Lesson S36: PreAnesthetic Assessment of the Patient With Probable Obstructive Sleep Apnea

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Read this article, reflect on the information presented, then go online and complete the lesson post-test and course evaluation before the termination date below. (CME credit is not valid past this date.) You must achieve a score of 80% or better to earn CME credit.

TIME TO COMPLETE ACTIVITY: 2 hours
RELEASE DATE: May 1, 2014
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Professional Gaps

The guidelines for anesthetic management of patients with obstructive sleep apnea (OSA) were updated by the American Society of Anesthesiologists (ASA) in February, 2014. The previous version of these guidelines, adopted in 2005, necessitated a revision as complications continued to occur. The latest ASA document incorporates recommendations from other related professional societies. Awareness of the problems related to undiagnosed OSA, especially postoperative complications, is essential for all anesthesiologists.

Learning Objectives

At the end of this activity, the participant should be able to:

1. Define obstructive sleep apnea
2. Recognize the high prevalence of undiagnosed OSA within the surgical population
3. Explain how obesity may contribute to OSA
4. List the anatomical features that contribute to OSA
5. Define appropriate monitoring for patients at risk of OSA
6. Understand why patients with OSA and OSAS may be more difficult to mask ventilate and intubate following induction of anesthesia
7. Identify patients at risk for OSA
8. Prescribe a plan for postoperative ventilation
9. Write an appropriate prescription for postoperative pain relief
10. Describe the pathophysiology of sleep

Case History

A 55-year-old male, 335 lbs (152 kg) and 6’ 0” (183 cm) with a body mass index (BMI) of 45.4 kg/m2,
was scheduled for a rotator cuff repair. During the preoperative assessment, his wife confirmed that he snored and that she often slept in another room because of it. He had not undergone any sleep studies but planned to do so in the near future. He admitted to being sleepy during the day but felt it was due to his weight and the Percocet® he took for pain. The anesthetic plan was to perform an interscalene block and follow it immediately with general anesthesia. Intraoperatively he received sevoflurane and a fentanyl infusion. The 1.5 hour case ended at 6 pm, and he was awake, extubated and transferred to the postanesthetic care unit (PACU). He complained immediately of severe pain and was medicated with morphine 4mg. He had no relief and the morphine was repeated after 15 minutes. His pain continued and midazolam 4mg was administered along with morphine 6mg. A surgical resident, responding to the nurse’s call for evaluation for further pain relief, ordered dilaudid 2mg, q 15 minutes. Thirty minutes after receiving a total of dilaudid 6mg, he felt comfortable and was discharged to the ward at 7 pm. Vital signs were normal and continuous monitoring stopped. At 10 pm, he again complained of pain and was given dilaudid 2mg. He fell asleep. A nurse entered his room about 1 am to check his vital signs and found him non-responsive with slow and gasping respiration. A code was called and a hospitalist responded but was unable to secure the airway.

Introduction

In 2006, the president of the American Society of Anesthesiologists predicted that the increasing incidence of obesity in the American population will lead to an increasing incidence of OSA, resulting in more postoperative complications in those patients requiring sedation or anesthesia. The ASA task force published practice guidelines in May, 2006, to assist anesthesiologists and other perioperative personnel in the management of patients with diagnosed and undiagnosed OSA.1 Respiratory arrest and even death continue to occur postoperatively, suggesting that the guidelines are not being followed or are incomplete. As a result, the ASA revised the recommendations in 2014, based on updated evaluation of scientific literature and findings from surveys of experts and selected ASA members.2 Several other organizations have also published statements regarding management of patients with OSA.3-5 The ASA guidelines differ in that they include critical analysis of data from a large scale survey of practicing anesthesiologists rather than the consensus opinion of a few individuals. Also, the ASA recommendations address both inpatients and outpatients and all ages, except infants.

