Obstructive Sleep Apnea in the Perioperative Setting

"You snooze, you lose…"

TAPAN – Texas Association of Perianesthsia Nurses Conference
October 2013 – Grapevine, Texas

Won Y. Lee, M.D.
Assistant Professor of Medicine
Division of Pulmonary and Critical Care Medicine
Medical Director, Clinical Center for Sleep and Breathing Disorders

* No financial disclosures to declare.

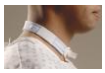
UT SOUTHWESTERN MEDICAL CENTER

Clinical Case

- 63 year-old obese man
  - History of hypertension and coronary artery disease
  - Severe excessive daytime sleepiness
- At age 30
  - Sleepiness symptoms started → no problems as child
  - Gained weight up to 255 pounds
  - Falling asleep all the time, even while driving
    - Motor vehicle accidents → multiple fender benders
    - Girlfriend noticed 30 second pauses during sleep
- Evaluated at an outside hospital – Late 1970'S
  - Diagnosed with obstructive sleep apnea (OSA)
    - Based on clinical symptoms and obesity → no polysomnogram performed

Clinical Case

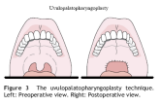
- What was the treatment for obstructive sleep apnea in the 1970's?
- Weight loss or tracheostomy
  - He declined both options



- "Experimental treatment" including:
  - daytime stimulant therapy
  - positional therapy (tennis ball sewn on the back of shirt)
  - female hormone replacement therapy (progesterone)

- None of these strategies improved his sleepiness

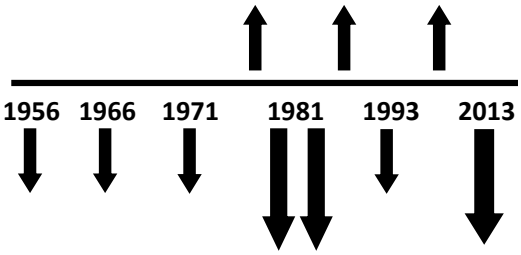
Clinical Case



- Early 1980's
  - Further evaluation at another hospital
  - Polysomnogram confirmed → Severe OSA
  - What was the treatment of OSA in the 1980's?
    - Tonsillectomy, septoplasty, and uvulopalatopharyngoplasty (UPPP)
- Mild improvement initially, but then had recurrence of daytime sleepiness symptoms
  - Worked as a construction worker on high rise buildings (30 to 40 stories)
    - fired from the job due to safety concerns

- Sleep study in 2008
  - Very severe OSA (AHI 105 and desaturations to 57%)
  - Successfully treated with positive airway pressure therapy

History of the Sleep Apnea Syndrome



Obstructive Sleep Apnea

Past
- Origins of the Pickwickian syndrome
- Mechanisms of obstructive sleep apnea
- Original paper on CPAP

Present
- Adverse cardiovascular consequences of untreated OSA
- Perioperative recognition of OSA
  - Anesthesiology literature

Future
- Epidemiology of sleep apnea
- Diagnostic testing
  - Out of center sleep testing (OCST) → home sleep studies
- Alternatives to CPAP therapy


Case Reports

Extreme Obesity Associated with Alveolar Hypoventilation— A Pickwickian Syndrome[1]

- 51 year old business executive
  - Gained significant weight → BMI: 43.8
- Began falling asleep while carrying on his daily routine
  - He played poker once a week, and was dealt "a full house"
  - Because he had dropped to sleep he failed to take advantage of this opportunity

- A few days later, he was admitted to the Peter Bent Brigham Hospital with obesity, fatigue, and somnolence

Burwell CS et al. Amer J. Med. 1956:21;811-817

The Pickwickian Syndrome

- "His general contour was strikingly similar to that of the boy shown in [the] figure … a character in Charles Dicken's Papers of the Pickwick Club"

Charles Dickens. 1836
The Posthumous Papers of the Pickwick Club
(commonly referred to as *The Pickwick Papers*).

Clinical features

- Obesity
- Hypoventilation
- Hypersomnolence
- Secondary polycythemia
- Right ventricular failure

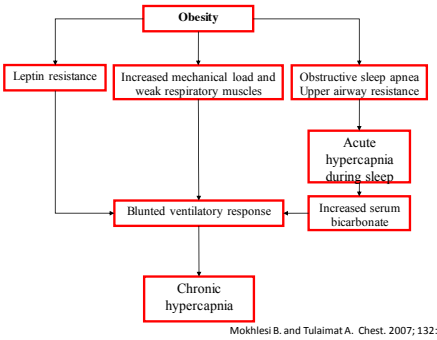
Burwell CS et al. Amer J. Med. 1956:21;811-817

Definition of
Obesity Hypoventilation Syndrome (OHS)
"Pickwickian Syndrome"

Obesity Hypoventilation Syndrome

Olson AL and Zwillich C. Am J of Med. 2005; 118(9):948-956

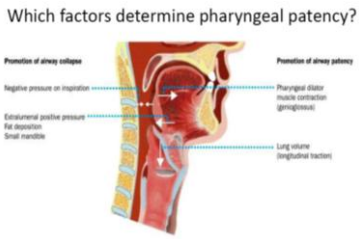
Pathophysiology of OHS



Mokhlesi B. and Tulaimat A. Chest. 2007; 132:1322-1336

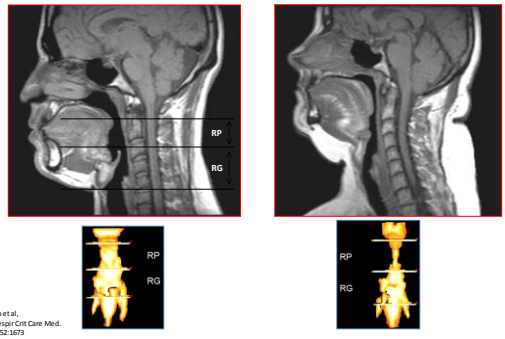
Pathophysiology of Obstructive Sleep Apnea

- Pharynx susceptibility to collapse
  - Little bony/rigid support from posterior end of nasal septum to the epiglottis
- Pharyngeal dilator muscles
  - genioglossus muscle tone
  - tensor palatini muscle
  - enervated by the hypoglossal nerve



Malhotra A and White DP. Lancet 2002; 360:237-245

Sagittal and Coronal Upper Airway MR Images



Schwab et al, Am J Respir Crit Care Med. 1995; 152:1673

Risk Factors for Obstructive Sleep Apnea

- Age (up to mid 60's)
- Male Gender (2:1)
- Women – Menopause
- Craniofacial anatomy
  - Retrognathia
  - Macroglossia
  - Down's syndrome
- Alcohol or nicotine use
- Genetic

Clinical Presentation of OSA

- Classic patient – easy to recognized
  - Male, obese, middle aged, snores, etc…
- Not so classic patient
  - Women – menopause, insomnia, depression
  - Asians – lower BMI
  - Thin with excessive daytime sleepiness
- Experienced sleep specialists can diagnose OSA only about 60% of the time, based on clinical symptoms
- A screening test and diagnostic procedure needs to be performed

STOP - Bang

STOP – Bang

- **S** Snoring
  - Do you snore loudly (louder than talking or loud enough to be heard through closed doors)?
- **T** Tired
  - Do you feel tired, fatigued, or sleepy during the daytime?
- **O** Observed
  - Has anyone observed you stop breathing during your sleep?
- **P** Blood pressure
  - Do you have or are you being treated for high blood pressure?

