Obesity and Sleep Apnea 2008

John E. Ellis MD
johnellis1700@gmail.com

Obesity and Sleep Apnea 2008

• Epidemiology
• Pathophysiology
  – Sleep Apnea
  – Cardiovascular
  – Metabolic / Endocrine
  – Respiratory
Obesity and Sleep Apnea 2008

- Preop Evaluation
- Common Procedures
- Bariatric Surgery
- Airway Management
- Postoperative Surveillance

Obesity and Sleep Apnea 2008

- 2nd hour with Mike Mulroy
- Discuss Virginia Mason Clinical Pathway
- Results University Hospital Cleveland Clinical Pathway
- Review important new work from Toronto
- Present some "hot off the press" abstracts from Oct 2008 ASA
Obesity Trends* Among U.S. Adults

*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person

Source: Behavioral Risk Factor Surveillance System, CDC.
Obesity Trends* Among U.S. Adults

BRFSS, 2007

(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)

Source: Behavioral Risk Factor Surveillance System, CDC.
Figure 2. Kaplan Meier survival estimates, by weight category.
Your friends make you fat!

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Fax: 617-432-5891
Staff Assistant: Nancy Smith

Bariatric surgery

Restrictive
Malabsorptive
Restrictive bariatric procedures
Malabsorptive procedures

Post-bariatric weight loss
Bariatric surgery and survival

BMI > 45 appears to benefit most

Sleep apnea pathophysiology
Gastric bypass improvements

Sleep study predicts perioperative complications

- 135 patient 1982-1987
- Surgical correction of OSA
  - T&A, tracheostomy, septoplasty
  - 18 complications (13%)
    - 13 airway
    - 3 hemorrhage
    - 1 arrhythmia

Esclamado RM et al. Laryngoscope 1989

sleep study predicts perioperative complications

Low SpO2 | Apnea Index
---------|---------
40        | 45
50        | 50
60        | 65
70        | 70
80        | 75
90        | 80

Esclamado RM et al. Laryngoscope 1989
Metabolic syndrome

- Abdominal obesity
- Glucose intolerance
  - “Di-obesity”
- Dyslipidemia
- Hypertension
- Inflammation / hypercoagulability

Obesity and Liver Function
Hepatic insulin resistance directly promotes formation of cholesterol gallstones

Sudha B. Biddinger1,2, Joel T. Haas1, Jian B. Yu1, Olivier Bezy1, Enxuan Jing1, Wenwei Zhang1, Terry G. Untermaier1, Martin C. Carey3,5,6 & C. Ronald Kahn1,3,6
The central role of the metabolic syndrome as a cause, not a result of OSA?

Metabolic syndrome begets OSA?

- Insulin resistance and visceral fat predict OSA better than BMI or neck circumference
- Visceral fat is metabolically active
- Excessive daytime sleepiness (EDS) occurs in many with metabolic syndrome even without OSA
- Exercise reduces OSA, EDS
- TNFα receptor blockers may reduce EDS
Excessive daytime sleepiness

Or… how fast do you fall asleep during these lectures once the lights are turned down???
Bariatric surgery for diabetes

Adjustable Gastric Banding and Conventional Therapy for Type 2 Diabetes
A Randomized Controlled Trial
John B. Dixon, MBBS, PhD; Paul E. O’Brien, MD; Julie Playfair, RN; Leon Chapman, MBBS; Linda M. Schachter, MBBS, Joseph Proietto, MBBS, PhD; Michael Bailey, PhD, MSc(stats); Margaret Anderson, B-HealthMan

• 60 obese patients
  – BMI >30 and <40
  – recently diagnosed (<2 years) type 2 DM
• Conventional diabetes Rx with a focus on weight loss by lifestyle change vs
• Laparoscopic adjustable gastric banding with conventional diabetes care.

Bariatric surgery for diabetes

Adjustable Gastric Banding and Conventional Therapy for Type 2 Diabetes
A Randomized Controlled Trial
John B. Dixon, MBBS, PhD; Paul E. O’Brien, MD; Julie Playfair, RN; Leon Chapman, MBBS; Linda M. Schachter, MBBS, Joseph Proietto, MBBS, PhD; Michael Bailey, PhD, MSc(stats); Margaret Anderson, B-HealthMan

• Remission of type 2 diabetes:
  – 73% in surgical group
  – 13% in conventional-Rx group.
OSA produces an endocrine mess

- Increases leptin
  - Hypoventilation
- Decreases testosterone in men
  - Obesity increases conversion of testosterone to estrogen
  - Associated with worse glucose tolerance / lipid / CAD risk factor profiles
  - But exogenous testosterone associated with worse sleep apnea
Industrialization and sleep loss
The New York Times

ITINERARIES

Constant Travelers Wear Their All-Nighters as a Badge of Pride

Mark Stevens, a marketing executive, says his clients care more about the quality of his ideas than whether he seems well rested.
A vicious cycle?
Sleep loss, hyperphagia, obesity, OSA....

