Perioperative Management of Obstructive Sleep Apnea

Charles W. Atwood Jr, MD, FCCP, FAASM
Associate Professor of Medicine
Director, Sleep Medicine Program, VA Pittsburgh Healthcare System;
Sleep Medicine Fellowship Director, University of Pittsburgh

NAMDRC 2014 Annual Conference
DISCLOSURE

Dr. Atwood has received research grants from Forest, Medimmune, Vapotherm and the Department of Defense and serves as a consultant for Carecore National and Philips, but these do not create a conflict related to the following presentation.
My Disclosures

Research Support (past 3 years)
Industry:
  – Vapotherm
  – Forest Research Institute
  – Medimmune
Advisory:
  - Care Core National
  - Philips-Respironics
  - Vapotherm
Directorships:
  - ABIM Pulmonary Board
  - Board of Registered Polysomnographic Technologists (BRPT)
  - World Assoc of Sleep Medicine
  - NAMDRC, Sec- Treasurer
Outline

• Background
• Perioperative Complications Associated with OSA
• Assessing Risk
• Stratifying Risk
• Mitigating Risk
• UPMC Pilot & Beyond
Question 1

How much of a problem do you perceive OSA in the perioperative period to be?

A. A large problem
B. A moderate problem
C. A small problem
D. No problem at all
How much of a problem do you perceive OSA in the perioperative period to be?

A. A large problem
B. A moderate problem
C. A small problem
D. No problem at all
Pathogenesis of Obstructive Sleep Apnea

Promotion of Airway Collapse

- Negative pressure on inspiration
- Extralumenal positive pressure
- Fat deposition
- Small mandible

Promotion of Airway Patency

- Pharyngeal dilator muscle contraction (genioglossus)
- Lung volume (longitudinal traction)

Risk mediated by the interaction of:
- **Genes** (Obesity, Craniofacial Structure, Respiratory Control)
- **Environment** (Obesity)

AJRCCM 2005 172:1363–1370
Obesity is now a bigger problem than malnutrition

- Deaths due to obesity now occur at three times the rate of deaths due to malnutrition.
- Globally, obesity is a bigger threat than malnutrition in every region aside from sub-Saharan Africa.
- Obesity has risen from the 10th most significant health risk factor in 1990 to 6th

Increased Prevalence of Sleep-Disordered Breathing in Adults

- The current prevalence estimates of moderate to severe sleep-disordered breathing (apnea-hypopnea index, measured as events/hour, ≥15) are:
  - 10% (95% CI: 7, 12) among 30–49-year-old men
  - 17% (95% CI: 15, 21) among 50–70-year-old men
  - 3% (95% CI: 2, 4) among 30–49-year-old women
  - 9% (95% CI: 7, 11) among 50–70 year-old women

- These estimated prevalence rates represent substantial increases over the last 2 decades - relative increases of between 14% and 55% depending on the subgroup

- The Prevalence of OSA is estimated to be 25% in candidates for elective surgery

- The Prevalence of OSA may be as high as 80% in Bariatric patients

Am J Epidemiol. 2013;177(9):1006–1014
NEJM 2013 368: 2352-2353
OSA and Cardiovascular Disease

- Primary HTN: 35% prevalence
- Drug-resistant HTN: 65 to 80% prevalence
  - Most common secondary cause
- Coronary Artery Disease: 30% prevalence
- Heart failure: 21-37% prevalence
- Atrial Fibrillation: OSA present 5 X more likely
- Stroke: 60% prevalence

Circulation 2012;126:1495-1510
SDB, irrespective of EDS, was associated with increased mortality.

