OBSTRUCTIVE SLEEP APNEA AND THE SURGICAL PATIENT

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OSA and the Surgical Patient

- Sleep Disordered Breathing
  - Simple snoring
  - Upper airway resistance syndrome (UARS)
  - Obstructive sleep apnea
  - Central sleep apnea with or without Cheyne-Stokes Respirations
  - Complex sleep apnea
  - Unobstructive hypoventilation

Clinical Scenario

- 45 year old male, 320 lbs and 5'11" had a rotator cuff repair under general anesthesia. The intraoperative course was uneventful. He was admitted to the ward for overnight pain control.
- Four hours after surgery, he received an intramuscular injection of Meperidine 100 mg with Phenergan 25 mg. This was repeated 3 hours later when severe pain prevented him from sleeping.
- Two hours later, nurses making a routine check found him to be in full arrest. He could not be resuscitated. The internist's history and physical mentioned his having been diagnosed with sleep apnea.

Ann Lofsky, M.D. Sleep Apnea and Narcotic Postoperative Pain Medication: A Morbidity and Mortality Risk

Clinical Scenario

- A 32 year old presented for an open reduction and internal fixation of an arm fracture, which was satisfactorily performed under general anesthesia. He was discharged to the ward on a fentanyl PCA (pt controlled analgesia) with a 25mcg bolus, 12-minute delay, and 25mcg hourly rate.
- At night, the nurses heard him snoring loudly. One hour after his last normal vital signs, he was found in respiratory arrest. He was resuscitated, but displayed signs of anoxic brain damage.
- By questioning the patient's wife, a consultant was able to elicit the husband's history of heavy snoring and nocturnal apneic spells that were felt to be clinically consistent with a diagnosis of sleep apnea.

Ann Lofsky, M.D. Sleep Apnea and Narcotic Postoperative Pain Medication: A Morbidity and Mortality Risk

OSA and the Surgical Patient

- The pharynx is a hollow potentially collapsible tube without rigid fixed bony structures for support and surrounded entirely by soft tissue.
- Patency is dependent on
  - Intrinsic mechanical stiffness of the airway
  - Upper airway muscle activity
- The imbalance of these forces is critical to the development of upper airway obstruction

Obstructive Sleep Apnea

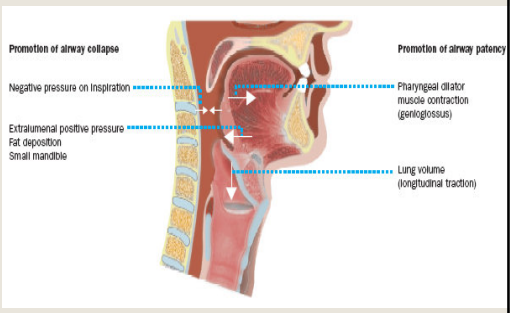
Airway collapse

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

Airway patency

- Pharyngeal dilator muscle contraction
  - Genioglossus
  - Tensor palantini
- Lung volume
  - Increased lung volume stiffer airway

The Balance of Forces (Malhotra & White, 2002)



Obstructive Sleep Apnea

- As a consequence of the previous factors patients with OSA are increasing dependent on the activity of the pharyngeal dilator muscles for airway patency.
  - OSA patients demonstrate increased EMG activity in the pharyngeal dilator muscles (Genioglossus muscle) during wakefulness.
  - The reduction in EMG activity in these muscles at sleep onset is greater in OSA patients than normals.
  - OSA patients have a reduced ability to compensate for factors that predispose them for upper airway collapse
    - Increased negative pharyngeal pressures during inspiration
    - Reductions in upper airway muscle tone

OSA and the Surgical Patient

- Factors in OSA which could result in increased perioperative complications
  - Anatomic imbalance
  - Lung volume reduction (Decreased FRC and ERV)
  - Sympathetic nervous system activation
  - Respiratory instability (loop gain)

OSA and the Surgical Patient

- Impact of sedatives, anesthetics, and analgesics (opioids) on respiratory function
  - Dose dependent depression of muscle activity of the upper airway muscles
    - Depression of central respiratory output/upper airway reflexes
    - Increased collapsibility of the upper airway
  - Direct action on hypoglossal (tongue) and phrenic (diaphragm) nerves
    - Phrenic nerve depression – decreases in lung volume
  - Alterations in apneic threshold/hypoxic sensitivity
  - Alterations in the chemical/metabolic/behavioral control of breathing

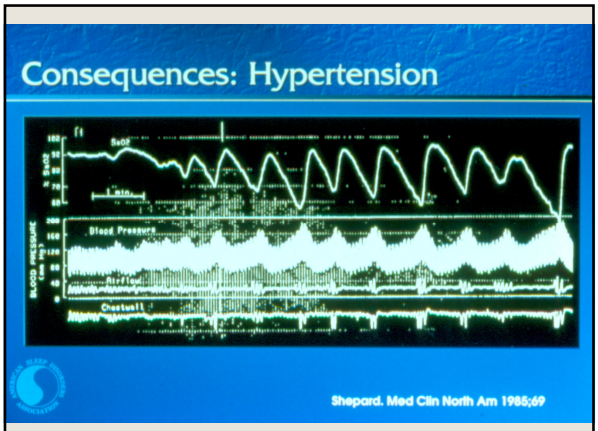
OSA and the Surgical Patient

- Opioids impact on sleep disordered breathing
  - Increases in apnea duration
  - Greater degree of oxygen desaturation
  - Irregular breathing pattern (chronic)
  - Non obstructive hypoventilation

OSA and the Surgical Patient

- Increase in sympathetic nervous system activation (catecholamine excess)
  - Surgical stress
  - Hpoxemia/Hypercarbia
  - Arousals
- Related to an increased risk of cardiac arrhythmias, cardiac ischemia and hypertension .
- Majority of unexpected and unexplained postoperative deaths occur at night and within 7 days of surgery. Rosenberg, J. et al British Journal of Surgery 1992.