Sleep deprivation turns college students into glucose-intolerant elderly!

Sleep-disordered breathing and the current epidemic of obesity: consequence or contributing factor?

Tasali E, Van Cauter E.

Sleep loss: a novel risk factor for insulin resistance and Type 2 diabetes.

Spiegel K, Kautson K, Leproult R, Tasali E, Van Cauter E.
Cardiovascular
Cerebrovascular

Coronary disease
Stroke
Congestive heart failure
Hypertension
Arrhythmias

Acute Thrombosis
Obesity and Coronary Artery Disease

CLINICAL RESEARCH

Obesity and Age of First Non–ST-Segment Elevation Myocardial Infarction

Mohan C. Madala, MD,* Barry A. Franklin, PhD,* Anita Y. Chen, MS,†
Aaron D. Berman, MD, FACC,* Matthew T. Roe, MD,† Eric D. Peterson, MD, FACC,†
E. Magnus Ohman, MD, FACC,‡ Sidney C. Smith, Jr, MD, FACC,‡ W. Brian Gibler, MD,§
Peter A. McCullough, MD, FACC,* for the CRUSADE Investigators

Royal Oak, Michigan; Durham and Chapel Hill, North Carolina; and Cincinnati, Ohio
**Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study**

Non-fatal CV events (%)

Fatal CV events (%)

Lancet 2005
Silent Brain Infarcts on MRI
- moderate to severe OSA (25.0%) !!
- obese control subjects (6.7%)
- patients with mild OSA (7.7%)

Platelet activation associated
nCPAP decreases platelet activation

Am J Respir Crit Care Med Vol 175, pp 612–617, 2007
OBESITY AND THE RISK OF HEART FAILURE

SATISH KENDAIAH, M.D., JANE C. EVANS, D.Sc., DANIEL LEVY, M.D., PETER W.F. WILSON, M.D.,
EMELIA J. BENJAMIN, M.D., MARTIN G. LARSON, S.D., WILLIAM B. KANNEL, M.D., M.P.H.,
AND PETER ANDERSON O. VAJAN, M.D.
OSA CHF Pathophysiology

OSA $\downarrow$ SpO2
Central apnea $\uparrow$ Sympathetic tone
HTN
LV failure

OSA CHF Pathophysiology

CPAP
OSA $\downarrow$ SpO2
Central apnea $\uparrow$ Sympathetic tone
HTN
LV failure
CPAP improves CHF in OSA

Cardiovascular Effects of Continuous Positive Airway Pressure in Patients with Heart Failure and Obstructive Sleep Apnea

Yasuyuki Kaneko, M.D., John S. Floras, M.D., D.Phil., Kengo Usui, M.D., Ph.D., Julie Plante, M.D., Ruzena Tkacova, M.D., Ph.D., Toshihiko Kubo, M.D., Ph.D., Shin-ichi Ando, M.D., Ph.D., and T. Douglas Bradley, M.D.

NEJM 2003;348:1233
Resistant hypertension?

- 63 pts with resistant hypertension
  - BP $\geq$ 140/90 mm Hg
  - using $>3$ antihypertensives
- OSA [AHI $\geq$ 10 episodes per hour] determined with portable home monitor
- 71% had OSA!

*Chest. 2007; 132:1858-1862*
Dysrhythmias
CPAP for AF ablation (MAC)
CPAP (continuous positive airway pressure)

- Patients can bring their own
- Use during MAC
- Use postop
- Patient may teach you!

PRACTICE GUIDELINES FOR THE PERIOPERATIVE MANAGEMENT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

A Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea

Approved by the House of Delegates October 25, 2005

Carin A. Hagberg, M.D.
Professor, Department of Anesthesiology
The University of Texas Medical School at Houston
Houston, Texas, USA
INTRAOPERATIVE RECOMMENDATIONS

- Anesthetic technique
  - Superficial procedures
    • LA or PNBs, w/ or w/o moderate sedation
    • Use CPAP or oral appliance during sedation in pts previously treated with these modalities
  - GA (w/ secure airway) preferable to deep sedation (w/ o secure airway)
  - Major conduction anesthesia (SAB/ED) should be considered for peripheral procedures

Respiratory

Restrictive lung disease
Atelectasis
Airway Airway Airway Airway!
FRC in Morbid Obesity

Adams & Murphy, BJA 2000: 91-108

How long until desaturation?
TIME TO HEMOGLOBIN DESATURATION WITH INITIAL $F_AO_2 = 0.87$

$SeO_2$, %

Time of $\dot{V}_E = 0$, minutes

Easy DL in a 700 lb patient!
Easy DL in a 700 lb patient!

Improving preoxygenation?

• Reverse Trendelenburg
• CPAP
• Noninvasive ventilation
Positioning before induction

CPAP with preoxygenation

- 30 patients BMI > 35
- Randomized
  - 10 cm H₂O for 5 min with 100% O₂ vs.
  - 5 min with 100% O₂

Gander S et al ASA 2003

![Graph showing pO2 before apnea and time till SpO2 = 90% with and without CPAP.](image-url)
CPAP for preoxygenation

CPAP with preoxygenation

Buys you an extra 60 seconds!!

