Pre-Operative Services Teaching Rounds 11
March 2011

Deborah Richman MBChB FFA(SA)
Director – Pre-Operative Services
Department of Anesthesia
Stony Brook University Medical Center, NY
drichman@notes.cc.sunysb.edu
Obstructive sleep apnea:

- Pathophysiology
- Comorbidities
- Screening
- Diagnosis
- Treatment

- Perioperative management
  - Testing
  - Location
  - Timing
  - Anesthesia plan
  - Post-operative disposition
    - Monitoring
    - treatment
Case

63 yr old lady for knee arthroscopy in ASC

PMH:
HTN, Obesity, GERD, OSA dx 4 months ago, not using CPAP

PSH:
Lap chole 2 years ago “difficulty waking up”

Meds:
Omeprazole, Atenolol, thiazide

Exam:
BMI 37, BP 140/90 P 65. No cardiac failure. Non-remarkable.
Definitions - Obstructive Sleep Apnea (OSA)

- Apnea: no airflow >10 sec
- Hypopnea: >50% reduction in flow >10 sec
- Secondary to obstruction,
  - There is an inspiratory effort
- Measured in polysomnography
- Daytime somnolence
OSA - missed

- Don’t ask
- Patients don’t consider it a disease
- No medication to ‘clue’ us in
Obstructive sleep apnea (OSA)

- Common 4-25% of males, 2-4% of females
  - Doubles if morbidly obese
  - 70-80% undiagnosed

- Central sleep apnea
- Obstructive sleep apnea
- Mixed sleep apnea

No animals have OSA except humans
Risk factors for OSA:

- Obesity
- Neck circumference
- Age / Menopausal status
- Male gender
- Genetic predisposition

- Nasal / pharyngeal obstruction
- Laryngeal obstruction
- Craniofacial abnormalities

- Alcohol, sedatives, smoking
- Medications and anesthesia

- Endocrine and metabolic causes
- Neuromuscular disorders
- Connective tissue disorders

Airway
- Small / receding mandible
- Buck teeth/posterior tongue
- Large tonsils
- High Mallimpati
Obstructive sleep apnea

- Tensor palatine
- Genioglossus
- Hyoid muscles – genio-/sterno-/thyro-
Pathophysiology

- Collapse of the upper airway
  - Structure
    - Obesity
    - Craniofacial abnormalities
  - Neuromuscular activity
    - Genioglossus – tone varies with phase of respiration
    - Decreased tone during sleep
    - Atonic during REM sleep
    - Resumes upon arousal
  - Loss of tone:
    - Apnea: no flow >10 sec
    - Hypopnea: >50% reduction in flow >10 sec
Chemo-responsiveness
- Altered genetically/drugs/alcohol

Compounded by long term hypoxia and hypercapnea which lead to:
- Altered control of breathing
- Altered hypoxic ventilatory response
- Altered response to carbon dioxide levels
Pathophysiology

- Obstruct - Apnea/hypopnea (loss of tone)
- Arousals
- Sympathetic (BP)
- Fixed BP change
- Ventricular hypertrophy / ischemia
- Arrhythmia / death
Effects of Sleep deprivation

- Irritability
- Cognitive impairment
- Memory lapses or loss
- Impaired moral judgement
- Severe yawning
- Hallucinations
- Symptoms similar to ADHD
- Impaired immune system
- Risk of diabetes Type 2
- Increased heart rate variability
- Risk of heart disease
- Decreased reaction time and accuracy
- Tremors
- Aches

Other:
- Growth suppression
- Risk of obesity
- Decreased temperature
Comorbidities:

- Obesity
- Airway
- GERD
- Hypertension
- Cardiac disease
- Cerebrovascular disease
- Pulmonary hypertension
- Type 2 Diabetes

- Poor sleep
  - Behavioral changes
  - Cognitive dysfunction
  - Personality abnormalities
  - Motor Vehicle Accidents
- Noisy sleep
  - Social isolation
OSA Screening

Stop and Bang (Chung 2008)
- Snoring
- Tiredness
- Observed apnea
- Pressure (BP)
- BMI (>35)
- Age (>50)
- Neck circumference >16” female/ >17” male (40cm)
- Gender (male)

(Berlin score / Flemons / ASA checklist / Epworth)
Berlin Questionnaire

Height _____ m  Weight _____ kg  Age_____  Male/Female

Please choose the correct response to each question.