Definition and incidence

Obstructive sleep apnea is a syndrome characterized by periodic, partial or complete obstruction in the upper airway during sleep, which results in repetitive arousal to restore airway patency and breathing. Two to four percent of adults were believed to have obstructive sleep apnea, more common in middle aged males.6 Some authorities estimate that approximately 1 in 5 American adults will be diagnosed with at least mild OSA if studied using polysomnography in a sleep laboratory setting.7 A query of the Vanderbilt University Perioperative Data Warehouse was recently performed to identify diagnostic trends and risk factors associated with OSA.8 Evaluation of more than 173,500 records indicated that the incidence of OSA increased from 4% in 2000 to 18% by 2013. A STOP-BANG screening tool (Figure 1) was incorporated by the Vanderbilt Preoperative Evaluation Center in 2013 and was used in the assessment of almost 9,000 patients who did not yet have a diagnosis of OSA.9 Eleven percent of patients scored 5 or more, indicating OSA.
Figure 1. STOP BANG Questionnaire. One of the simplest and easiest means to assess OSA is application of the STOP-BANG questionnaire. The score is based on responding yes to 3 or more questions indicates a high probability of OSA: Snore, Tired, Observed (apnea), Pressure, BMI (> 35), Age (>50), Neck circumference > 40cm or 17in and Gender male.

STOP BANG Questionnaire

Height _____ inches/cm            Weight _____ lb/kg            Age _____

Male/Female            BMI _____

Collar size of shirt: S, M, L, XL, or _____ inches/cm            Neck circumference* _____ cm

1. Snoring
Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?        Yes No

2. Tired
Do you often feel tired, fatigued, or sleepy during daytime?        Yes No

3. Observed
Has anyone observed you stop breathing during your sleep?        Yes No

4. Blood pressure
Do you have or are you being treated for high blood pressure?  Yes No

5. BMI
BMI more than 35 kg/m2?  Yes No

6. Age
Age over 50 yr old?  Yes No

7. Neck circumference
Neck circumference greater than 40 cm?  Yes No

8. Gender
Gender male?  Yes No

* Neck circumference is measured by staff

High risk of OSA: answering yes to three or more items
Low risk of OSA: answering yes to less than three items

Adapted from: STOP-BANG Questionnaire; Chung F et al:

Diagnosis

The majority of patients with OSA have not been diagnosed with polysomnography, a sleep study which measures and characterizes any pauses in breathing. In central apnea, pauses are followed by a relative decrease in oxygen saturation, an increase in carbon dioxide retention, and the body's motions of breathing stop. In OSA, the chest continues to make the movements of inhalation, but the
movements become more vigorous. Monitors for airflow at the nose and mouth demonstrate that efforts to breathe are present, and often exaggerated.

During polysomnography, the effect of “events” are measured and documented based on electroencephalography (EEG), electromyography (EMG), electro-oculography (EOG), electrocardiography (ECG), heart rate and spO₂. An event can be either apnea defined as complete cessation of airflow for at least 10 seconds; or hypopnea defined as a 50 percent decrease in airflow for 10 seconds or a 30 percent decrease with an associated decrease in oxygen saturation or arousal from sleep. To grade the severity of sleep apnea, the number of events per hour is reported as the apnea-hypopnea index (AHI). An AHI of less than 5 is considered normal. An AHI of 5-15 is mild; 15-30 is moderate and more than 30 events per hour indicates severe sleep apnea. This fairly complicated, time-consuming, and expensive overnight process may not be available or practical as a preoperative screening tool prior to surgery, particularly if the patient needs timely surgery. Several other tests are available that are less costly such as a single channel home recording.

In patients who are at high risk of OSA, a randomized controlled trial found that home pulse oximetry may be adequate and easier to obtain than formal polysomnography. High probability patients can be identified by the Epworth Sleepiness Scale (ESS) (a score of 10 or greater) and a Sleep Apnea Clinical Score (SACS) (a score of 15 or greater). Home oximetry does not measure apneic events or respiratory event-related arousals and thus does not produce an AHI value.

