Evaluation and Management of Obstructive Sleep Apnea in the Perioperative Period

Clinical Committee
Society of Anesthesia and Sleep Medicine
Goals

1. Introduction
2. Preoperative Evaluation
3. Intraoperative Risk Mitigation
4. Postoperative Management
5. Follow-up Care After Discharge
Introduction & Background
Obstructive Sleep Apnea (OSA)

• OSA is a breathing disorder during sleep characterized by repetitive collapse of the upper airway

• Bed partners complain of snoring, observed apneas, choking/gasping, or restless sleep

• Daytime symptoms secondary to disrupted sleep include sleepiness, fatigue, memory loss and poor concentration
OSA Prevalence

• Obstructive Sleep Apnea (OSA) is a common condition. Estimated prevalences:
  • As defined by an apnea hypopnea index (AHI) ≥5 events per hour measured by polysomnogram
    • 20-30% in males
    • 15% in females
  • As defined by AHI ≥5/hr and at least one symptom of disturbed sleep (e.g. daytime sleepiness), or if AHI is ≥15/hr
    • 15% in males
    • 5% in females

Peppard, et al; Am J Epidemiol 2013
Complications of OSA

• Impaired daytime function and cognition

• Cardiovascular morbidity
  - HTN
  - CAD
  - CVA
  - CHF
  - Arrhythmias

• Diabetes and metabolic syndrome

• Perioperative complications

• Increased all-cause mortality
Perioperative Complications in OSA

• Patients with OSA are at higher risk for perioperative complications (all listed are statistically significant)
  • Respiratory complications:
    • acute respiratory failure (OR 2.4), postop $O_2$ desaturation (OR 2.3) (Kaw, et al; Br J Anaesth 2012)
    • intubation/mechanical ventilation (10.8 vs 5.9%), aspiration pneumonia (2.8 vs. 2.1%), ARDS (3.8 vs. 2.4%) (Memtsoudis, et al; Anesth Analg 2011)
  • Cardiac complications:
    • Myocardial infarction/ischemia (OR 2.1) (Kaw, et al; Br J Anaesth 2012), atrial fibrillation (OR 1.25) (Mokhlesi, et al; Obes Surg 2013)
Perioperative Complications in OSA

• Patients with OSA are at higher risk for perioperative complications (all listed are statistically significant)
  • ICU transfer (OR 2.81) (Kaw, et al; Br J Anaesth 2012)
  • Postoperative delirium (OR 4.3) (Flink, et al; Anesthesiology 2012)
  • Wound hematoma (OR 1.36) and pulmonary embolism (OR 2.1) (D’Apuzzo, et al; J Arthroplasty 2012)
  • Longer hospital stay after joint arthroplasty (6.8 vs. 5.1 days) (Gupta, et al; Mayo Clin Proc 2001)
Perioperative Mortality

- There is no clear association between OSA and perioperative mortality
  - **Increased mortality:** 258,455 joint arthroplasty revisions patients identified with OSA in the Nationwide Inpatient Sample (NIS) database (D’Apuzzo, et al; J Arthroplasty 2012)
  - **No change in mortality:** 30 days or one year in ~15,000 surgical patients at-risk for OSA by questionnaires at a single institution (Lockhart, et al; Sleep Med 2013)
  - **No change in mortality:** 84,655 patients undergoing lumbar fusion identified with OSA in Premier Perspective database (Stundner et al, Bone Joint J 2014)
  - **Reduced mortality:** 1,058,710 patients undergoing elective orthopedic, abdominal, and cardiovascular surgery using NIS database (Mokhlesi, et al; Chest 2013)
  - **Reduced mortality:** 91,028 patients undergoing bariatric surgery using NIS database (Mokhlesi, et al; Obes Surg 2013)

**caveat – none of these studies required polysomnography-confirmed OSA**
Perioperative Factors That Aggravate OSA Condition

- Sedation, analgesia, and anesthesia all reduce central respiratory drive, upper airway protective reflexes and arousal responses
- Upper airway narrowing due to post-intubation edema, nasal packings, nasal tubes or hematomas
- Forced supine position
- Sleep deprivation
- REM rebound following surgery
- Inability to use CPAP due to multiple factors (pain, nausea, tubes, and absence of equipment, properly fitting masks, or personnel)
Obesity Hypoventilation Syndrome (OHS)