Category 1
1. Do you snore?
   a. Yes  
   b. No  
   c. Don't know

If you snore:
2. Your snoring is:
   a. Slightly louder than breathing
   b. As loud as talking
   c. Louder than talking
   d. Very loud—can be heard in adjacent rooms

3. How often do you snore?
   a. Nearly every day
   b. 3–4 times a week
   c. 1–2 times a week
   d. 1–2 times a month
   e. Never or nearly never

4. Has your snoring ever bothered other people?
   a. Yes
   b. No
   c. Don't know

5. Has anyone noticed that you quit breathing during your sleep?
   a. Nearly every day
   b. 3–4 times a week
   c. 1–2 times a week
   d. 1–2 times a month
   e. Never or nearly never
Berlin Questionnaire (cont)

Category 2
6. How often do you feel tired or fatigued after your sleep?
   a. Nearly every day
   b. 3–4 times a week
   c. 1–2 times a week
   d. 1–2 times a month
   e. Never or nearly never

7. During your waking time, do you feel tired, fatigued, or not up to par?
   a. Nearly every day
   b. 3–4 times a week
   c. 1–2 times a week
   d. 1–2 times a month
   e. Never or nearly never

8. Have you ever nodded off or fallen asleep while driving a vehicle?
   a. Yes
   b. No
   If yes:
   9. How often does this occur?
      a. Nearly every day
      b. 3–4 times a week
      c. 1–2 times a week
      d. 1–2 times a month
      e. Never or nearly never

Category 3
10. Do you have high blood pressure?
    a. Yes
    b. No
    c. Don’t know
Scoring: Berlin Questionnaire
Adapted from table 2 in Netzer et al. 7
The questionnaire consists of three categories related to the risk of having OSA.

Categories and scoring:

Category 1: items 1, 2, 3, 4, and 5
Item 1: If yes is the response, assign 1 point.
Item 2: If c or d is the response, assign 1 point.
Item 3: If a or b is the response, assign 1 point.
Item 4: If a is the response, assign 1 point.
Item 5: If a or b is the response, assign 2 points.
Category 1 is positive if the total score is 2 or more points.

Category 2: items 6, 7, and 8 (item 9 should be noted separately)
Item 6: If a or b is the response, assign 1 point.
Item 7: If a or b is the response, assign 1 point.
Item 8: If a is the response, assign 1 point.
Category 2 is positive if the total score is 2 or more points.

Category 3 is positive if the answer to item 10 is yes or if the BMI of the patient is greater than 30 kg/m2.

High risk of OSA: two or more categories scored as positive
Low risk of OSA: only one or no category scored as positive
ASA Checklist
Adapted from Gross et al.

Category 1: Predisposing Physical Characteristics
a. BMI 35 kg/m2
b. Neck circumference 43 cm/17 inches (men) or 40 cm/16 inches (women)
c. Craniofacial abnormalities affecting the airway
d. Anatomical nasal obstruction
e. Tonsils nearly touching or touching the midline

Category 2: History of Apparent Airway Obstruction during Sleep
Two or more of the following are present (if patient lives alone or sleep is not observed by another person, then only one of the following need be present):
a. Snoring (loud enough to be heard through closed door)
b. Frequent snoring
c. Observed pauses in breathing during sleep
d. Awakens from sleep with choking sensation
e. Frequent arousals from sleep
ASA Checklist (cont)

**Category 3: Somnolence**
One or more of the following are present:

a. Frequent somnolence or fatigue despite adequate “sleep”
b. Falls asleep easily in a nonstimulating environment (e.g., watching TV, reading, riding in or driving a car) despite adequate “sleep”
c. [Parent or teacher comments that child appears sleepy during the day, is easily distracted, is overly aggressive, or has difficulty concentrating]*
d. [Child often difficult to arouse at usual awakening time]*

**Scoring:**
If two or more items in category 1 are positive, category 1 is positive.
If two or more items in category 2 are positive, category 2 is positive.
If one or more items in category 3 are positive, category 3 is positive.

*High risk of OSA: two or more categories scored as positive
Low risk of OSA: only one or no category scored as positive*
Obstructive Sleep Apnea
Clinical diagnosis: (No sleep study)

• Sleep disordered breathing (SDB)
  – Significant snoring
  – apnea

• Arousals
  – Extremity movement
  – Vocalization
  – Turning
  – Snoring

• Daytime somnolence
  – Full asleep driving/lectures/quiet times
Diagnosis

Polysomnography (PSG) is the gold standard

Done overnight in sleep center
Full night or split night with CPAP titration

Home testing
A Sensor at nose to measure air flow

Wires transmit data to a computer. A technician in a nearby room monitors the data.

Sensor on face and scalp measure eye movement and brain activity

Elastic belt sensors around chest and belly measure amount of effort to breath

B Polysomnogram record (over time)

<table>
<thead>
<tr>
<th>Blood oxygen level</th>
<th>Decrease in blood oxygen level after an event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breathing event</td>
<td>Height = length of event</td>
</tr>
<tr>
<td>REM sleep stage</td>
<td>Top levels = wake/REM sleep</td>
</tr>
<tr>
<td></td>
<td>Bottom levels = deep sleep</td>
</tr>
</tbody>
</table>
Polysomnography (PSG)

- Apnea hypopnea index (AHI)
  - <5 UARS (upper airways resistance syndrome)
  - Mild 5-15
  - Moderate 15-30
  - Severe >30
- Desaturations >4% considered significant
- Arousals (respiratory effort related arousal: RERA)