Gander S et al ASA 2003
Pressure support for preO2?

![Graph showing comparison between NPPV and control groups over time.]

Fewer awake intubations

![Image of medical equipment and a monitor.]
I think we are getting better!

Growing awareness = better outcome?

SpO2 (%)

<table>
<thead>
<tr>
<th>Sitting</th>
<th>Supine</th>
<th>At intubation</th>
<th>Nadir</th>
</tr>
</thead>
<tbody>
<tr>
<td>OSA</td>
<td>non-OSA</td>
<td>OSA</td>
<td>non-OSA</td>
</tr>
</tbody>
</table>

$^{*}p<0.05$ versus non-OSA (t-test).
$^{*}p<0.1$ versus non-OSA, after adjustment for age, gender, and BMI.
Means and SEM

ASA 2008 A227
Between 2000 and 2007, GAETT was provided to 2,037 adult patients with PSG diagnosed OSA.

- Airway complications in 11 patients:
  - incidence of 0.549%.
- Significantly lower (p < 0.0001) than the 3.58%; incidence (5 of 139) between 1997 and 1999.

**Illinois Masonic in Chicago**

- Placing the patient in a ramped position before intubation;
- Preoxygenation for a minimum of 5 min;
- Awake or anesthetized fiberoptic intubation in select patients;
- Use of various intubation aids;
- Reduced doses of opioids and sedatives;
- Close hemodynamic control;
Illinois Masonic in Chicago

- **Extubation** when the patient is wide awake including
- Use of doxapram as needed;
- Extubation over an airway exchange catheter in select patients,
- Use of nasal trumpets and
- Use of head elevation during extubation, transport and recovery.

ASA 2008 A774

Who can’t be mask-ventilated?

- 40,000 Anesthetics from 2004 to 2008,
- 46,941 attempts at MV were recorded.
- 70 cases of IMV (0.15%) were observed.
- Independent predictors
  - Male gender
  - Mallampati III or IV,
  - history of sleep apnea,
  - history of neck radiation

ASA 2008 A1243
CPAP with preoxygenation prevents atelectasis

Prevention of Atelectasis Formation During the Induction of General Anesthesia in Morbidly Obese Patients

Marta Conto, MD, Stefania Freiotti, MD, Pierre Schupelz, MD, Philippe Francazollo, PhD, Michel Sutor, MD, PhD, Donat R. Spahn, MD, and Lennart Magnusson, MD, PhD

Departments of *Anesthesiology, †Diagnostic Radiology, and ‡General Surgery, University Hospital, Lausanne, Switzerland

Anesth Analg 2004

Before induction

After intubation
How should I ventilate the morbidly obese patient?

Think PEEP to keep alveoli open.

Mt. Sinai, New York

- 2 attendings present for induction
  - Unless awake intubation
- 2 attendings present for emergence
Difficult ETT = OSA???

Pts with difficult intubation
n=33

OSA (AHI>5)
n=22

OSA (AHI = 5 to 10)
n=3

OSA (AHI =10-15)
n=7

OSA (AHI>15)
n=6

OSA (AHI>30)
n=6

Non-OSA (AHI<5)
n=11

Anesth Analg 2008; 107:915-920
For patients on CPAP or BiPAP

How soon postop should it be started?

Lap gastric bypass

- 40 MO patients with known OSA undergoing LBS with standardized anesthesia care
- Randomly assigned to receive:
  - NIPPV immediately following extubation in the operating room (immediate post-extubation (IG) group), or
  - NIPPV 30 minutes following extubation in the PACU recovery room (SG standard group).

ASA 2008 A849
The Boussignac CPAP System

- works on the same principle as a turbine engine.
- Oxygen is forced through a system of micro channels that accelerate the molecules.
- This accelerated flow meets a deflector that directs the oxygen molecules into a central zone within the device.
- The turbulence created when the O$_2$ molecules collide creates a positive pressure.
Immediate CPAP after bariatric

<table>
<thead>
<tr>
<th></th>
<th>Standard Group</th>
<th>Early CPAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decrease FEV1 POD1</td>
<td>-46%</td>
<td>-24%</td>
</tr>
<tr>
<td>Decrease FVC POD1</td>
<td>-45%</td>
<td>-23%</td>
</tr>
</tbody>
</table>

ASA 2008 A849
Pressure support for extubation?

Do you really want a partially paralyzed, obese, supine patient to start to “breathe on their own” at the end of surgery???
You are called to ICU…

- To intubate a 350 pound patient with OSA, HTN, DM, CAD, A fib
- Now with hypoxic respiratory failure with Sat 88% on BiPAP
- What now?