Several surveys indicate that anesthesiologists are more likely to diagnose OSA than surgeons. It is valuable to have a quick and reliable means to identify patients at risk, especially for the anesthetic care provider who sees the patient only moments before induction.

A presumed diagnosis of OSA can be inferred from a history of abnormal breathing during sleep (e.g. loud snoring and witnessed apnea by a bed partner), frequent arousals from sleep to wakefulness (e.g. periodic extremity twitching, vocalization, turning, and snorting), severe daytime sleepiness, a BMI of ≥ 35 kg/m², increased neck circumference (≥17 inches for males, ≥16 inches for females), and the presence of coexisting morbidities (e.g. essential systemic hypertension, pulmonary hypertension, cardiomegaly and type ll diabetes). While OSA is more common in men, it does occur in women and gender differences have been described. Women report less daytime sleepiness but more insomnia. BMI also tends to be higher and AHI lower. The characteristics of the current population of patients with OSA is similar to that of 5 years ago having typical clinical and elevated BMI. The number of positive diagnoses has increased as has the severity of the disease.

Architecture of Sleep Patterns

A normal adult experiences several sleep cycles every night. Each cycle has two general components: non rapid eye movement (NREM) and rapid eye movement (REM) sleep (Figure 2). NREM sleep is further subdivided into four stages that progressively deepen and are marked by slowing of the EEG. NREM stages 3 and 4 show slow wave/deep sleep. This is the most restful and restorative sleep period and absolutely essential to life. NREM stages 3 and 4 sleep occurs early—within the first two or three cycles of sleep. REM sleep occurs later in the night after NREM sleep. Dreaming, nightmares, and rapid eye movement, readily detected by EOG, often accompany REM sleep. Paradoxically, all muscles, other than the extraocular muscles, have a generalized loss of muscle tone during REM sleep, readily demonstrated on EMG.
Most patients experience a disturbance in sleep architecture for several days following anesthesia and surgery. This is exaggerated in patients with OSA who already have altered architecture sleep patterns as a consequence of the disease. Most patients do not experience the deeper planes of NREM sleep or REM sleep for the first three postoperative days. “REM rebound” then follows as a “catch-up” on missed REM sleep phase. During REM rebound, nightmares may trigger a sympathetic surge, causing dysrhythmias, and myocardial ischemia. Also, during REM sleep, the increase in upper airway resistance, coupled with generalized atonia and airway obstruction, may lead to severe hypoxemia.

Patients with OSA have other anatomical and functional factors that contribute to airway compromise. Obesity, body mass index (BMI) $\geq 30$ kg/m$^2$, with enlarged neck circumference (males $\geq 17$ inches; females $\geq 16$ inches) are often present. Weight loss may cure most cases of OSA. Other anatomical causes for OSA include nasal polyps, septal deviation, lingual tonsils, large adenoids, retrognathia, or tumors of the naso-orohypopharynx.

The residual effects of anesthetic agents and neuromuscular blocking agents that tend to have a more profound effect on the upper airway muscles than on ventilatory muscles further contribute to respiratory obstruction. Benzodiazepines as well as opioids (especially methadone) may cause central followed by obstructive apneic events. Thus, profound/prolonged upper airway muscle weakness may be present despite adequate spontaneous ventilation by the patient.

Given these contributing factors, it is clear that patients with OSA are at considerable risk of cardiorespiratory complications after surgery and during a period when analgesia may be maintained principally with opiates. Primary events that result from obstructive sleep apnea, with corresponding physiologic responses and clinical features during sleep are shown in Figure 3.
Figure 3. The sequences of primary events that result from obstructive sleep apnea


Treatment

In many instances, OSA may be improved by weight loss, an option clearly not available in the immediate preoperative setting. Other cases respond to surgical intervention, including uvulopalatopharyngectomy (UP3) although repeat sleep studies are still indicated. A recent study suggested that deep brain stimulation showed a subjective and objective improvement of sleep quality and amelioration of OSA.21 Practically speaking, use of some means of providing positive airway pressure during sleep and also in the early postoperative period is most frequently employed.