The striking high CV mortality risk in untreated severe SDB, suggests that SDB Rx should not be contingent on daytime sleepiness symptoms.
Rationale for Multidisciplinary Model for Peri-operative Management of Sleep Apnea

• OSA is common and significant risk for respiratory, cardiovascular and cerebrovascular events
• Post-op complications in OSA patients nearly double
• Recent high profile cases of morbidity and mortality places spotlight on impact of under-diagnosed OSA, particularly in combination with peri-operative anesthetics, narcotics and other sedatives
• ASA Practice Guidelines from 2006 recommended screening for OSA prior to surgery
• Since then-some proliferation of OSA screening, but virtually no comprehensive peri-operative management programs

Chung F et al, Anesth Analg, 2008
Outline

- Background
- Perioperative Complications Associated with OSA
- Assessing Risk
- Stratifying Risk
- Mitigating Risk
- UPMC Pilot & Beyond
Incidence of respiratory complications for patients with and without sleep apnea

CONCLUSION: Sleep Apnea is an independent risk factor for perioperative pulmonary complications.

Anesth Analg 2011;112:113–21
Perioperative outcomes among patients undergoing noncardiac surgery (NCS)


Design: Retrospective observational cohort

Results: Out of a total of 1,759 patients who underwent both PSG and NCS, 471 met the study criteria. 282 patients had OSA, and 189 served as control subjects.

The presence of OSA was associated with a higher incidence of:

- Postoperative hypoxemia \( \text{OR}, 7.9; P = .009 \)
- Overall complications \( \text{OR}, 6.9; P = .003 \)
- ICU transfer \( \text{OR}, 4.43; P = .069 \)
- Longer hospital length of stay \( \text{OR}, 1.65; P = .049 \)

CHEST 2012; 141(2):436–441
Meta-analysis of the association between obstructive sleep apnea and postoperative outcome

### Postoperative ICU transfer

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>OSA Events</th>
<th>OSA Total</th>
<th>Non-OSA Events</th>
<th>Non-OSA Total</th>
<th>Weight</th>
<th>Odds Ratio M-H, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chung 2008</td>
<td>12</td>
<td>147</td>
<td>1</td>
<td>64</td>
<td>7.1%</td>
<td>5.60 [0.71, 44.02]</td>
</tr>
<tr>
<td>Finkel 2009</td>
<td>1</td>
<td>661</td>
<td>0</td>
<td>2117</td>
<td>3.6%</td>
<td>9.62 [0.39, 236.37]</td>
</tr>
<tr>
<td>Gali 2007</td>
<td>5</td>
<td>115</td>
<td>0</td>
<td>25</td>
<td>4.2%</td>
<td>2.54 [0.14, 47.39]</td>
</tr>
<tr>
<td>Gali 2009</td>
<td>16</td>
<td>221</td>
<td>9</td>
<td>472</td>
<td>17.3%</td>
<td>4.02 [1.75, 9.24]</td>
</tr>
<tr>
<td>Gupta 2001</td>
<td>22</td>
<td>101</td>
<td>8</td>
<td>101</td>
<td>17.0%</td>
<td>3.24 [1.37, 7.67]</td>
</tr>
<tr>
<td>Hallowell 2007</td>
<td>20</td>
<td>454</td>
<td>23</td>
<td>436</td>
<td>19.9%</td>
<td>0.83 [0.45, 1.53]</td>
</tr>
<tr>
<td>Kaw 2006</td>
<td>4</td>
<td>37</td>
<td>14</td>
<td>185</td>
<td>13.6%</td>
<td>1.48 [0.46, 4.78]</td>
</tr>
<tr>
<td>Kaw 2009</td>
<td>21</td>
<td>270</td>
<td>3</td>
<td>202</td>
<td>13.1%</td>
<td>5.59 [1.65, 19.02]</td>
</tr>
<tr>
<td>Vasu 2010</td>
<td>4</td>
<td>56</td>
<td>0</td>
<td>79</td>
<td>4.1%</td>
<td>13.63 [0.72, 258.43]</td>
</tr>
</tbody>
</table>

**Total (95% CI)**
- Events: 2062
- Total: 3681
- Weight: 100.0%

**Total events**: 105

**58**

**Heterogeneity**: $\tau^2 = 0.47$; $\chi^2 = 18.40$, df = 8 (P = 0.02); $I^2 = 57$

**Test for overall effect**: $Z = 3.08$ (P = 0.002)

---

British Journal of Anesthesia 2012 109:897-906
The consultants agree that pre-procedure identification of a patient’s OSA status improves perioperative outcomes, and they are equivocal regarding whether overall costs are decreased.