- **Triad**
  - Sleep disordered breathing
  - BMI $\geq 30$ kg/m$^2$
  - Daytime hypoventilation ($\text{paCO}_2 \geq 45$ mmHg)

- **Prevalence**
  - General population is 3 in 1000
  - In patients with OSA, 1 in 10

- **Surgical mortality as high as 8%**

Chau, et al; Anesthesiology 2012
Preoperative Evaluation
Preoperative Identification of OSA

- Screening for OSA is recommended as part of a pre-anesthesia and pre-surgical plan (ASA Task Force; Anesthesiology 2014)
- Ideally, screening should take place prior to referral for elective surgery
- Timing and methods for screening are not standardized
- A screening program should identify patients at-risk for OSA to help guide clinical decision making
- Screening questionnaires and oximetry are commonly used
- A true diagnosis of OSA by either polysomnography (PSG) or home sleep apnea testing (HSAT) is required to prescribe PAP therapy for home use
OSA Screening Questionnaires

These have all been used in the preoperative arena:

- **STOP-Bang Questionnaire (SBQ)** (Chung, et al; Anesthesiology 2008)
- **Berlin Questionnaire** (Chung, et al; J Clin Anesth 2007)
- **Sleep Apnea Clinical Score (SACS)** (Gali, et al; Anesthesiology 2009)
- **American Society of Anesthesiologists Checklist** (Chung, et al; Anesthesiology 2008)
- **Perioperative Sleep Apnea Prediction Score (P-SAP)** (Ramachandran, et al; Anesthesia and Analgesia 2010)
### STOP-Bang Questionnaire (SBQ)

1) **STOP-Bang Questionnaire** ([www.stop-bang.ca](http://www.stop-bang.ca))[^7]

<table>
<thead>
<tr>
<th>Question</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Snoring: Do you snore loudly (loud enough to be heard through closed doors)?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>2. Tired: Do you often feel tired, fatigued, or sleepy during daytime?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>3. Observed: Has anyone observed you stop breathing during your sleep?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>4. Blood Pressure: Do you have or are you being treated for high blood pressure?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>5. BMI: BMI more than 35 kg m^{-2}?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>6. Age: Age over 50 yr old?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>7. Neck circumference: Neck circumference &gt;40 cm?</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>8. Gender: Male?</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

High risk of OSA: Yes to 5-8 questions.
Intermediate risk of OSA: Yes to 3-4 questions.
Low risk of OSA: Yes to 0-2 questions.

[^7]: Questionnaire reproduced with permission from Dr. Chung.
Improving STOP-Bang Specificity

Serum Bicarbonate ≥ 28 mmol/L
Increases specificity to 80-85% (from 27-27%)

Chung F, et al; Br J Anaesth 2012
Chung F, et al; Chest 2013

0-2: Low Risk
3-4: Intermediate Risk
5-8: High Risk
Overnight Oximetry

- Oxygen desaturation index (ODI) is a sensitive and specific tool to detect sleep-disordered breathing in surgical patients (Chung, et al; Anesth Analg 2012)
- However, oximetry is a screening tool, and does not establish a diagnosis of OSA

Repeated saw tooth oscillations are suggestive of sleep-disordered breathing
Polysomnography (PSG)

- Gold standard for diagnosis of sleep apnea, and for titration of positive airway pressure (PAP)
- Is the modality of choice if the patient has significant comorbid medical conditions (such as cardiopulmonary disease), and/or if the timing of surgery is not an important factor
- Allows for precise determination of PAP settings
Disadvantages of PSG in the Preoperative Setting

- More expensive than other diagnostic modalities
- Wait times may preclude testing in a timely manner, particularly in urgent preoperative settings
- OSA may be worse in the post-anesthesia setting, rendering PSG-determined PAP settings potentially less meaningful
- Access to such testing may be limited in certain areas
# Home Sleep Apnea Testing (HSAT)