- **B** BMI > 35 kg/m2
- **A** Age > 50 years old
- **N** Neck circumference greater than 40 cm
- **G** Gender male

- High risk of OSA → answering YES to 3 or more items (sensitivity 93%), low specificity (~43%)
- Specificity increases to > 90% when 7 or 8 are answered affirmatively
- High negative predictive value of 90 %

British Journal of Anaesthesia 2012; 108 (5): 768–75

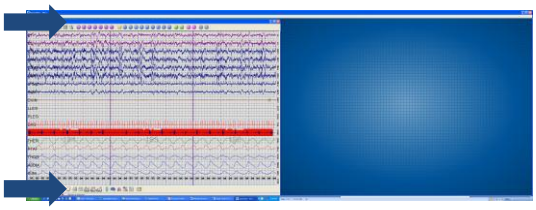
What is a Sleep Study?

- **Polysomnogram** – Diagnostic study or therapeutic study
  - Overnight attended study
    - Come to the sleep lab at 8 pm, stay the night until 6 am
    - Sleep technologist stays with the patient
  - EEG – electroencephalogram → stages of sleep / seizure
  - ECG – electrocardiogram → arrhythmia
  - EMG – electromyogram → periodic limb movements
  - EOG – eye movements → rapid eye movements
  - Oronasal airflow
  - Respiratory effort (chest and abdominal belts)
  - Pulse oximetry

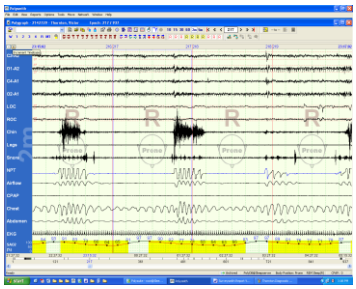
Sleep Study (polysomnogram)

SOUTHWESTERN MEDICAL CENTER

Normal Pattern of Breathing



Apnea: 10 seconds, no airflow
Hypopnea: 10 seconds, reduction in airflow, 4% desaturation



What is an apnea hypopnea index (AHI)?

- The number of apneas and hypopneas PER hour
  - Apneas and hyponeas are equally pathologic and clinically important

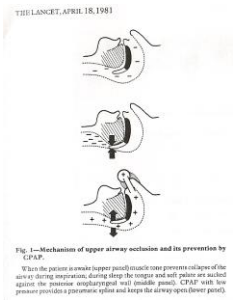
Severity of OSA	Events per hour
Normal	Less than 5
Mild	5 – 15
Moderate	15 – 30
Severe	More than 30

- Highest I've seen in Texas?
  - AHI 166

Epstein LJ et al.
J Clin Sleep Med 2009;5:263-76

Reversal of obstructive sleep apnoea by continuous positive airway pressure applied through the nares

- Hypothesis: CPAP
  - A pneumatic splint to prevent upper airway occlusion
  - Push the soft palate and tongue forward and away from the posterior oropharyngeal wall
- CPAP was produced by:
  - Connect one end of a wide bore tube to a vacuum-cleaner blower motor with variable speed control
- "We were very tentative going into this, not knowing what would happen, how the patient might respond, or even if we might 'blow the patient up"

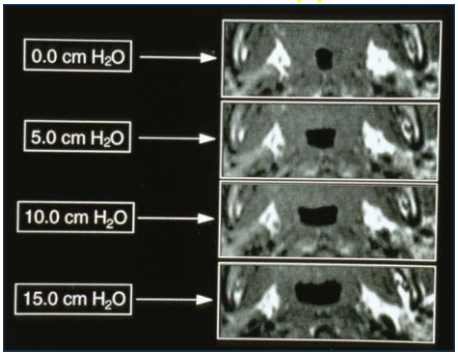


Reversal of obstructive sleep apnoea by continuous positive airway pressure applied through the nares

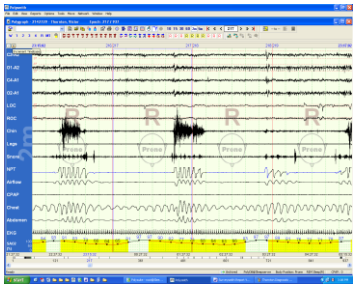
- Results
  - 5 patients (4 adults and 1 child age 13)
    - Mean AHI
      62 events/hour
    - Mean lowest oxygen saturation 84%
    - Pressure range: 4.5 to 10 cm of water pressure
      - Completely abolished the obstruction in all patients
    - One patient was able to watch television the next day, something he ha le to do for years.

Sullivan CE et al. Lancet. April 1981; 1:862-865

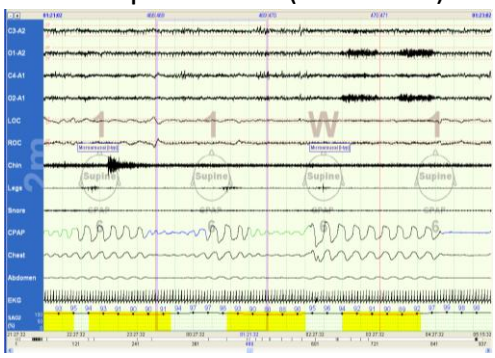
CPAP Therapy



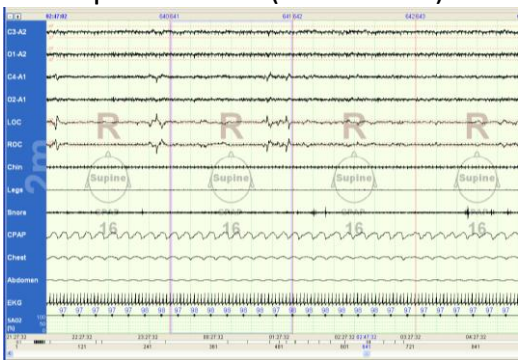
No CPAP



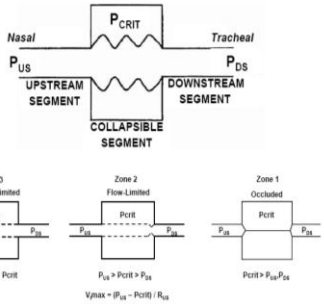
Inadequate CPAP (6 cm H2O)