OSA vs. Central vs. mixed sleep apnea
Sleep architecture
OSA Treatment

**Weight loss**
- Drugs / alcohol avoidance
- Sleep hygiene
- Supportive

**CPAP**
- Appliances
- Surgery
  - T’s and A’s
  - Uvulopalatopharyngoplasty
  - Mandibular advancement

**Experimental - Neuromuscular stimulation**
CPAP

- EBM – severe OSA
- But even UARS feel better
- Reverses
  - Airway edema
  - metabolic syndrome
  - CV dysfunction
Mandibular advancement device
Perioperative factors

- Anesthesia agents:
  - Decrease pharyngeal tone
  - Depress ventilatory response to:
    - Hypoxia
    - Hypercapnia
- Disruption of sleep architecture
  - 1st 3 days post op
- REM rebound
- Increased apnea risk up to a week
Case

63 yr old lady for knee arthroscopy in ASC

PMH:
HTN, Obesity, GERD, OSA dx 4 months ago, not using CPAP

PSH:
Lap chole 2 years ago “difficulty waking up”

Meds:
Omeprazole, Atenolol, thiazide

Exam:
BMI 37, BP 140/90 P 65. No cardiac failure. Non-remarkable.
Pre-operative management

1) CPAP start or reinforce compliance to decrease:
   - airway edema
   - reduce blood pressure variability
   - LV strain
   - Arrhythmias
Bring CPAP day of surgery

2) Undiagnosed: suspected moderate to severe OSA with comorbidities:
   consider referral for sleep consult/PSG

3) Further testing
   ECHO is concern for pulmonary hypertension

4) Timing – book early for longer post-op monitoring

5) Location – appropriate for free standing ambulatory surgi-center?
   Assess this risk – sleep apnea score out of total of 6.
Clinical Impression – severity of OSA
(Results of sleep study trump clinical impression.)

<table>
<thead>
<tr>
<th>Signs/Symptoms (No sleep study)</th>
<th>OSA severity</th>
<th>AHI (PSG)</th>
<th>OSA severity Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Borderline</td>
<td>Mild</td>
<td>5-15</td>
<td>1</td>
</tr>
<tr>
<td>Definite</td>
<td>Moderate</td>
<td>15-30</td>
<td>2</td>
</tr>
<tr>
<td>Extreme</td>
<td>Severe</td>
<td>&gt;30</td>
<td>3</td>
</tr>
</tbody>
</table>
Choose the higher of these 2 scores and add to OSA severity score.

<table>
<thead>
<tr>
<th>Post op Opiate need</th>
<th>Surgical Invasiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 = None</td>
<td>0 = None</td>
</tr>
<tr>
<td>1 = Low dose oral</td>
<td>1 = Superficial</td>
</tr>
<tr>
<td>2 = High Dose oral</td>
<td>2 = Peripheral/GA</td>
</tr>
<tr>
<td>3 = Parenteral/neuroaxial</td>
<td>3 = Airway/major/abd</td>
</tr>
</tbody>
</table>
ASA practice advisory 2006

- > 4 OSA score very high risk
- OSA score of 4 = high risk
  - Decisions: individualized case by case
- Main hospital:
  - OSA 5&6
  - T’s <3 yrs age,
  - UPPP,
  - upper abdominal laparoscopy
- Anesthesia plan
- Post op monitoring (book early)
Our patient

- General Anesthesia (2)
- Severe OSA (3)
- OSA score of 5 (no CPAP use)
  - CPAP use (? subtract 1 from OSA score)
- Main OR
- Book early
- Encourage CPAP compliance
- Consider block/regional
**Intra-operative management**

- Opiate sparing premed
- Pre-oxygenation
- Difficult Airway
- Local/regional
- Minimize sedation
- Short acting anesthetic medications
- Multimodal analgesia
- Awake extubation / to CPAP
- (invasive monitoring as indicated for pulmonary hypertension/cardiac disease)
Post-operative management

- Elevate head of bed
- $O_2$ sats monitor
- CPAP
- High flow nasal cannulae
- Longer post-op monitoring in non-stimulating environment (ASA practice advisory)
  - 3 hours more than regular patient
  - 7 hours more if an episode of $O_2$ desat
- Overnight admission / monitored bed for high risk
- Follow up in sleep clinic for undiagnosed patients
OSA

- **Drug sensitivity**
  - Sedatives
  - Opiates
  - Neuromuscular blockers
    - Decreased arousals. Sleep disturbances increased after surgery

- **Regional/local**
OSA

- High index of suspicion
- Perioperative morbidity
- Cost of sleep evaluation:
  - Efficiency/delay/ease of appts
  - Pt satisfaction
  ($110,000 in 1st year
  = 10% of death suit settlement
  = 1% of brain injury settlement)
OSA practical points

- Review STOP BA(N)G
- If 2 or more positive in STOP, convey info to chart
- Book early for ambulatory cases
- Consider local or regional block
- Get PSG for chart if it will change management (Move to Main OR/ post op monitored bed)