<table>
<thead>
<tr>
<th></th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td>Sleep Technician attended PSG</td>
<td>Unattended PSG at home</td>
<td>Unattended Cardiopulmonary test</td>
<td>Unattended single or dual channel test</td>
</tr>
<tr>
<td><strong>Parameters measured</strong></td>
<td>Minimum 7, including EEG, EMG, EOG, resp effort, O&lt;sub&gt;2&lt;/sub&gt; sat, airflow, HR or rhythm</td>
<td>Minimum 7, including EEG, EMG, EOG, resp effort, O&lt;sub&gt;2&lt;/sub&gt; sat, airflow, HR or rhythm</td>
<td>Minimum 4, including 2 respiratory (effort and flow), O&lt;sub&gt;2&lt;/sub&gt; sat, and a cardiac variable</td>
<td>Minimum 1 include O&lt;sub&gt;2&lt;/sub&gt; sat, airflow or chest movement</td>
</tr>
<tr>
<td><strong>Can determine sleep stages</strong></td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Body position</strong></td>
<td>Documented or objectively measured</td>
<td>Possible</td>
<td>Possible</td>
<td>No</td>
</tr>
<tr>
<td><strong>Leg movement</strong></td>
<td>EMG or motion sensor</td>
<td>Optional</td>
<td>Optional</td>
<td>No</td>
</tr>
<tr>
<td><strong>Intervention during study</strong></td>
<td>Possible</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Adapted from Ferber et al, Sleep 1994
Home Sleep Apnea Testing (HSAT): Advantages

- Testing can be done in the home environment
- Generally more accessible than PSG
- Devices are mostly easy to use
- Is less expensive than in-lab testing
- Acceptable diagnostic accuracy in perioperative context, especially if PSG not feasible.

Finkel KJ, et al; Sleep Medicine 2009
Chung F, et al; Sleep Breath 2011
Home Sleep Apnea Testing (HSAT): Disadvantages

- Not indicated in patients with significant co-morbid conditions with risk of hypoventilation (i.e. Neuromuscular disease, COPD) or central apneas (i.e. CHF)

- Carry about a 15% false negative rate. With a high pretest probability and negative HSAT, repeat testing or in-lab testing is recommended

- 10-15% technical failure rate

- Cannot make therapeutic interventions during the study
# When Should a Sleep Medicine Consultation be Considered?

**Known OSA**

1. Noncompliant with treatment
2. Technical difficulty with equipment
3. Significant weight gain / loss (i.e. 10%)
4. Recent exacerbation of symptoms despite therapy
5. Undergone upper airway surgery and no longer on therapy
6. Follow-up after surgery

**Suspected OSA**

1. High probability of OSA on screening test *and*
   - A. Significant comorbidities (e.g. stroke, morbid obesity, uncontrolled HTN, heart failure) *or*
   - B. Major elective surgery requiring optimization
2. Follow-up after surgery due to long-term health risks of untreated OSA
Preoperative PAP Therapy

- Recommended by ASA Taskforce (and others) in patients with known OSA (ASA Task Force, Anesthesiology 2014)
- Controversial in patients at-risk for but not yet diagnosed with OSA
  - There is limited evidence on outcomes other than postoperative AHI and O₂ saturation (Lia P et al, Anesth 2013)
  - It may delay surgery
  - May incur additional cost
  - Optimal duration for PAP therapy preop is unknown
Intraoperative Risk Mitigation
Intraoperative Issues

- Sensitivity to Anesthesia Agents
- Difficult Airway
- Upper Airway Obstruction
- Obesity
- GERD
- Opioid-Induced Ventilatory Impairment
<table>
<thead>
<tr>
<th>Anesthetic Concern</th>
<th>Principles of Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premedication</td>
<td>- Avoid sedating premedication</td>
</tr>
<tr>
<td></td>
<td>- Consider alpha-2 adrenergic agonists (dexmedetomidine)</td>
</tr>
<tr>
<td>Potential difficult airway (difficult mask ventilation and tracheal intubation)</td>
<td>- Optimal positioning (Head Elevated Laryngoscopy Position-HELP) if the patient is obese</td>
</tr>
<tr>
<td></td>
<td>- Adequate preoxygenation</td>
</tr>
<tr>
<td></td>
<td>- Consider CPAP preoxygenation</td>
</tr>
<tr>
<td></td>
<td>- Two-handed triple airway maneuvers</td>
</tr>
<tr>
<td></td>
<td>- Anticipate difficult airway. Personnel familiar with a specific difficult airway algorithm</td>
</tr>
<tr>
<td>GERD</td>
<td>- Consider proton pump inhibitors, antacids, rapid sequence induction with cricoid pressure</td>
</tr>
</tbody>
</table>