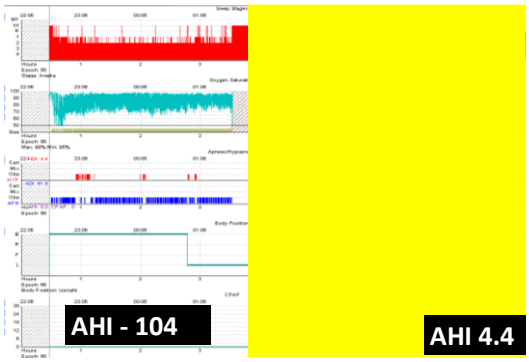
Optimal CPAP (16 cm H2O)



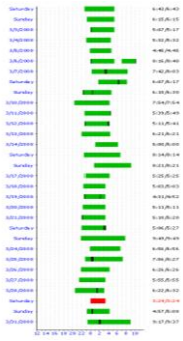
Starling Resister Model – Upper Airway



Polysomnogram – Split Night Study



CPAP adherence can be objectively monitored

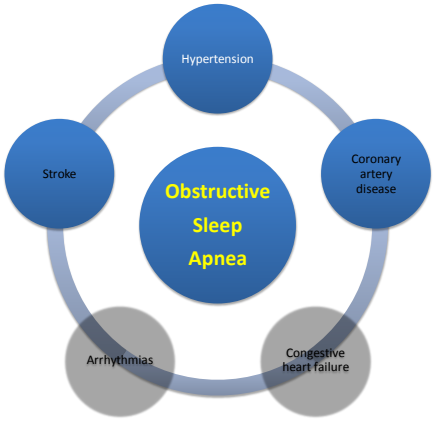


- Patients overestimate their use of CPAP
- Objective compliance?
  - Duration of usage
  - Residual AHI
  - Leakage
  - 4 hour threshold
    - 70 % of nights
    - Green
    - Red
    - Black

Obstructive Sleep Apnea

Present

- Cardiovascular disorders associated with OSA
- Perioperative recognition of OSA



Sleep Research Cohorts

- Wisconsin Sleep Cohort
- Large population based study of Wisconsin state employees
- Evaluate the consequences and natural history of sleep apnea
- Epidemiology

- Sleep Heart Health Study, NIH sponsored since 1994
- Prospective community based cohort, multicenter
- Asymptomatic men/women, age 40 +
- Focus – incident cardiovascular

MAYO CLINIC

- Mayo Clinic Sleep/Cardiology Clinic studies
- Sleep and cardiology clinics
- Referral bias

- Spanish Sleep and Breathing Cohort
- Sleep Clinic
- Referral bias, most representative of clinical practice

OSA and Cardiovascular Disorders Research Questions

- Question 1
  - Is OSA causal in the development of cardiovascular disease?
    - Causality vs. association
- Question 2
  - Does treatment of sleep apnea (CPAP) result in clinical improvement?
    - Fewer cardiovascular events ?
    - Reduced morbidity and mortality ?

OSA and Cardiovascular Disorders Research Limitations

- Limitation 1
  - Close association between obesity and OSA
    - Effect of obesity ?
    - Effect of OSA ?
    - Synergy ?
- Limitation 2
  - Shared co-morbidities between obesity and OSA
    - Cardiovascular disease, metabolic syndrome, and diabetes
- Limitation 3
  - Suboptimal randomization schemes
    - Difficult to perform randomized, double blind, placebo controlled studies
      - technically challenging for the placebo arm (SHAM CPAP)
    - Ethical to withhold CPAP therapy ?

What are the adverse cardiovascular implications of untreated OSA?

- Hypertension → strongest data of association
  - OSA is independently associated with development of hypertension
  - OSA is associated with difficult to control hypertension (drug resistant)
  - Dipping phenomenon (dipping is good at nighttime)
    - Dipping is decrease in mean BP by ~ 10-20% at night
  - CPAP (compliant with therapy) → modest reduction in BP
- Coronary artery disease (ischemia and infarction/revascularization)
  - OSA is independently associated with coronary artery disease
    - Strongest association in men and women with SEVERE OSA (AHI > 30)
  - CPAP therapy (observational data) has shown a decrease in myocardial infarction and all causes of death
- Stroke
  - OSA is independently associated with stroke (AHI > 30)
  - Impact of CPAP (?) primary or secondary prevention?

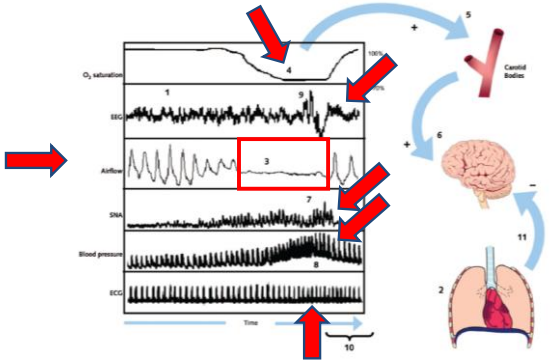
Lee WY et al. Expert Rev Respir Med. 2008 June 1; 2(3): 349–364

What are the adverse cardiovascular implications of untreated OSA?

- Congestive heart failure
  - Associated with higher prevalence of OSA
- Cardiac arrhythmias
  - Reasonable evidence linking association
    - Atrial fibrillation, frequent PVC's, ventricular tachycardia, bradycardia (diving reflex)
- Neurocognitive dysfunction
  - Automobile accidents, decreased quality of life, mood disorders
- Diabetes mellitus/insulin resistance

Lee WY et al. Expert Rev Respir Med. 2008 June 1; 2(3): 349–364

Mechanism of OSA on sympathetic neural activity



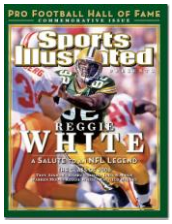
Caples SM et al. Ann Intern Med. 2005; 142:187-197


The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Day–Night Pattern of Sudden Death in Obstructive Sleep Apnea

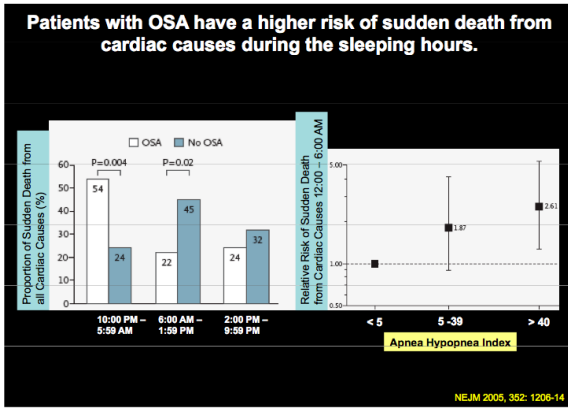
Apoor S. Gami, M.D., Daniel E. Howard, B.S., Eric J. Olson, M.D., and Virend K. Somers, M.D., Ph.D.



