in OSA patients; it has been suggested that the best way to ensure this continuity of care is to issue medical alert bracelets to patients who have severe OSA. Even though initial costs may rise due to the increase in time and equipment needed to screen and diagnose patients, ultimately, litigations will decrease due to improved patient care in the perioperative environment.[56]

Conclusion

While there may not be consensus regarding the best and most cost effective methods to ensuring fewer perioperative complications from OSA, there continues to be a need for informed clinicians, as patients are typically presenting with undiagnosed or misdiagnosed cases. The potential for perioperative negative sequelae associated with an OSA diagnosis remains high; however, clinicians in the preoperative clinic can aid in identifying at-risk patients by conducting screening tests in the clinic setting. At home sleep tests may also be useful in providing a preliminary identification of patients with OSA that need to be closely monitored in the peri- and postoperative setting. Recent advances in the diagnostic tools of OSA, including simplified questionnaires and a myriad of inexpensive, quick at home sleep tests have provided a necessary first step in arriving at a solid, evidence-based system for identifying patients with OSA prior to the operating room setting, which can only serve to diminish the potentially negative outcomes associated with surgery and OSA. Postoperative management of patients with OSA should include close monitoring postoperatively. Encouraging clinicians to be cognizant of patients with specific risk factors for OSA remains an important aspect of quality health care.

Future Directions

Hillman, Chung

The importance of the problem of OSA, both in terms of prevalence and consequences, is driving changes in the way OSA is investigated worldwide. As primary care physicians have become more adept at identifying the problem clinically, these resources have been overwhelmed and lengthy waiting lists have resulted. The expense has also caused access problems for some. This has resulted in increased use of simple home based studies to triage the problem. These are suitable methods to rule in patients with a high pre-test probability on clinical grounds and may prove helpful to anesthesiologists seeking information quickly in patients presenting for pre-anesthetic assessment.

Anesthesiologists also need to be aware that straightforward OSA is on the simpler end of a spectrum of sleep related breathing disorders that include sleep hypoventilation and periodic breathing. The conditions can coexist. Sleep hypoventilation is observed in patients with ventilatory insufficiency due to pre-existing lung disease, respiratory muscle weakness or chest wall problems, including obesity. Periodic breathing is often seen in the context of left ventricular dysfunction or neurological disease. These problems are likely to be of similar significance for anesthesiology, but require more detailed investigation.

OSA is a widely prevalent problem and will become an increasing preoccupation of anesthesiologists, partly because as knowledge is developed in this area, the difficult airway is being seen in a broader context than just the perioperative considerations. Prevalence is increasing with increasing obesity and aging.

Thus, the symposium has provided the impetus to form a "Society of Anesthesia and Sleep Medicine" to promote discussion, education, development of clinical standards and research related to these issues and to others common to anesthesia and sleep. These issues relate to the shared neurophysiological and neuropharmacological ground that exists between the states. This is a fertile area for exploration and enlightenment, and includes consideration of shared pathways determining unconsciousness, common effects of state change on ventilatory drive and reflex gain and the effects of anesthesia on and its interplays with postoperative sleep.

The society (http://anesthesiaandsleep.org) will promote cross fertilization of ideas between anesthesiology and sleep medicine, to the benefit of these and related disciplines. While sleep medicine specialists and respiratory therapists are typically the "go to" person when facing a sleep disorder diagnosis, a multidisciplinary approach to perioperative care is paramount to ensuring positive patient outcomes. There is much work to be done to improve understanding and clinical practice in these areas, both educational- and research-focused.

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