Analysis of the New Revised ASA Guidelines

The ASA revisited earlier guidelines following concern that complications of OSA such as cardiorespiratory depression remain of significant perioperative importance.

The guidelines apply to inpatients and outpatients in any location where sedation or anesthesia are administered. They do not focus on patients with pure central apnea, abnormalities of the upper and
lower airway not associated with OSA, children < 1 year and obesity in the absence of OSA. The guidelines can also serve as a resource for physicians and health care workers involved in the care of sedated patients.

The final document was produced after thorough analysis of scientific and opinion based evidence from experts, and the testimony of the membership of the ASA and open forum. The document addresses preoperative, intraoperative and postoperative management of the patient and provides criteria for discharge to unmonitored settings.

**Preoperative evaluation**

1. Anesthesiologists and surgeons should work together to develop a protocol to evaluate patients suspected of OSA before the day of surgery allowing sufficient time to put an appropriate plan in place.

2. Preoperative evaluation should include a comprehensive review of previous medical records, concentrating on co-morbidities, airway evaluation and any prior difficulties, as well as the results of any sleep studies. Focused questions are encouraged including application of the ASA scoring system (Figure 4) and/or the STOP-BANG questionnaire. Physical examination is directed especially at the head and neck. If the evaluation suggests OSA, the anesthesiologist and surgeon should decide whether to manage the patient based on clinical criteria or obtain sleep studies and initiate OSA treatment. Clinical criteria should have a high degree of specificity. For some patients more aggressive treatment might be indicated. The patient, family and surgeon should be aware of the potential perioperative implications of OSA.

3. A determination should be made regarding the advisability of inpatient versus outpatient surgery depending on sleep apnea status, anatomical and physiologic abnormalities, co-morbid diseases, the nature of the surgery, the need for postoperative opioids, age, and adequacy of post-discharge observations and the capabilities of the outpatient facility. In addition, the availability of emergency difficult airway and other respiratory equipment, radiology services and transport agreements should be taken into consideration.

4. Preoperative preparation should encompass initiation or continuation of CPAP or non-invasive positive pressure ventilation. If feasible, mandibular advancement devices or oral appliances or weight loss programs should be incorporated. Patients who have undergone UP3 may still be at risk unless a normal sleep study has been documented. Patients with difficult airways must be managed according to the Updated Report on the Practice Guidelines for Management of the Difficult Airway.
### Figure 4. The ASA OSA Risk Score

- Points are assigned for each of three categories (A, B, C) and then totaled (D).
- The overall point score is calculated as the score for A PLUS the greater of the scores for either B or C (yielding a maximum overall score of 6).
- Patients with overall score of ≥ 4 may be at increased perioperative risk from OSA. Patients with a score of ≥5 may be at significantly increased perioperative risk from OSA.

<table>
<thead>
<tr>
<th>A</th>
<th>Severity of sleep apnea</th>
<th>Based on a sleep study (i.e. AHI) or clinical indicators if a sleep study is not available (i.e. presumptive diagnosis).</th>
<th>Points (A): _________</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = None</td>
<td>1 = Mild OSA</td>
<td>2 = Moderate OSA</td>
<td></td>
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<tr>
<td>3 = Severe OSA</td>
<td></td>
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</tbody>
</table>

One point may be subtracted if a patient has been on CPAP or bilevel positive airway pressure (BiPAP) prior to surgery and will be using this consistently during the postoperative period. One point should be added if a patient with mild or moderate OSA has a resting PaCO2 exceeding 50 mm Hg.