Adapted from Olson E, et al. Up-To-Date 2014
Head Elevated Laryngoscopy Position (patient)

Reverse Trendelenburg Position (OR table)

## Intraoperative Risk Mitigation

<table>
<thead>
<tr>
<th>Anesthetic Concern</th>
<th>Principles of Management</th>
</tr>
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</table>
| Opioid-related respiratory depression                  | - Minimize opioid use  
- Use of short-acting agents (remifentanil)  
- Multimodal approach to analgesia (NSAIDs, acetaminophen, tramadol, ketamine, gabapentin, pregabalin, dexmedetomidine, clonidine, Dexamethasone, melatonin)  
- Consider local and regional anesthesia where appropriate |
| Carry-over sedation effects from longer-acting intravenous and volatile anesthetic agents | - Use of propofol / remifentanil for maintenance of anesthesia  
- Use of insoluble potent anesthetic agents (desflurane)  
- Use of regional blocks as a sole anesthetic technique |

Adapted from Olson E, et al. Up-To-Date 2014
# Intraoperative Risk Mitigation

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<th>Anesthetic Concern</th>
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<tbody>
<tr>
<td>Excessive sedation in monitored anesthetic care</td>
<td>- Use of intraoperative capnography for monitoring of ventilation</td>
</tr>
<tr>
<td>Post-extubation airway obstruction</td>
<td>- Verify full reversal of neuromuscular blockade</td>
</tr>
<tr>
<td></td>
<td>- Extubate only when fully conscious and cooperative</td>
</tr>
<tr>
<td></td>
<td>- Non-supine posture for extubation and recovery</td>
</tr>
<tr>
<td></td>
<td>- Resume use of positive airway pressure device after surgery</td>
</tr>
</tbody>
</table>

Adapted from Olson E, et al. Up-To-Date 2014
Operating Room and PACU

• Consider extubation only when awake
• Place patients in semi-upright position prior to extubation
• If known or at high-risk for OSA, notify all members of care team (from bedside staff to pharmacy personnel)
• OSA post-care algorithms should be enacted

PACU

• Consider use of a sedation scale (e.g., Richmond Agitation Sedation Scale) to guide management

• Avoid systemic opioids, if possible. If necessary, titrate long acting opioids to the lowest dose that works.

• Consider lateral decubitus position post-extubation, if feasible

PACU

• Observe patients for apneic episodes, increased FIO$_2$ requirements, pain-sedation mismatch, or episodes of desaturation.

• Patients with recurrent events may be at higher risk of postoperative complications

Gali, B et al; Anesthesiology2009
### PACU Evaluation

<table>
<thead>
<tr>
<th>Event</th>
<th>Initial Evaluation</th>
<th>2nd Evaluation</th>
<th>3rd Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Bradypnea:</strong> &lt; 8 respirations/minute (3 episodes needed for yes)</td>
<td>30 min. after extubation or PACU admit (whichever occurs later)</td>
<td>30 min. after initial eval. (60 min after extubation or PACU admit)</td>
<td>30 min. after 2nd eval. (90 min after extubation or PACU admit)</td>
</tr>
<tr>
<td><strong>Apnea:</strong> ≥ 10 seconds (only 1 episode needed for yes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Desaturations:</strong> Pulse Ox &lt;90% with nasal cannula (3 episodes needed for yes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pain/Sedation mismatch:</strong> RASS score -3 thru -5 and Pain scale score &gt; 5 (only 1 episode needed for yes)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RASS = Richmond Agitation-Sedation Scale  
Pain Score = Visual Analog Score  
Recurrent events: if any event occurs at more than one evaluation period (not necessary to be same event)