Emergency Intubation

<table>
<thead>
<tr>
<th></th>
<th>Normal</th>
<th>Overweight</th>
<th>Obese</th>
<th>Morbidly Obese</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI range</td>
<td>&lt; 25</td>
<td>25-30</td>
<td>30-40</td>
<td>&gt;40</td>
</tr>
<tr>
<td>% patients</td>
<td>25%</td>
<td>39%</td>
<td>25%</td>
<td>11%</td>
</tr>
<tr>
<td>Mallampati 4</td>
<td>2.6%</td>
<td>2.6%</td>
<td>4.4%</td>
<td>42%</td>
</tr>
<tr>
<td>Grade 4 view</td>
<td>9%</td>
<td>9%</td>
<td>22%</td>
<td>31%</td>
</tr>
<tr>
<td>ETT 1st attempt</td>
<td>69%</td>
<td>69%</td>
<td>50%</td>
<td>39%</td>
</tr>
<tr>
<td>SpO2 &lt;90%</td>
<td>17%</td>
<td>17%</td>
<td>25%</td>
<td>38%</td>
</tr>
</tbody>
</table>

Shaw, Mort ASA 2003
Respiratory Depression after Opiates

Opiate use predicts perioperative complications!

Esclamado RM et al. Laryngoscope 1989
**Ventilatory Response to CO₂ in Children with Obstructive Sleep Apnea from Adenotonsillar Hypertrophy**

Susan G. Strauss, M.D.†, Anne M. Lynn, M.D.‡, Susan L. Bratton, M.D.†, and Mary Kay Nespeca, RN, BSN†

*Department of Anesthesiology, University of Washington School of Medicine; and †Department of Anesthesia and Critical Care, Children’s Hospital and Medical Center, Seattle, Washington*

- Obesity occurred more frequently in:
  - patients with OSA
  - patients with depressed ventilatory responses
- Children with OSA from adenotonsillar hypertrophy have a diminished ventilatory response to CO2 stimulation

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**Recurrent Hypoxemia in Young Children with Obstructive Sleep Apnea Is Associated with Reduced Opioid Requirement for Analgesia**

Karen A. Brown, M.D., †André Laferrière, B.A., †Immanuel Ravé Moss, M.D., Ph.D.†

- Less morphine after T&A:
  - Younger age
  - Worse sleep study
Effects of OSA, inhalational anesthesia, and fentanyl on the airway and ventilation of children

KAREN A. WATERS, FERGUS MCBRRIEN, FENNY STEWART, MURRAY HINDRE, AND SALLY WHARTON
Departments of Sleep Medicine, Anesthesiology, and Biomedical Engineering, The Children’s Hospital at Westmead, Westmead NSW 2145, and Departments of Medicine and Pediatrics and Child Health, University of Sydney, New South Wales 2000, Australia

Central apnea in intubated patients after fentanyl 0.5 mcg/kg

- Patients with moderate OSA (AHI 15-30) diagnosed by baseline PSG (sleep study) were randomly assigned to one of two groups and a repeat PSG was performed.
- Group control (n=9) received a normal saline infusion (20 ml/hr) and
- Group remifentanil (n=10) received a remifentanil infusion (0.075 mg/kg/min).

Remifentanil in OSA patients
Remifentanil in OSA patients

- Decreased sleep efficiency and
- Decreased time spent in REM sleep
- Increased the number of arousals both during and in the absence of respiratory events.
- Interestingly, there were actually fewer obstructive episodes observed in the remifentanil group.

Remifentanil in OSA patients

- However, AHI increased significantly owing to a dramatic increase in the number of central apneas observed (0.4 ± 0.7 baseline vs. 17 ± 30 during remifentanil infusion)
- Remifentanil also decreased the lowest observed oxygen saturation in subjects while awake, while asleep and during respiratory events.
Remifentanil in OSA patients

- Further, the number of desaturations below 90%; as well as the amount of time spent below 90%; was increased in the remifentanil group.
Special Article:
Sleep Apnea and Narcotic Postoperative Pain Medication: A Morbidity and Mortality Risk

by Ann Lofsky, MD

Risk Management

Panel members were struck by the fact that all of the cases reviewed could have been prevented by audible pulse oximeter monitoring on the ward. Although this is not currently the standard of care, the apparent high incidence of respiratory obstruction in SAS patients should make this a strong consideration, especially if narcotic analgesics are to be used.

Nocturnal Oxygenation During Patient-Controlled Analgesia

J. Gilbert Stone, MD*, Kathryn A. Cozine, MD, and Alvin Wald, PhD

*Department of Anesthesiology, New York Medical College, St. Vincent's Medical Center, and †Department of Anesthesiology, Columbia University, College of Physicians & Surgeons, New York, New York

Figure 2. Successive overnight SpO2 recordings from a patient breathing air with and without supplemental O2.
Friend or foe???
Dangers of Postoperative Opioids

• “...SpO2 is an effective method to detect hypoventilation in almost all situations if the patient is breathing room air.
• …if the patient is breathing as little as 25% supplemental oxygen, SpO2 may not decrease.”