The severity of the patient’s OSA, the invasiveness of the diagnostic or therapeutic procedure, and the requirement for postoperative analgesics should be taken into account in determining whether a patient is at increased perioperative risk from OSA.

Anesthesiologists should work with surgeons to develop a protocol whereby patients in whom the possibility of OSA is suspected on clinical grounds are evaluated long enough before the day of surgery to allow preparation of a perioperative management plan.
Who is Ready?

• The Joint Commission National Patient Safety Goals: Hospitals have a plan to reduce the risk of post-operative complications in OSA

• In 2007, only 4% of respondents stated that their hospital had any protocol for the peri-post-operative management of sleep apnea patients

Question 2

Which of the following likely best explains the increasing prevalence of sleep apnea?

A. Increase in opiate prescribing
B. More sensitive diagnostic testing
C. Home sleep apnea testing allowing for more patients to be diagnosed
D. Increasing prevalence of obesity and aging
Which of the following likely best explains the increasing prevalence of sleep apnea?

A. Increase in opiate prescribing
B. More sensitive diagnostic testing
C. Home sleep apnea testing allowing for more patients to be diagnosed
D. Increasing prevalence of obesity and aging

![Bar chart showing percentages: 96% for D, 2% for B and C, 0% for A.]

A. B. C. D.
96%
2%
2%
Outline

• Background
• Perioperative Complications Associated with OSA
• Assessing Risk
• Stratifying Risk
• Mitigating Risk
• UPMC Pilot & Beyond
Diagnosis of OSA: The Problem

- Nearly 90% of Cases of OSA are undiagnosed
  
- Disparities (especially in women and in those with lower BMI) exist between current recognition rates for OSA and the estimated prevalence by symptom report across the United States

- In standardized patient interview (OSCE) only 10% of primary care physicians asked questions relevant to OSA

---

1 IOM Report 2006
2 Sleep & Breathing 2002 6:49-54
3 Sleep 2004 27:1518-25
## How to screen?

<table>
<thead>
<tr>
<th></th>
<th>STOP BANG</th>
<th>Berlin</th>
<th>ASA</th>
<th>SACS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AHI &gt;5</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sens</td>
<td>88.0</td>
<td>68.9</td>
<td>72.1</td>
<td></td>
</tr>
<tr>
<td>Spec</td>
<td>53.0</td>
<td>56.4</td>
<td>38.2</td>
<td></td>
</tr>
<tr>
<td><strong>AHI&gt;15</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sens</td>
<td>93.0</td>
<td>78.6</td>
<td>78.6</td>
<td></td>
</tr>
<tr>
<td>Spec</td>
<td>35.0</td>
<td>50.5</td>
<td>37.4</td>
<td></td>
</tr>
<tr>
<td><strong>AHI&gt;20</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sens</td>
<td></td>
<td></td>
<td>76.0</td>
<td></td>
</tr>
<tr>
<td>Spec</td>
<td></td>
<td></td>
<td>54.0</td>
<td></td>
</tr>
</tbody>
</table>

- The ASA has the high sensitivity but the lowest specificity
- The STOP BANG has the highest sensitivity for moderate to severe disease
- Post op respiratory complications were best predicted by the STOP BANG and ASA questionnaires

SLEEP 2000 23: 929-38
Anesthesiology 2008 108:822–30
JAMA 2013 310:731-41
## STOP–Bang Questionnaire