- Mayo Clinic study
- 112 patients who died of "sudden cardiac death"
  - Time period from 1987 to 2003
  - Not attributed to a known cause
- All had sleep studies – Mayo Clinic
- Review of death certificates
  - Evaluated 'time of death'

MAYO CLINIC

Gami AS et al. NEJM. 2005;352:1206-14.



Long-term cardiovascular outcomes in men with obstructive sleep apnoea-hypopnoea with or without treatment with continuous positive airway pressure: an observational study

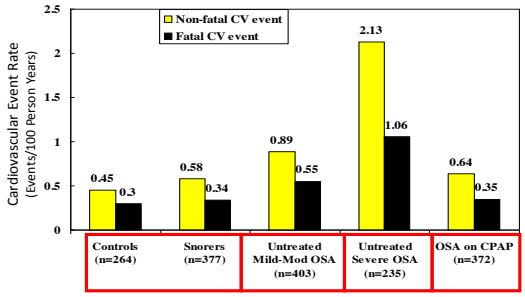
Lancet 2005; 365: 1046-53 Jose M Marin, Santiago J Carrizo, Eugenio Vicente, Alvar G N Agusti

- Question:
  - What is the cardiovascular outcome of men with OSA?
    - Treated or not treated with CPAP ?
- Design:
  - Observational study
  - 1651 men referred to a sleep clinic unit in Spain

- What?
  - Evaluate the incidence of new fatal and non fatal cardiovascular events
  - 10 years
    - stroke or myocardial infarction
    - CABG and PTCA

Marin, JM et al. Lancet. 2005; 365:1046-1053.

Incidence of cardiovascular events in 10 years (events/100 person years)



Marin, JM et al. Lancet. 2005; 365:1046-1053.

Arrhythmias associated with OSA

- Bradyarrhythmias
  - Prolonged apnea and hypoxemia elicits the diving reflex, resulting in cardiac vagal activation
    - AV block and asystole
  - CPAP can reverse these bradyarrhythmias
- Prevalence of arrhythmias in sleep apnea
  - Nocturnal arrhythmias have been reported to occur in up to 50% of OSA patients
    - Sleep Heart Health Study (2006) of 2-4 higher risk of nocturnal complex arrhythmias (comparing AHI > 30 vs. AHI < 5)
      - Atrial fibrillation (4x odds of developing)
      - Nonsustained ventricular tachycardia (3x odds of developing)
      - Complex ventricular ectopy PVC's (2x odds of developing)

Mehra et al. Am J Respir Crit Care Med 2006;173(8):910–6
Somers VK et al. Circulation. 2008; 118:1080-1111

Is OSA an independent risk factor for peri-operative complications?

Three Sudden Postoperative Respiratory Arrests Associated with Epidural Opioids in Patients with Sleep Apnea

Andreas M. Ostermeier, MD, Michael F. Roizen, MD, Martin Hautkappe, MD, P. Allan Klock, MD, and Jerome M. Klafta, MD
Department of Anesthesia and Critical Care, University of Chicago, Chicago, Illinois

- Description of 3 overweight patients
  - Known history of sleep apnea, not on treatment
  - Underwent uneventful surgeries
    - 2 orthopedic surgeries
    - 1 ventral hernia repair
  - All were treated with epidural analgesia for pain control
  - All died from sudden, unexpected cardiac and respiratory arrest
    - Autopsy showed no alternative reasons for death
    - Presumed death due to acute cardiopulmonary arrest from untreated sleep disordered breathing

Ostermeier AM et al. Anesth Analg. 1997; 85:452-460

Original Article

mayo

Postoperative Complications in Patients With Obstructive Sleep Apnea Syndrome Undergoing Hip or Knee Replacement: A Case-Control Study

- Hip or knee replacement at Mayo Clinic 1995 – 1998
  - Retrospective study
- 101 patients with OSA
  - 65 patients had known OSA before surgery (Only 33 were using CPAP)
  - 36 undiagnosed before surgery, eventually diagnosed within 3 years
- 101 patients without OSA
  - matched patients (BMI, type of surgery, amount of medications)
- Research question
  - Compare postoperative complications between the 2 groups

Gupta RM et al. Mayo Clin Proc. 2001;76:897-905

Complication rates were higher in OSA patients

- Total complication rate
  - Hypercapnia, oxygen desaturations
  - Arrhythmia, myocardial ischemia or infarction
  - Delirium

39% of OSA patients vs. 18% of non OSA patients

- Serious complications
  - Unplanned transfer to the intensive care unit
    - management of acute cardiac ischemia or arrhythmia
    - urgent need for respiratory support (ventilator or CPAP)

24% of OSA patients vs. 9% in the non OSA patients

Gupta RM et al. Mayo Clin Proc. 2001;76:897-905

Most complications occurred on post operative day #1

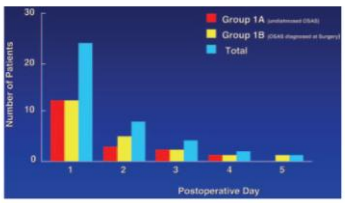


FIGURE 1. Time course of postoperative complications in patients undergoing hip or knee replacement. Based on data from Gupta et al.[44]

- OSA patients → in hospital longer (6.8 vs. 5.1 days)
- Pre-surgery CPAP usage associated with improved complication rate
  - Very few patients used CPAP postoperatively

Kaw R et al. CHEST. 2006; 129:198-205

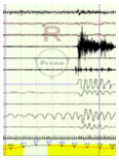
Adverse Outcomes in OSA Patients Undergoing Surgery