New monitoring modalities

ASA 2008 a1730
New monitoring modalities

Three sudden postoperative respiratory arrests associated with epidural opioids in patients with sleep apnea.

- Department of Anesthesia and Critical Care, University of Chicago, Illinois 60637, USA.
Obesity and Sleep Apnea 2008

- 2nd hour with Mike Mulroy
- Review important new work from Toronto
- Discuss Virginia Mason Clinical Pathway
- Results University Hospital Cleveland Clinical Pathway
- Present some "hot off the press" abstracts from Oct 2008 ASA
Use of Preop Questionnaires for detecting OSA

Can we make cost-effective use of expensive polysomnography (PSG) and postop ICU?
Toronto – Chung et al

- Prevalence of OSA in surgical patients is higher than in the general population.
- Studies show that undiagnosed OSA is associated with increased perioperative morbidity and mortality.
- However, screening tools for OSA haven’t been validated in surgical patients.
Toronto – Chung et al

• Most screening tools for OSA so far have been validated in patients referred to sleep clinics or sleep laboratories.
• Patients referred to sleep centers are suspected of having sleep-related disorders, especially OSA. They are preselected patients.
• These tools need to be first validated in the target patient population.
Appendix 1: STOP 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

Two or more "yes" answers means higher risk of OSA
Body mass index > 35
Age > 50
Neck circumference > 40cm
Gender = male

- When incorporating BMI, age, neck circumference, and gender into the STOP scoring (STOP-Bang), the sensitivity and NPV significantly increased.
- They were both > 90% for the patients with moderate and severe OSA.
STOP is very simple

Table 3. Structural Characteristics of the Screening Tools

<table>
<thead>
<tr>
<th></th>
<th>Berlin Questionnaire</th>
<th>ASA Checklist</th>
<th>STOP Questionnaire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of items</td>
<td>11</td>
<td>12 or 14*</td>
<td>4</td>
</tr>
<tr>
<td>Number of category</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Format of questions</td>
<td>Multiple choice</td>
<td>Checklist</td>
<td>Yes/no</td>
</tr>
<tr>
<td>Scoring</td>
<td>Categories → final</td>
<td>Categories → final</td>
<td>Final</td>
</tr>
<tr>
<td>Healthcare staff involved</td>
<td>Scoring</td>
<td>Evaluation + scoring</td>
<td>Scoring</td>
</tr>
</tbody>
</table>

* 12 items for adults and 14 items for children.
How did the **screening tools** perform in predicting **PSG**?

- 416 postop f/u = chart review by a research anesthesiologist who was blinded to the results of the three questionnaires and polysomnography.
- Respiratory complications and prolonged oxygen most common
- **There were no deaths or life-threatening complications in either group of patients.**

---

How did the **screening tools** perform in predicting **PSG**?

<table>
<thead>
<tr>
<th>AHI &gt;30</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensitivity, %</td>
<td>79.5 (63.5–90.7)</td>
</tr>
<tr>
<td>Specificity, %</td>
<td>48.6 (40.0–63.0)</td>
</tr>
<tr>
<td>PPV, %</td>
<td>30.4 (21.7–40.3)</td>
</tr>
<tr>
<td>NPV, %</td>
<td>89.3 (80.1–95.3)</td>
</tr>
<tr>
<td>Likelihood ratio</td>
<td>1.545 (1.261–2.010)</td>
</tr>
<tr>
<td>Odds ratio</td>
<td>3.656 (1.636–9.054)</td>
</tr>
<tr>
<td>Area under ROC curve</td>
<td>0.769</td>
</tr>
</tbody>
</table>
Ethical practice

• If the apnea–hypopnea index (AHI) of a patient was greater than 30/h, the anesthesiologist and surgeon who were taking care of the patient were informed.

How did the screening tools perform in predicting clinical events?

• Patients ranked as high risk by the STOP questionnaire had a significantly higher incidence of:
  – Respiratory complications (23.8% vs. 10.6%; P < 005),
  – Desaturation (22.2% vs. 9.4%; P < 0.05), and
  – Severe desaturation (15.1% vs. 4.7%; P < 0.05).
How did the **screening tools** perform in predicting **clinical events**?

- Patients identified as having a high risk of OSA by the ASA checklist had higher incidences of:
  - postoperative respiratory complications (25.7% vs. 9.9%; \( P < 0.05 \)) and
  - desaturation (21.4% vs. 8.5%; \( P < 0.05 \))

What if we “wait to see how he does in PACU and then decide?”
OSA risk and PACU course both predictive

- 693 patients
- Close f/u in PACU
- Continuous spO2 on ward (48 hrs)
- ODI = oxygen-desaturation index = number of desaturations/hour of >4% for ≥10 seconds
- Risk factors for both ODI>10 and postoperative respiratory complications after PACU discharge
  - High SACS score
  - Recurrent respiratory events in the PACU

U. Michigan ASA 2008

- 43,576 adult cases had valid data in reference to OSA.
- Of these, 3128 patients (7.17%) had diagnosed untreated or treated OSA.
- Derivation of a Simple Preoperative Sleep Apnea Prediction Score (P-SAP Score)
What to do with high-risk by screening criteria???