<table>
<thead>
<tr>
<th>STOP</th>
<th>Description</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>S (snore)</td>
<td>Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>T (tired)</td>
<td>Do you often feel tired, fatigued, or sleepy during daytime?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>O (observed)</td>
<td>Has anyone observed you stop breathing during sleep?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>P (blood pressure)</td>
<td>Do you have or are you being treated for high blood pressure?</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BANG</th>
<th>Description</th>
<th>Yes/No</th>
</tr>
</thead>
<tbody>
<tr>
<td>B (body mass index [BMI])</td>
<td>$BMI &gt; 35 \text{ kg/m}^2$?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>A (age)</td>
<td>Age &gt; 50 years?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>N (neck)</td>
<td>Neck circumference &gt; 40 cm?</td>
<td>Yes/No</td>
</tr>
<tr>
<td>G (gender)</td>
<td>Gender male?</td>
<td>Yes/No</td>
</tr>
</tbody>
</table>

- Fewer than 3 questions positive: low risk of OSA
- 3 or more questions positive: high risk of OSA
- 5 to 8 questions positive: high probability of moderate-to-severe OSA

Br J Anaesth 2012;108:768–75
Outline

- Background
- Perioperative Complications Associated with OSA
- Assessing Risk
- Stratifying Risk
- Mitigating Risk
- UPMC Pilot & Beyond
Stratifying Risk: PSG vs. Home Sleep Testing

Attended In-Lab Study

Unattended Home Study
Portable Monitor for Out of Center Sleep Testing

Detailed Signal View

Full night view

Signals:
- Nasal flow
- Snore
- Respiratory effort
- Oxygen saturation
- Pulse

Expanded view

Signals: (Selectable)
- Nasal flow
- Respiratory effort
- Oxygen saturation
- Pulse

Adjustable signal amplitude

Selectable time

Time select bar
Event type selection
Desirable Features for HSAT devices

• KISS
• Durable
• Inexpensive, including consumable supplies
• Good software, prefer auto-scoring
• Can fit in an UPS or Fed-ex mailer
Outline

• Background
• Perioperative Complications Associated with OSA
• Assessing Risk
• Stratifying Risk
• Mitigating Risk
• UPMC Pilot & Beyond
**AIM:** Observational study to compare incidence of fatal and non-fatal cardiovascular events in simple snorers, patients with untreated OSA, patients treated with CPAP, and healthy men recruited from the general population.

**Design:** Prospective observational cohort. 264 healthy men, 377 simple snorers, 403 with untreated mild-moderate OSA (AHI 5-30), 235 with untreated severe OSA (AHI > 30), and 372 with OSA and treated with CPAP.

**Conclusion:** In men, severe OSA significantly increases the risk of fatal and non-fatal cardiovascular events. CPAP treatment reduces this risk.

*Lancet 2005 365: 1046–53*
Does acute introduction of CPAP / Bi-Level Preoperatively Impact Risk?

- **CPAP Adherence Peri-operatively is poor**
  - *JCSM 2012 8:501-506* “CPAP Adherence in Patients with Newly Diagnosed Obstructive Sleep Apnea prior to Elective Surgery

- **CPAP use Pre-op did not have an association with post op complications**

- **Auto-titrating CPAP has had no significant impact on outcomes**
  - *Anesthesiology 2002 96:817-26* “Automatic CPAP Compared with Conventional Treatment for Episodic Hypoxemia and Sleep Disturbance after Major Abdominal Surgery”
  - *Chest 2013 144:72-78* “Does Auto-titrating Positive Airway Pressure Therapy Improve Postoperative Outcome in Patients at Risk for Obstructive Sleep Apnea Syndrome? A Randomized Controlled Clinical Trial”
The Relationship of Self Reported Sleepiness to Sleep Apnea

n = 4653

J Clin Sleep Med 2010 6:196-204
What is the impact of anesthesia on risk?