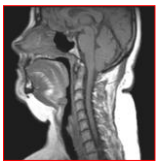
Study	Number of patients	Types of surgery	Higher incidence of events in OSA group
Retrospective matched cohort Liao et al. Can J Anaesth. 2009	240 OSA 240 matched controls	▪Cardiothoracic ▪Gastrointestinal ▪Gynecologic ▪Orthopedic ▪Otolarnygology ▪Plastics ▪Urology	▪Respiratory complications ▪Oxygen desaturations ▪Prolonged oxygen therapy ▪Need for additional monitoring ▪More ICU monitoring
Retrospective case control study Gupta et al Mayo Clin Proc. 2001	101 OSA 101 matched controls	▪Orthopedic - Hip replacement - Knee replacement	▪Unplanned ICU transfers ▪Cardiac events ▪Longer hospital length of stay
Prospective case control study Hwang et al Chest. 2008	74 OSA 98 without OSA	▪Cardiothoracic ▪Gastrointestional ▪Gynecologic ▪Orthopedic ▪Otolaryngology ▪Urologic	▪Respiratory ▪Cardiovascular ▪Gastrointestional bleeding ▪Longer postanesthesia recovery stay
Retrospective case control study Kaw et al J Cardiovas Surg. 2006	37 OSA 185 matched control	▪Cardiothoracic	▪Encephalopathy ▪Postoperative infections (mediastinitis) ▪ICU length of stay

Adesanya AO, Lee W, Grelich NB, and Joshi GP. CHEST 2010;138:1489-1498

The impact of anesthetics, analgesics, and sedatives on OSA

- Impaired arousal reflex
  - Central nervous system depression
  - Decreased response to hypoxia or hypercapnia
  - Decreased respiratory drive
  - Prolonged apneas → worse desaturation
- Unstable upper airway
  - Relaxed pharyngeal muscle tone
  - Increased collapsibility of the upper airway
  - Increases upper airway resistance
- Physiologic impact of obesity
  - Compromised lung mechanics (decrease in FRC)
  - Challenging airway management
- RESPIRATORY COMPLICATIONS
  - Hypoventilation and hypoxia

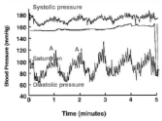




Jain SS and Dhand R. Curr Opin in Pulm Med. 2004; 10:482-488

OSA and Perioperative Setting

- Cardiovascular impact of OSA
  - Arrhythmia (afib, PVCs, SVT, bradycardia)
  - Hypertension
  - Coronary artery disease
  - Congestive heart failure



- Supine positioning may exacerbate obstructive respiratory events
- REM Rebound
  - Patients with severe OSA, may be chronically sleep deprived
  - May experience significant REM rebound upon receiving opioids
    - Exacerbates obstructive respiratory events
    - May contribute to hemodynamic instability, myocardial ischemia

Kaw R et al. CHEST. 2006; 129:198-205

Original Article

Prevalence of undiagnosed obstructive sleep apnea among adult surgical patients in an academic medical center

Kevin J. Finkel[a], Adam C. Searleman[a], Heidi Tymkew[a], Christopher Y. Tanaka[a], Leif Saager[a], Elika Safer-Zadeh[a], Michael Bottros[a], Jacqueline A. Selvidge[a], Eric Jacobsohn[b], Debra Pulley[a], Stephen Duntley[c], Colleen Becker[d], Michael S. Avidan[a,c]

[a]Washington University School of Medicine, Department of Anesthesiology, 660 S Euclid Ave, Campus Box 8054, St. Louis, MO 63110, USA
[b]University of Manitoba, Department of Anesthesia, Lennox Bell Lodge, LB315, 60 Pearl St., Man., Canada R3E1S2
[c]Washington University School of Medicine, Sleep Medicine Center, 212 N Kings Highway Suite 237, St. Louis, MO 63108, USA
[d]Barnes-Jewish Hospital, Perioperative Services, One Barnes-Jewish Hospital Plaza, #90/72-406, St. Louis, MO 63110, USA

- What is the prevalence of undiagnosed OSA in the surgical population?
- 1 academic tertiary care hospital in St. Louis, MO
- 2877 patients (elective surgery) screened for OSA using a questionnaire
  - ARES (apnea risk evaluation system)
    - Combination of Berlin questionnaire, Flemons Index, and Epworth sleepiness score
  - 23.7% were high risk for OSA (661 patients)
    - Most were not previously diagnosed
    - Portable sleep study detected OSA in 82% of these individuals (534 patients)
      - AHI > 5
  - Overall prevalence of OSA was ~ 22%

Finkel KJ et al. Sleep Medicine. 2009; 10: 753-758

SPECIAL ARTICLES

Anesthesiology 2006; 104:1081-93

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

- Guidelines → not standards or absolute requirements
  - Improve perioperative care
  - Reduce the risk of adverse outcomes in patients with OSA
  - Develop clinical screening tools to identify undiagnosed OSA patients

Anesthesiology 2006; 104:1081-93

Perioperative Management of OSA

PERIOPERATIVE CPAP USAGE

Preoperative Evaluation

- What screening questionnaires are available to diagnose OSA?
  - Gold standard – attended, polysomnogram
    - Limitations of resources, expense, and time constraints of arranging the study before surgery
  - A non sleep trained physician (anesthesiologist, primary care physician, or surgeon) may be the first health professional to inquire about sleep disordered breathing
    - STOP Bang
- When is it appropriate to defer elective surgery?
  - Sleep medicine consultation timing?
    - Severe untreated OSA with a major elective surgery
- High risk patients should be steered away from the ambulatory surgical arena
  - Consideration of in-hospital monitoring
- Optimize other comorbidites associated with obesity and OSA
  - HTN, DM, CHF, arrhythmias, CAD

Passannante AN and Tielborg M. Clin Chest Med. 2009; 30:569-579

Intraoperative Management

What can be done to reduce complications?

- Few studies address anesthetic management of OSA patients
- Anticipation of difficult airway
  - ASA difficult airway management guidelines
- Consideration of regional anesthesia, if feasible
  - Minimize opioids, or use of short acting agents
  - Use of nerve block or epidural catheters
- Careful extubation parameters
  - The patient is conscious, alert, and breathing spontaneously
  - Full reversal of neuromuscular blocking agents
  - Upright and > 30 degrees
    - Supine position can exacerbate OSA

Anesthesiology 2006; 104:1081-93

Postoperative Management

What should be done in the post anesthesia care unit (PACU)?

- Close monitoring until level of consciousness improves and analgesic requirements are minimized
  - Hypoxemia (oxygen may or may not be helpful)
  - Hypercapnia
- What type of monitoring should be performed after leaving the post anesthesia recovery room?
  - ICU, step down unit, or telemetry floor
  - Close monitoring should be performed for the 1st 24 hours
    - Highest risk of complications
    - Continuous pulse oximetry (remote pulse oximetry)
- Can we assess what happened in the post anesthesia recovery room as a guide to triage patient disposition?