- Sleep Medicine Consult = PSG - delays, costly, but gets patient treated long-term, plus gives them CPAP postop if they need it. Is CPAP protective against rare/catastrophic events???
- SDU/ICU/telemetry - costly, but no delay. Will this reduce events, or is Rx (CPAP, caffeine, modafinil, etc) more efficacious?
- Alter anesthetic care - anesthetic technique (multimodal), ventilation

Analogous to cardiac stress testing, where goal is to detect 3 vessel CAD that kills, not minor CAD?

Here, should the goal should be identify

AHI >15? 30?
Guidelines for perioperative care?

Recently produced by ASA

PRACTICE GUIDELINES FOR THE PERIOPERATIVE MANAGEMENT OF PATIENTS WITH OBSTRUCTIVE SLEEP APNEA

A Report by the American Society of Anesthesiologists Task Force on Perioperative Management of Patients with Obstructive Sleep Apnea

Approved by the House of Delegates October 25, 2005

Carin A. Hagberg, M.D.
Professor, Department of Anesthesiology
The University of Texas Medical School at Houston
Houston, Texas, USA
ASA OSA Checklist

- Category 1: Predisposing Physical Characteristics
  - a. BMI $\geq 35$ kg/m$^2$
  - b. Neck circumference $>43$ cm/17 inches (men) or $40$ cm/16 inches (women)
  - c. Craniofacial abnormalities affecting airway
  - d. Anatomical nasal obstruction
  - e. Tonsils nearly touching or touching the midline
ASA OSA Checklist

• 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 OSA Checklist

• 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]*
Preoperative Evaluation

• 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.

• For safety, clinical criteria (table 1) should be designed to have a high degree of sensitivity (despite the resulting low specificity), meaning that some patients may be treated more aggressively than would be necessary if a sleep study were available.

• 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 (table 2). The patient and his or her family as well as the surgeon should be informed of the potential implications of OSA on the patient’s perioperative course.
Preoperative Preparation

• **Preoperative initiation of CPAP should be considered, particularly if OSA is severe.** For patients who do not respond adequately to CPAP, NIPPV should be considered. In addition, the preoperative use of mandibular advancement devices or oral appliances and preoperative weight loss should be considered.

• **A patient who has had corrective airway surgery (e.g., UPPP, surgical mandibular advancement) should be assumed to remain at risk for OSA complications unless a normal sleep study has been obtained and symptoms have not returned.**

• **Patients with known or suspected OSA may have difficult airways and therefore should be managed according to the “Practice Guidelines for Management of the Difficult Airway.”**

• **In patients at risk for perioperative complications from OSA, a preoperative determination must be made regarding whether surgery should be performed on an inpatient or outpatient basis.**

Inpatient versus Outpatient Surgery and Criteria for Discharge to Unmonitored Settings

• **The availability of emergency difficult airway equipment, respiratory care equipment, radiology facilities, clinical laboratory facilities, and a transfer agreement with an inpatient facility should be considered in making this determination.**
Inpatient versus Outpatient Surgery and Criteria for Discharge to Unmonitored Settings

• These patients should not be discharged from the recovery area to an unmonitored setting (i.e., home or unmonitored hospital bed) until they are no longer at risk for postoperative respiratory depression. Because of their propensity to develop airway obstruction or central respiratory depression, this may require a longer stay as compared with non-OSA patients.

Inpatient versus Outpatient Surgery and Criteria for Discharge to Unmonitored Settings

• Adequacy of postoperative respiratory function may be documented by observing patients in an unstimulated environment, preferably while they seem to be asleep, to establish that they are able to maintain their baseline oxygen saturation while breathing room air.
### CONSULTANT OPINIONS RE: PROCEDURES WHICH MAY BE PERFORMED SAFELY ON OUTPATIENTS AT INCREASED PERIOPERATIVE OSA RISK

<table>
<thead>
<tr>
<th>Type of surgery/Anesthesia</th>
<th>Consultant Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial surgery/ LA or RA</td>
<td>Agree</td>
</tr>
<tr>
<td>Superficial surgery/ GA</td>
<td>Equivocal</td>
</tr>
<tr>
<td>Airway surgery (adult, e.g., UPPP)</td>
<td>Disagree</td>
</tr>
<tr>
<td>Tonsillectomy in children &lt; 3yo</td>
<td>Disagree</td>
</tr>
<tr>
<td>Tonsillectomy in children &gt; 3yo</td>
<td>Equivocal</td>
</tr>
<tr>
<td>Minor orthopedic surgery/ LA or RA</td>
<td>Agree</td>
</tr>
<tr>
<td>Minor orthopedic surgery/ GA</td>
<td>Equivocal</td>
</tr>
<tr>
<td>Gynecologic laparoscopy</td>
<td>Equivocal</td>
</tr>
<tr>
<td>Laparoscopic surgery, upper abdomen</td>
<td>Disagree</td>
</tr>
<tr>
<td>Lithotripsy</td>
<td>Agree</td>
</tr>
</tbody>
</table>

“Postop patients with OSA do not necessarily need an ICU, but they definitely need more monitoring care than normal patients”

“A simple audible SpO2 monitor in an isolated room on the ward will not work.”