<table>
<thead>
<tr>
<th>B</th>
<th>Invasiveness of the surgical procedure and anesthesia</th>
<th>Based on type of surgery/anesthesia.</th>
<th>Points (B): _________</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = superficial surgery under local or peripheral nerve block, anesthesia without sedation</td>
<td>1 = superficial surgery with moderate sedation or general anesthesia or peripheral surgery with spinal or epidural anesthesia (with no more than moderate sedation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 = peripheral surgery with general anesthesia or airway surgery with moderate sedation</td>
<td>3 = major surgery under general anesthesia or airway surgery under general anesthesia</td>
<td></td>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C</th>
<th>Requirement for postoperative opioids</th>
<th>Points (C): _________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Points: 0 = none; 1 = low-dose oral opioids; 3 = high-dose oral opioids or parenteral or neuraxial opioids.</td>
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<table>
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<tr>
<th>D</th>
<th>TOTAL POINTS</th>
</tr>
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### Intraoperative Management

1. Consideration of the potential for postoperative compromise should be made in selecting intraoperative medications.

2. Local anesthesia or peripheral nerve blocks should be considered for superficial procedures with or without moderate sedation.
3. If moderate sedation is used, ventilation should be continuously monitored by capnography or another automated method.

4. If used previously, CPAP or an oral appliance should be administered.

5. General anesthesia with a secured airway is preferred to deep sedation, especially for airway procedures.

6. Spinal/epidural anesthesia should be considered for peripheral procedures.

7. Extubation should be carried out awake.

8. Complete reversal of neuromuscular blockade should be verified and documented before extubation.

9. If possible, the lateral, and semi-upright position should be maintained during extubation and recovery.

Postoperative Management

1. Regional analgesic techniques should be used rather than systemic opioids.

2. If neuraxial analgesia is planned, the benefits of local anesthetics alone (no respiratory depression) should be considered over narcotic based mixture (better analgesia).

3. Continuous background infusions should be avoided in patient controlled analgesia.

4. Non-steroidal anti-inflammatory agents (NSAIDs) and other modalities (ice, transcutaneous electrical stimulation) should be added to reduce the need for opioids.

5. Concurrent administration of benzodiazepines increases the risk of respiratory depression and airway obstruction and should be avoided.

6. Supplemental oxygen should be given until the patient can maintain his/her baseline oxygen saturation on room air. However, it should be understood that supplemental oxygen may increase the duration of apneic episodes and delay recognition of atelectasis and hypoventilation measured by pulse oximetry alone.

7. CPAP or other modalities should be used for patients who use these devices preoperatively. Patients should bring their own equipment to the hospital.

8. Non supine positions are recommended for recovery whenever possible.

9. Patients at increased risk for OSA should have continuous pulse oximetry after discharge from the PACU, provided in a critical care or step down unit, by telemetry on a hospital ward or by a dedicated trained professional observer in the patient’s room.

10. CPAP should be initiated for patients with airway obstruction or hypoxemia.
Criteria for Discharge to an Unmonitored Setting

1. Patients at risk should not be discharged to an unmonitored setting (home or unmonitored ward bed) until they are no longer at risk of respiratory depression.

2. A longer stay may be required.

3. Adequate respiratory function is established by ensuring the patient’s ability to maintain adequate oxygen saturation while breathing room air in an unstimulated environment.

Management of the Case

There are many points for consideration in the management of the case presented.

Preoperative Considerations

Closer cooperation and discussion with the surgeon, patient and family is valuable in identifying and ameliorating potential issues for any patient and should have been employed in this case. Once the potential for OSA was identified, the patient would have benefited from a formal polysomnographic sleep study to define the AHI, categorize the severity of OSA and make recommendations for appropriate nasal CPAP or BiPAP. Use of these devices for several weeks preoperatively has been found to be highly effective at preserving airway patency during sleep and anesthesia as well as diminishing reflex responses to hypoxia and hypercapnia. Upper airway stabilization as a residual effect of CPAP begins within as little as four hours of treatment. Chronic CPAP use preoperatively has been found to abolish mean, systolic, and diastolic blood pressure fluctuations in OSA patients reducing the risk of cardiac ischemic events and recurrent atrial fibrillation. A plan for postoperative pain relief could have been established prior to the procedure.