AASM
Journal of Clinical Sleep Medicine
SCIENTIFIC INVESTIGATIONS

Management Plan to Reduce Risks in Perioperative Care of Patients with Presumed Obstructive Sleep Apnea Syndrome

- Could a combined preoperative and postoperative management plan PREDICT patients at highest risk for hypoxemia at 24-48 hours?
  - Step 1: Preoperative screening tool for OSA
    - SACS (sleep apnea clinical score) → > 15 is high risk for OSA
  - Step 2: Postoperative monitoring of respiratory episodes (PACU)
    - 30, 60, and 90 minutes after extubation
      - number of apneas
      - need for supplemental oxygen
      - pain/sedation mismatch (high pain score with high sedation score)
      - episodes of desaturation
  - Step 3: Followed patients discharged to the hospital with continuous pulse oximetry
    - Followed ODI (oxygen desaturation index → # 4% desats for 10 seconds)

Gali B et al. J Clin Sleep Med. 2007;3(6):582-588

PACU Data Sheet

Date_____
Patient's Name_____ Clinic Number: __-__ __-__ __ __

Time of Admission to PACU (military time)_____

Time of Extubation_____

Initial evaluation: 30 minutes after extubation or PACU admission (whichever occurs later)
Time:_____
___ Hypopnea < 8 respirations/minute (3 episodes)
___ Apnea > 9 seconds (1 episode)
___ Desaturations < 90% on pulse oximetry (3 episodes) on Nasal Cannula
___ Ramsay score > 3 and Pain scale Score >5
___ No events
Ramsay Score _____

Second Evaluation: 30 minutes after initial evaluation (60 minutes after extubation or PACU admission)

Third Evaluation: 30 minutes after second evaluation (90 minutes after extubation or PACU admission)

Modified Ramsay Sedation Scale	
Patient anxious and irritated, or restless, or both	1
Cooperative, oriented and tranquil	2
Responds to commands only	3
Brisk response to light glabellar tap or loud auditory stimulus	4
Sluggish response to a light glabellar tap or loud auditory stimulus	5
No response to a light glabellar tap or loud auditory stimulus	6

0 — 10
No pain — Worst pain

Visual analog scale (VAS): a 100 mm line with "no pain" at the beginning, and "worst pain" at the end. Patients place a mark to estimate their pain, and the distance from the origin (no pain) is measured.

Figure 2—Postanesthesia Care Unit (PACU) Evaluation Form

Post operative hypoxia noted for highest risk group

Group 1 – low SACS and no post op events — LOW risk
Group 2 – high SACS and no post op events — MODERATE risk
Group 3 – high SACS and frequent post op events — HIGH risk

	Group 1 Low risk (n=25)	Group 2 Moderate risk (n=92)	Group 3 Highest risk (n=23)
ODI < 10	88%	63%	43%
ODI > 10	12%	37%	57%

Gali B et al. J Clin Sleep Med. 2007;3(6):582-588

What is the role of perioperative CPAP treatment on perioperative complications?

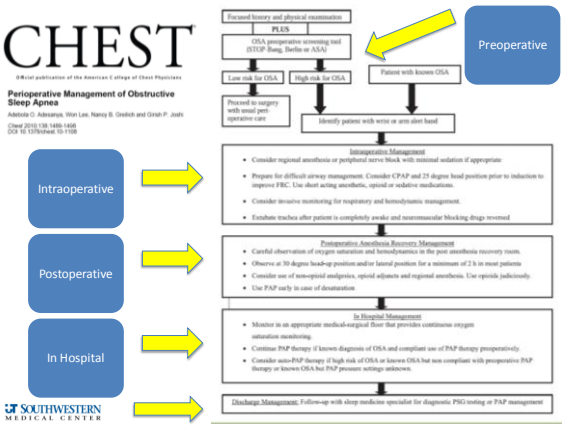
- CPAP is the most efficacious immediate <u>noninvasive</u> treatment for OSA
- What is the potential benefit of PREOPERATIVE CPAP usage?
  - Preoperative CPAP use (not postoperative use) resulted in improvement of postoperative complications → retrospective data
  - Preoperative CPAP for 4-6 weeks may reduce upper airway edema, increase pharyngeal size, decrease tongue volume
- BUT → ~30-40% of patients are INTOLERANT to CPAP therapy

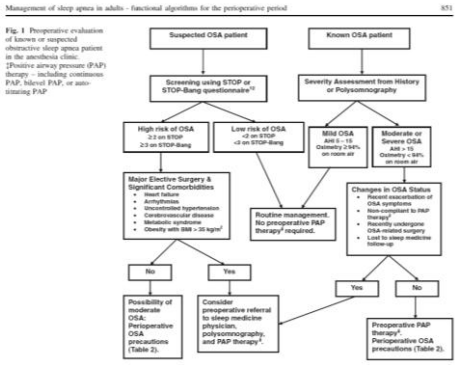
Jain SS and Dhand R. Curr Opin Pulm Med. 2004; 10:482-488

Postoperative Use of CPAP Therapy?

- No consensus agreement on whether CPAP should be administered if there is evidence of apneas and desaturation or if hypoxia persists
  - Insufficient evidence from the literature to evaluate whether the perioperative use of CPAP may reduce adverse events in OSA patients undergoing surgery
    - Well designed research studies are lacking
- Those patients compliant with CPAP preoperatively should probably continue CPAP usage postoperatively
  - Cardiovascular benefits
- May be difficult for those who have never used CPAP therapy or those who were non compliant with CPAP therapy to use CPAP therapy perioperatively
  - The post operative setting is not really the ideal time to start a patient on CPAP therapy, if he/she has not been on positive pressure therapy before
  - CPAP may cause agitation or pain

Jain SS and Dhand R. Curr Opin Pulm Med. 2004; 10:482-488
Chung SA et al. Anesth Analg. 2008; 107:1543-1563





Seet E and Chung F. Can J Anesth/J Can Anesth. 2010; 57:849-864.