Letters to the Editor:

Jonathan L. Benumof, MD  
San Diego, CA

**Creation of Observational Unit May Decrease Sleep Apnea Risk**
Virginia Mason OSA Protocol

Identification / Assessment of Patients at Risk for Obstructive Sleep Apnea
VMMC Obstructive Sleep Apnea Scoring System

A. Severity of Sleep Apnea based on Sleep Study or Clinical Indicators (see page 2 if Sleep Study not available).

<table>
<thead>
<tr>
<th>Severity of OSA</th>
<th>Adult AH1</th>
<th>Pediatric AH1</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>(0-5)</td>
<td>(0)</td>
<td>0</td>
</tr>
<tr>
<td>Mild</td>
<td>(6-20)</td>
<td>(15)</td>
<td>1</td>
</tr>
<tr>
<td>Moderate</td>
<td>(21-40)</td>
<td>(6-10)</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>(&gt;40)</td>
<td>(&gt;15)</td>
<td>3</td>
</tr>
</tbody>
</table>

* One point may be subtracted if a patient has been on CPAP or NIPPV prior to surgery and will be using his/her appliance during the post op period.

* One point should be added if a patient with mild or moderate OSA also has a resting PaCO2 > 50 mmHg

Please complete to determine score in Section A if no sleep study available

Predisposing physical characteristics associated with OSA

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>8) Edema of leg or penis</td>
<td></td>
<td></td>
<td>ISK</td>
</tr>
<tr>
<td>9) Neck circumference 17 inches (men) or 16 inches (women)</td>
<td></td>
<td></td>
<td>Neck Circumference</td>
</tr>
<tr>
<td>10) Craniofacial abnormalities affecting the mouth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11) Anomalous nasal obstruction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12) Tonsils nearly touching in midline</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

History of apparent airway obstruction during sleep (or none of the following are present, if patient lives alone or sleep is not observed by another person, then only one of the following needs to be present)

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>13) Patient has sleep apnea</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14) Snoring loud enough to be heard through closed door</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15) Frequent snoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16) Observed gasping or breathing during sleep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17) Apnea with choking sensations</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18) Frequent awakenings from sleep</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19) Inconsistent apnea during sleep (children only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20) Parental report of restless sleep, difficulty breathing or struggling respiratory effort during sleep (children only)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Somnolence (one or more of the following is present)

<table>
<thead>
<tr>
<th>Item</th>
<th>Yes</th>
<th>No</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>21) Frequent somnolence or fatigue despite adequate &quot;sleep&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22) Falls asleep early in non-stimulating environment (e.g., watching TV, reading, napping in or drift napping in or drift asleep) despite adequate &quot;sleep&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23) Parents or teachers comments that child appears sleepy during the day; is easily distracted, is socially regressed, or has difficulty concentrating (children only)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24) Child often difficult to arouse or usually wakens gruffly (children only)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Virginia Mason OSA Protocol

B. Invasiveness of proposed surgery and anesthesia (circle one)
(Skip this section if not a surgical patient)

<table>
<thead>
<tr>
<th>Type of Surgery and Anesthesia</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial surgery under local or peripheral nerve block anesthesia</td>
<td>0</td>
</tr>
<tr>
<td>Superficial surgery with moderate sedation or general anesthesia</td>
<td>1</td>
</tr>
<tr>
<td>Peripheral surgery with spinal or epidural anesthesia</td>
<td>1</td>
</tr>
<tr>
<td>Peripheral surgery with general anesthesia</td>
<td>2</td>
</tr>
<tr>
<td>Airway surgery with moderate sedation</td>
<td>2</td>
</tr>
<tr>
<td>Major surgery, general anesthesia</td>
<td>3</td>
</tr>
<tr>
<td>Airway surgery, general anesthesia</td>
<td>3</td>
</tr>
</tbody>
</table>

Point Score ________ (0 – 3)

C. Requirement for postoperative opioids (circle one)

<table>
<thead>
<tr>
<th>Opioid requirement</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Low dose oral opioids (e.g., 0 – 0.5 mg/kg/day of oxycodone or equivalent)</td>
<td>1</td>
</tr>
<tr>
<td>High dose oral opioids, parenteral or neuraxial opioids (e.g., &gt; 1 mg/kg/day)</td>
<td>3</td>
</tr>
</tbody>
</table>

Point Score ________ (0 – 3)

Estimation of perioperative risk (overall score is A + the greater of the score for either B or C)

Overall Point Score ________ (0 – 6)
Virginia Mason OSA Protocol
(1)

• Patients scheduled for outpatient procedures with a preoperative score of 5 or 6 should be referred to the downtown VMMC hospital based outpatient surgery center for their surgical procedure.