**Recurrent events are associated with higher risk of postoperative complications**

Gali, B et al; Anesthesiology 2009
PACU

• Patients considered high risk from PACU
  • Consider enhanced monitoring
    • Monitored setting (e.g. a step down unit)
    • Continuously monitored oximetry
  • Interventions to optimize
    • Elevate head of bed
    • Nasal trumpet
    • Implementation of PAP therapy

PACU - Known OSA

• Patients with known OSA on therapy should be placed on their PAP therapy, either:
  • Home machine
  • Hospital machine set to home settings
  • Autoadjusting CPAP (Sleep Medicine can help with settings)

• Obstructive events witnessed while on PAP therapy
  • Will need to consider adjustment of PAP settings

PACU-Ambulatory

• Ambulatory facilities
  • Should prepare for the need for interventions
  • Transfer agreements with inpatient facilities should be in place
  • Consider transfer of patients with ongoing respiratory issues or need for high dose opioids

Postoperative Care
Post-Operative Changes in Sleep Disordered Breathing

- Apnea Hypopnea Index (AHI) is increased after surgery in both OSA and non-OSA patients
- The peak increase in AHI occurs on post-op day 3
- The central apnea index is increased on post-op day one in non-OSA patients
- Disturbances in sleep architecture are greatest on post-op day one

Chung, et al; Anesthesiology 2014
High Risk Patients Include

Extra PACU monitoring (Aldrete criteria met + 60 min)

Diagnosed OSA
- AHI > 30, or
- Significant comorbidities, or
- Non-compliance with PAP, or
- Recurrent PACU respiratory events, or
- Post-op parenteral opioids

Suspected OSA
- STOP-Bang ≥ 5 and
- Recurrent PACU respiratory events, or
- Post-op parenteral opioids

Adapted from Olson E, et al. Up-To-Date 2014
Oxygen Therapy

• There are multiple potential causes of hypoxemia
  • Assess for causes other than untreated OSA
  • $O_2$ may be needed to prevent hypoxemia

• However, $O_2$ may prolong apneas in some individuals

• And $O_2$ may mask hypercapnia
  • Especially in obesity-hypoventilation syndrome or overlap syndrome (OSA/COPD)

Respiratory Depression After PACU

- Floor team should have understanding of OSA concerns
  - Naloxone should be readily available for patients receiving opioids
  - Respiratory compromise should lead to transfer to a higher level of care

Monitoring

- Ideal location for monitoring and parameters to be monitored have not been clearly established

- ICU, step-down units, or general ward beds with monitoring capability may be appropriate, depending on:
  - Type of surgery and anesthesia
  - Analgesic requirements (e.g. PCA)
  - Comorbid conditions
  - Severity of OSA

Monitoring

- Continuous pulse oximetry is often recommended
- Oximetry does not detect hypercapnia
- Continuous capnography is an emerging technology that may assist in management
- Other emerging technologies:
  - Monitoring respiratory rate (by plethysmography or acoustic monitoring)
  - Minute ventilation

Monitoring

• Monitoring algorithms must be created using a team approach
  • Nursing staff are on the front line as far as responding to alarms
  • Appropriate alarm thresholds must be determined
  • Alarm fatigue is an issue; any system that causes too many false alarms will not be utilized
  • Education is required on a local level

Potential Issues with Alarm Fatigue - Possible Sequence of Events

Figure 4. Type III Pattern: Note the Potential for Alarm Fatigue Preceding Arousal Failure.

Continued dips below alarm threshold can lead to alarm fatigue and inability to recognize acute decompensation

Curry JP, et al; APSF Newsletter Vol 26(2);Fall 2011.p.34
Follow-up Care and Patient Disposition
Follow-up Care After Discharge

- Caution should be used with sedatives and opioids on discharge in patients with suspected OSA
- Sleep apnea is a chronic medical condition and needs chronic care
- Patients with suspected OSA should be referred to their PCP or a Sleep Specialist for further evaluation

Follow-up Care After Discharge

• Patients with known OSA should be educated at the time of discharge
  • To wear their PAP whenever sleeping
  • Use the smallest possible dose of opioids

• PAP therapy cannot be prescribed for home use unless a definite diagnosis of sleep apnea has been made (by either a Home Sleep Apnea Test or a Polysomnogram) at some point