Obstructive Sleep Apnea

Future

- Epidemiology of sleep apnea
  - Increasing obesity rates
  - Undiagnosed OSA
- Diagnostic testing
  - Out of center sleep testing (OCST) → portable/home sleep studies
  - Alternatives to CPAP therapy

Epidemiology of OSA

- Obstructive sleep apnea syndrome
  - OSA and daytime sleepiness
  - Common sleep disorder → multiple studies
    - 4% of men
    - 2% of women
- Largely unrecognized in the general population
  - Up to 80% of patients are not diagnosed
    - Poor awareness of OSA
    - Lack of routine screening
    - Limited number of diagnostic sleep study facilities

TABLE 1

Population-based studies reporting the prevalence of OSA and OSA syndrome

Study	Number of subjects	AHI ≥ 5	AHI ≥ 15	OSA syndrome	Methodology	Hypopnea Definition[f]
Wisconsin, U.S.A.[f] 1993 [20]	Men: 352 Women: 250 (age 30–60)	Men: 24% Women: 9%	Men: 9% Women: 4%	Men: 4% Women: 2%	Attended PSG (oronasal airflow and respiratory inductance plethysmography)	Discernable reduction in airflow plus ≥ 4% oxygen desaturation[†]
Pennsylvania, U.S.A.[¶] 1998, 2001 [22,23]	Men: 741 Women: 1000 (age 20–100)	Men: 17% Women: 5%	Men: 7% Women: 2%	Men: 3.3% Women:1.2%	Attended PSG (oronasal thermocouple)	Discernable reduction in airflow and ≥ 4% oxygen desaturation[†]
Spain[¶] 2001 [21]	Men: 325 Women: 235 (age 30–70)	Men: 26% Women: 20%	Men: 14% Women: 7%	Men: 3.4% Women:3%	Attended PSG (oronasal thermistor)	30% airflow reduction Accompanied by either ≥ 4% oxygen desaturation or an EEG arousal
Australia[f] 1991 [24]	294 men (age 40–65)	Men: 25.9%	Men: 10% (AHI ≥ 10)	Men: 3.1% Women: n/a	MESAM IV portable monitoring (sensing and oximetry)	≥ 3% oxygen desaturation along with increased heart rate of 10 beats/minute as logic of sensing
Hong Kong, China[f] 2001, 2004 [25,26]	Men: 153 Women:106 (age 30–60)	Men: 8.8% Women: 3.7%	Men:3.3% Women: 1.2%	Men: 4.1% Women:2.1%	Attended PSG (oronasal thermistor, thoracic and abdominal impedance belts)	Discernable reduction in airflow and ≥ 4% oxygen desaturation[†]
Korea[f] 2004 [27]	Men: 309 Women: 148 (age 40–69)	Men: 27% Women: 16%	Men: 10.1% Women: 4.7%	Men: 4.5% Women:3.2%	In laboratory or home PSG (oronasal thermistor)	Discernable reduction in airflow and ≥ oxygen 4% desaturation
India[f] 2004 [28]	210 men (age 35–65)	Men: 19.3%	Men: 8.4%	Men: 7.3% Women: n/a	Home PSG (oronasal thermistor)	Discernable 50% reduction in airflow and ≥ 4% oxygen desaturation[†]
India[f] 2006 [29]	Men: 88 Women: 63 (age 30–60)	Men: 19.7% Women: 7.4%	n/a	Men: 4.9% Women:2.1%	Attended in laboratory PSG	Discernable 50% reduction in airflow and ≥ 4% oxygen desaturation[†]

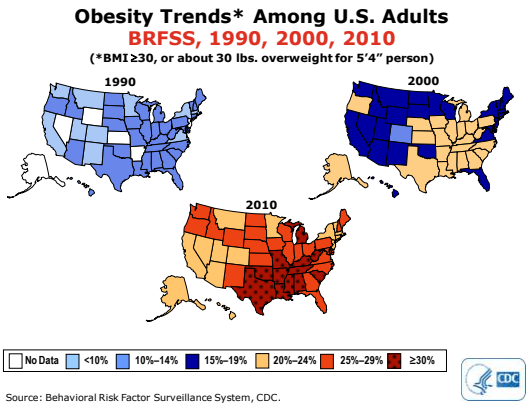
[f]Studies that did not use EEG microarousal as part of the definition of hypopnea

[#]OSA Syndrome defined as: AHI ≥ 5 + EDS

[#]OSA Syndrome defined as: AHI ≥ 10 + EDS

MESAM IV: Madono Medizin-Elektronik – Freiburg, Germany; PSG: Polysomnography

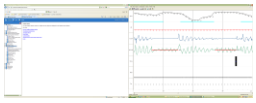
~ 1 in 5 adults have mild OSA
~ 1 in 15 adults have moderate or severe OSA



Portable Monitoring

53 year old obese man
Hypertension and hyperlipidemia
STOP Bang → 5/8 questions positive

- AHI 42
- Total recording time 225 minutes
- Desaturations to 80%



Portable Monitoring

Portable Monitoring vs. Laboratory Testing

Portable testing

- Pros
  - Less expensive
  - Improve access to care
  - Less discomfort for patients
- Cons
  - Suboptimal monitoring
    - Can't assess sleep (no EEG)
    - Loss of airflow or pulse oximetry data
  - Loss of equipment
  - Other markers (arrhythmias, legs)
- CPAP adherence?

Laboratory testing

- Pros
  - Detailed, comprehensive testing
  - Monitoring, safety
  - Recognition of complex breathing
  - Arrhythmias
- Cons
  - More expensive, more cumbersome
  - Limited access → depending on geographic area
- CPAP adherence?

Recent trials comparing home vs. lab testing

Study Study design	Number of patients	Methods	Outcomes Time points
Berry RB et al Sleep. 2008 31(10): 1423-1431. Randomized, prospective Single center University of Florida	53 patients – LAB 53 patients - HOME	LAB - attended diagnostic and CPAP titration studies HOME – level 3 device – WatchPAT100 (peripheral arterial tone, heart rate, pulse oximetry, actigraphy)	No difference in nightly CPAP adherence, sleepiness severity, quality of life, CPAP satisfaction at 6 weeks
Skomro RP et al Chest 2010 138(2): 257-263. Randomized, prospective Single center University of Saskatchewan	51 patients – LAB 51 patients – HOME	LAB – attended diagnostic and CPAP titration study, split study if indicated HOME – level 3 home test, followed by 1 week of auto CPAP	No difference in sleepiness scores, quality of life, blood pressure, or CPAP adherence at 4 weeks
Kuna ST et al AJRCCM. 2011. 183(9): 1238-1244 Randomized, prospective 2 centers – VA Medical Centers	148 patients – LAB 148 patients – HOME	LAB – attended diagnostic and CPAP titration study, split study if indicated HOME – level 3 home test	No difference in functional outcomes of sleep questionnaire, CPAP adherence at 3 months
Rosen CL et al. SLEEP. 2012;35(6):757-767 Randomized, open-label, parallel group, unblinded, multicenter trial 7 sleep centers – University	186 patients - LAB 187 patients- HOME	LAB – attended diagnostic study and CPAP titration study HOME – home sleep testing and home auto CPAP titration	No difference - acceptance of PAP therapy, titration pressures, effective titrations, time to treatment 3 month PAP adherence was higher in the HOME arm

Top Reasons Patients Hate Wearing CPAP

- Reminds me of an anesthesia mask – bad childhood experience
- I look like Hanibel Lector

- CPAP is simply not seductive
- CPAP pressure is too high
- Difficulty breathing out against the machine
- Mask is uncomfortable

Personal communication – many patients

What are alternatives to CPAP therapy? How effective are they?