Virginia Mason OSA Protocol
(2)

• All patients with a preoperative score of 4 or greater should be evaluated postoperatively in PACU using PACU Discharge Criteria for Patients at Risk for Sleep Apnea.

• If VMMC Sleep Apnea Discharge Criteria are met, outpatients may be discharged home.
Virginia Mason OSA Protocol (3)

- If these patients do not meet discharge criteria, patients will be admitted to an inpatient ward and monitored via VMMC policy.

- Inpatients will be admitted to a Hospital Specialty Ward, Intermediate Care Unit, or Intensive Care Unit via the PACU discharge criteria and discretion of the attending anesthesiologist.
Perioperative Complications During Use of an Obstructive Sleep Apnea Protocol Following Surgery and Anesthesia

Cleveland MetroHealth OSA Protocol

- November 2004 through April 2006
- 438 (2%) known or suspected OSA.
  - 82% inpatient
    - 88% to designated OSA bed on a general nursing floor.
    - 12% to a stepdown/ICU
  - 18% ambulatory
Cleveland MetroHealth OSA Protocol

- 77% were tracheally intubated
- Difficult intubation in 15%
- FOB in 4%

Sleep-related desaturation
- spO2 < 90 seen in 16%
- spO2 < 85 seen in 12%
- spO2 < 80 seen in 7%
- 14x more likely with IV opiates
- 12x more likely with oral opiates
4 patients required postoperative tracheal intubation for respiratory failure

Unplanned or urgent transfer to the ICU occurred in 2 patients (0.5%).

2 cardiac arrests and no deaths.

- One cardiac arrest occurred in the sole patient managed off protocol
- Another cardiac arrest occurred in a patient at home while receiving PO opioids (one day after discharge) after having completed overnight OSA monitoring.
2) Procedures Possibly Requiring Oral Postoperative Narcotics

- Consider Ambulatory Surgery Center

- Mild OSA (AHI < 16, BMI < 45)
- Moderate/Severe OSA (AHI > 15, BMI > 45) or NO Sleep Study

- May Schedule at Ambulatory Center

- If extubated
- If remains intubated

- Oral Postop Narcotics
- No Postop Narcotics

- Discharge Home
- Prolonged PACU Stay

- Consider Discharge Home
- Consider 23 hour observation

GO TO INPATIENT FACILITY

3) Procedures Possibly Requiring Intravenous Postoperative Narcotics

- Schedule at Hospital-based Surgical Center

- If extubated

- Oral Narcotics
- Intravenous Narcotics

- OSA orders

- AHI < 16
- AHI > 15

- OSA bed on general floor
- Step-down of no OSA

- OSA bed on general floor
- Step-down of no OSA

23 hr or d/c home
What if your hospital has a sedation service?

Should they be “allowed” to do OSA patients?
Should you “back them up?”

MGH – Sedation service and OSA

• 25,000 procedures annually by sedation service
• January 2007 to December 31, 2008 there were 94 PS consults requested through the hospital paging system. (~0.2%)
AIRWAY EVALUATION

No CPAP use → Routine CPAP use → CPAP Independent¹ → CPAP Dependent²

Normal → Questionable or Abnormal → Anesthesia Consult (pager #32888)

Procedures That Will Allow CPAP → Procedures with Oropharyngeal Compromise Prohibiting CPAP

Consult respiratory therapy (pager #24225)³ for CPAP

¹CPAP-independent: does not use CPAP routinely; does not bring CPAP machine on trip; functions well when CPAP not used.
²CPAP-dependent: cannot sleep without CPAP; always uses CPAP; brings CPAP on trip; has pulmonary artery HTN
³Patients are not permitted to use home CPAP machine unless previously inspected by respiratory therapy. If CPAP dependent, page respiratory therapy (pager #24225) to set up CPAP machine via a physician’s order for either the patient’s known CPAP settings or 10 cm H2O if settings are unknown. Upon discharge, please page respiratory therapy to remove the CPAP machine.
⁴For example: colonoscopy, cardiac catheterization, vascular access catheters
⁵For example: upper GI endoscopy, EUS, ERCP, HEE
Perioperative Care

- Take a good history
- Encourage CPAP
  - Preop
  - Intraop (MAC, regional)
  - Postop
- Be prepared!
  - LMAs, FOB
  - Airways
  - Extra hands
- Reverse trendelenburg position

Perioperative Care

- Short-acting drugs
- Encourage regional anesthesia / analgesia
- Maximize non-narcotic analgesia
- Be prepared for postop problems
  - Consider prolonged PACU or ICU
  - Consider invasive monitoring
Next step for researchers:

• Now we can define high-risk cohorts by screening +/- PSG
• Next, do RCTs of interventions:
  – Ventilation strategies
  – Multimodal analgesia = avoiding opiates
  – Postoperative respiratory surveillance
  – CPAP in naive patients
  – Caffeine / modafinil???