- There were few adverse effects reported when patients with known OSA underwent elective surgery with currently available sedatives and anesthetics.
- Adverse events were reported with midazolam
- The quality and the number of studies were limited
- There is need for further trials with larger numbers and uniform reporting of outcomes

J of Anesthesia Clin Pharm 2011: 447-458
Question 3

Which of the following is true regarding OSA and peri-operative risk?

A. OSA is associated with a lower rate of post-operative myocardial infarction
B. Treatment of OSA decreases peri-operative complications in non-cardiac surgery patients
C. Screening for OSA with questionnaires is recommended by the Joint Commission
D. Sleep apnea screening questionnaires tend to be sensitive but not specific
Which of the following is true regarding OSA and peri-operative risk?

A. OSA is associated with a lower rate of post-operative myocardial infarction
B. Treatment of OSA decreases peri-operative complications in non-cardiac surgery patients
C. Screening for OSA with questionnaires is recommended by the Joint Commission
D. Sleep apnea screening questionnaires tend to be sensitive but not specific

A. 0%
B. 13%
C. 3%
D. 85%

D. is correct.
Does enhanced monitoring impact risk?
Use of a Wireless Continuous Pulse Oximetry System for Improved Patient Safety on an Orthopedic Unit
Project Aim

- To determine the effectiveness of a wireless continuous pulse oximetry system in improving patient safety on a large orthopedic unit.
- The system combines pulse oximetry for $O_2$ saturation and pulse rate monitoring with wireless notification to nurses via pagers to provide direct patient surveillance.
- Data analyzed Feb 2012 to Feb 2013
- Compared to previous year (Feb. 2011 through Feb. 2012)
Masimo Continuous Pulse Oximetry

- Dedicated wireless paging system to communicate patient alarm conditions to the nurse
- 15 second delay in the bedside unit to allow patient time to correct
- After 15 seconds, audible bedside alarm sounds
- If persists for 15 seconds, the nurse is paged
- If nurse doesn’t respond within 60 seconds, the nurse and charge nurse will receive a page
- No response within 3 minutes, both pagers receive an alert
Indications for Use

• Patients on PCA pumps for duration of treatment
• Patients with OSA or suspected OSA
• All postoperative patients for first 24 hours postop
• Any patient specified by MD order
• Any patient as deemed necessary by nursing judgment
Patients Going to Monitored Beds Postop

• Previous year – 68 patients; average 5.6/month
• Intervention year – 34 patients; average 2.8/month
• 50% fewer patients going to monitored beds postop from PACU
Patients Transferred to Monitored Bed Later in Stay

- Previous year – 73 patients; average 6.1/month
- Intervention year – 45 patients; average 3.8/month
- 38% fewer patients being transferred to monitored beds later in their hospital stay

Condition C’s:
- Previous year – 27 Conditions (1-A, 26-Cs); average 2.25/month
- Masimo – 29 Conditions (all Cs); average 2.4/month
- 7% increase in the number of Conditions called/month
- Minimal increase, and has varied month to month over the course of the study period
Unanswered questions

For the surgical patient

• How much apnea confers risk?
• What is the best screening test for apnea is this population?
• How long should the apnea patient be treated pre-operatively to favorably modify perioperative risk?
• What is the most cost effective monitoring strategy post-operatively?
• What is the best intervention and how should it be implemented?
What more is needed to clarify the role of OSA and peri-operative complications?

• Better quality studies
  – RCT for pre-operative CPAP vs. treatment as usual
• More comprehensive evaluation programs –
• Standard definitions of complications and focus on important ones! (*is transient hypoxemia important?*)
Question 4

Based on this presentation, how convinced are you that peri-operative morbidity is influenced by OSA?

A. I am convinced
B. I am not convinced
C. I am not sure
Based on this presentation, how convinced are you that peri-operative morbidity is influenced by OSA?

A. I am convinced  
B. I am not convinced  
C. I am not sure