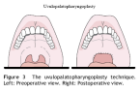


Figure 3 The uvulopalatopharyngoplasty technique. Left: Preoperative view. Right: Postoperative view.

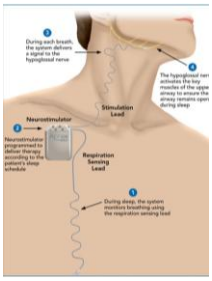
- Surgical options
  - UPPP (uvulopalatophrayngoplasty)
    - Success rates of around 40%
  - MMA (maxillomandibular advancement) and tracheostomy
    - Both are very effective
- Oral appliance – retrognathia patients
  - Can be effective, but in mild OSA

- Positional therapy
  - May be effective, but can't follow compliance to therapy

- Weight loss, most effective therapy
  - 10% reduction in weight = 30% reduction in AHI

Hypoglossal Nerve Stimulator

- Surgical implantation of hypoglossal nerve stimulator (HGNS) system
- Stimulates the hypoglossal nerve during inspiration sleep (sensed by change in thoracic impedance)



http://www.apnexmedical.com

RANDOMIZED TRIAL OF NOVEL EPAP DEVICE FOR TREATMENT OF OSA

A Novel Nasal Expiratory Positive Airway Pressure (EPAP) Device for the Treatment of Obstructive Sleep Apnea: A Randomized Controlled Trial

Richard B. Berry, MD[1], Meir H. Kryger, MD[2], Clifford A. Massie, PhD[3]

[1]Division of Pulmonary, Critical Care, and Sleep Medicine, University of Florida, Gainesville, FL; [2]Gaylord Sleep Medicine, Gaylord Hospital, Wallingford, CT; [3]Chicago Sleep Group of Suburban Lung Associates, Elk Grove Village, IL

- Nasal EPAP
  - Mechanical valve with very low inspiratory resistance but high expiratory resistance
  - Positive pressure throughout exhalation and splints the upper airway
- Applied to each nostril with band-aid adhesive
- Randomized, double-blind, sham-controlled study
- 3 months (77 patients using EPAP)
  - Median AHI 14.4 → 5.6
    - Oxygenation slightly improved also
  - Improved subjective daytime sleepiness scores
  - Reported nightly adherence rates of 88%
  - No serious adverse events

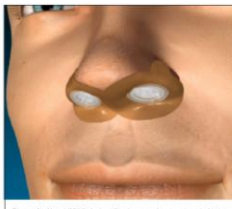


Figure 1—Nasal EPAP device. Single use valves are inserted into ea nostril and sealed with adhesive.

SLEEP 2011;34(4):479-485.

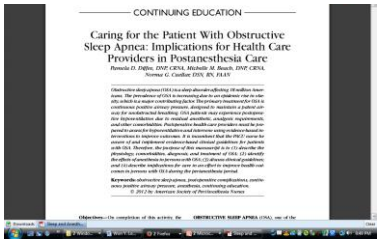
Future of Sleep Medicine

- Obesity epidemic
  - Screening for OSA in outpatient and peri-operative settings
- Increase portable monitoring
  - Appropriate patient selection (exclude cardiopulmonary disorders)
  - Appropriate review of raw data by board certified sleep physician
- Increase emphasis on longitudinal CPAP care, OSA as a chronic disease, Sleep Centers > Sleep Laboratories
  - Multidisciplinary care
    - Physicians trained in sleep (pulmonary, neurology, psychiatry, and internal medicine)
    - Physician extenders (NP, PA)
    - Ancillary staff (RT, RPSGT, RN)
  - Preventative care → primary and secondary cardiovascular events
  - Other sleep conditions
    - Narcolepsy, RLS/PLMD, insomnia, parasomnias
- Research on alternative treatments for OSA → ongoing efforts
- Noninvasive positive pressure ventilation → expanding role chronic hypercapnic respiratory failure
  - Neuromuscular population/chronic respiratory failure → ALS, diaphragm disorders
  - Expertise in bilevel PAP, advanced ventilation, tracheostomy management

J Perianesth Nurs. 2012 Oct;27(5):329–40. doi: 10.1016/j.jopan.2012.05.012.

Caring for the patient with obstructive sleep apnea: implications for health care providers in postanesthesia care.

Diffee PD, Beach MM, Cuellar NG.
The University of Alabama, Capstone College of Nursing, Box 870358, Tuscaloosa, AL 35487, USA. diffdawglet@cox.net


CONTINUING EDUCATION

Caring for the Patient With Obstructive Sleep Apnea: Implications for Health Care Providers in Postanesthesia Care

Pamela D. Diffee, DNP, CRNA, Michelle M. Beach, DNP, CRNA, Norma G. Cuellar DDS, RN, FAAN

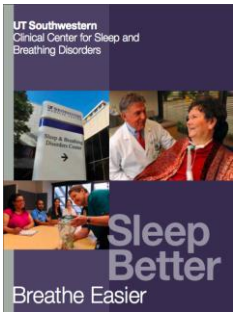
SASM - PROCEEDINGS OF 2012 ANNUAL MEETING

Society of anesthesia and sleep medicine: proceedings of 2012 annual meeting

Roop Kaw · Babak Mokhlesi · Frances Chung · Peter Gay · Norman Bolden · David Hillman

Received: 18 March 2013 / Accepted: 25 March 2013

Clinical Center for Sleep and Breathing Disorders



Obstructive Sleep Apnea in the Perioperative Setting

"You snooze, you lose…"

TAPAN – Texas Association of Perianesthsia Nurses Conference
October 2013 – Grapevine, Texas

Won Y. Lee, M.D.
Assistant Professor of Medicine
Division of Pulmonary and Critical Care Medicine
Medical Director, Clinical Center for Sleep and Breathing Disorders

UT SOUTHWESTERN MEDICAL CENTER