Intraoperative Considerations

An attempt was made to provide a regional technique and was apparently unsuccessful. Time should have been taken to ensure adequate analgesia before immediately proceeding to a general anesthetic technique.

Postoperative Considerations

A multi-modal approach to pain management should have been used, including pre- and post-procedure administration of NSAIDs, and continuous local anesthetic infiltration. Benzodiazepines were not indicated. It is unclear if the responding physician realized that dilaudid is far more potent than morphine. The patient should not have been discharged from the PACU within 1 hour of the procedure and should have been placed in a monitored setting.

Conclusion

The patient with undiagnosed obstructive sleep apnea who presents immediately preoperatively presents a challenge to the anesthesiologist. Guidelines have been developed and will prove helpful in these situations.
Dr. Elizabeth A.M. Frost, who is the editor of this continuing medical education series, is clinical professor of anesthesiology at The Icahn School of Medicine at Mount Sinai in New York City. She is the author of Clinical Anesthesia in Neurosurgery (Butterworth-Heinemann, Boston) and numerous articles. Dr. Frost is past president of the Anesthesia History Association and former editor of the journal of the New York State Society of Anesthesiologists, Sphere. She is also editor of the book series based on this CME program, Preanesthetic Assessment, Volumes 1 through 3 (Birkhäuser, Boston) and 4 through 6 (McMahon Publishing, New York City).
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**Post-test**

1. Which of the following physiologic events is MOST likely to occur during REM sleep in an OSA patient?
   a. Increased upper airway resistance and obstruction
   b. Increased body muscle tone
   c. Extraocular eye muscle atonia
   d. A dreamless state

2. The recent ASA guidelines for management of patients with OSA apply to:
   a. Inpatients and outpatients
   b. Patients with pure central apnea
   c. Ambulatory settings only
   d. All of the above

3. Which of the following is a true statement regarding a patient who has undergone a UP3?
   a. They are no longer at risk for OSA
   b. A repeat sleep study is indicated
   c. Dilaudid in the postoperative period is the drug of choice
   d. None of the above

4. The incidence of undiagnosed OSA in the preoperative surgical population is estimated to be:
   a. unknown
   b. 0.1%
   c. About 18%
   d. 30%

5. Regarding gender differences and OSA:
   a. None have been described
   b. Women report more insomnia
   c. The overall incidence is greater among women
   d. Women infrequently snore
6. Pain management in the post-operative period should NOT include:
   a. Regional analgesic techniques
   b. Local anesthetics
   c. Concurrent administration of benzodiazepines
   d. NSAIDS

7. Practical pre- and peri-operative interventions that can improve the obstructive symptoms of a patient with OSA include:
   a. CPAP and BiPAP
   b. Weight gain
   c. Supine positioning
   d. All of the above

8. Polysomnography:
   a. Incorporates EEG, EMG, EOG and ECG
   b. Grades severity of OSA as an AHI
   c. Is complicated and time-consuming
   d. All of the above

9. ASA preoperative risk score in the evaluation of the OSA patient examines all of the following except:
   a. Severity of sleep apnea
   b. Alcohol and smoking history
   c. Invasiveness of the surgical procedure
   d. Requirement for postoperative opioids

10. Which of the following is a true statement regarding discharging a patient with OSA?
    a. Patient may be discharged if O2 saturation is normal while breathing room air in an unstimulated environment.
    b. Patient may be discharged if respirations are normal while receiving supplemental oxygen.
    c. Patient may be discharged as soon as pain is well controlled.
    d. All OSA patients should be discharged with CPAP.