Consequences: Hypertension



OSA and the Surgical Patient

- Risk factors for postoperative complications
  - Presence of sleep disordered breathing
    - OSA, OSA-OHS, OSA-CSA/CSR
    - Hypoxemia, hypercapnea, sympathetic activation
  - Impact of neuraxial/parenteral opioids; sedatives; general anesthesia on the upper airway and OSA
  - Site and invasiveness of surgery
  - Co-morbid conditions

OSA and the Surgical Patient

- Additional risk factors for postoperative complications
  - Sleep fragmentation/deprivation
  - Supine position
  - Re-establishment of sleep patterns following a period of sleep disruption (REM rebound).

OSA and the Surgical Patient

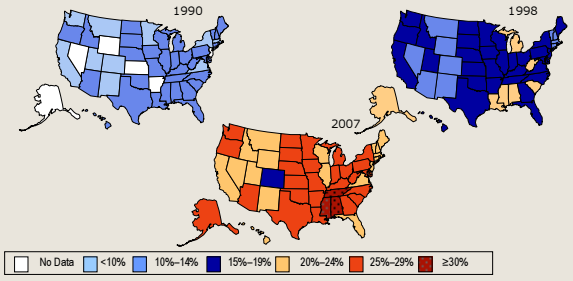
- What is the scope of the problem?
- How does anesthesia and post operative care affect individuals with obstructive sleep apnea?
- Does OSA result in postoperative complications more frequently than the general population?

OSA and the Surgical Patient

- What is the prevalence of obstructive sleep apnea in the general surgical population?
  - Data obtained primarily from screening questionnaires.
  - Results would suggest that 25%-30% of patients presenting for elective general surgery would screen positive for OSA.
- Is this going to be less of a problem or more of a problem in the future?

Obesity Trends* Among U.S. Adults BRFSS, 1990, 1998, 2007

(*BMI ≥30, or about 30 lbs. overweight for 5'4" person)



OSA and the Surgical Patient

- Critical points of the NHANES data
  - Prevalence of clinically severe obesity is increasing much faster than that of moderate obesity.
    Strum, R. Increase in morbid obesity in the USA. Public Health 2007, 121(7), 492-496. Data from 2000-2005.
  - BMI > 40 kg/m2 has increased fivefold
    - 1:200 adults to 1:33 adults
  - BMI > 50kg/m2 has increased tenfold
    - 1:2,000 adults to 1:200 adults
- More not less of these individuals will be showing up for surgical intervention.

OSA and the Surgical Patient

- How is Obstructive Sleep Apnea affected by the surgical process?
- Abstract: Evolution of Sleep Pattern and Breathing Disorders During First Seven Nights After Surgery-A Pilot Study. Chung, F. et al.
  - 14 patients underwent 10 channel portable sleep test. Preoperative, Post op night 1,3,5,7.
  - 9 males, 5 females. Age 65+-5. BMI 31+- 6.
  - Surgeries: 11 orthopedic, 1 spine, 1 gyn.
  - Anesthesia: 4 GA 10 regional

OSA and the Surgical Patient

- Preoperative AHI 13.3/hr +-29. BMI 31+-6
  - AHI > 5/hr. in 6 pts. (43%) REM% 22%
  - PON 1 AHI 21.3 REM% 6.7%
  - PON 3 AHI 25.0 REM% 13%
  - PON 5 AHI 20.6 REM% 17%
  - PON 7 AHI 15.5 REM% 18%
- Maximum increase in AHI at 72 hours post-op.
- No comment regarding use of narcotics.

OSA and the Surgical Patient

- Does the presence of obstructive sleep apnea place patients at increased risk for postoperative complications?
  - Respiratory or cardiovascular difficulties
  - Transfer to higher level of care acuity
  - Increased length of hospital stay
  - Mortality

OSA and the Surgical Patient

- Post operative complications in patients with OSAS undergoing hip/knee replacement: a case control study. Gupta, et al. Mayo Clinic Proceedings 2001: 76, 897-905.
  - Retrospective case-control study in orthopedic surgery. Pts underwent hip or knee replacement within 3 years before or anytime after OSA diagnosis. Total-101. Matched controls: same operation without OSA.
  - 36 pts joint surgery before OSA dx; 65 pts joint surgery after OSA dx .
  - 33/65 pts were using CPAP at home preoperatively.
    - 11/32 non-compliant
    - 21/32 mild OSA no treatment

OSA and the Surgical Patient

- Results:

	Complications	Major	LOS
OSA	39%	24%	6.8 days
Control	18%	9%	5.1 days

- Complications included: episodic hypoxemia(9), reintubation(2), acute hypercapnia(2), myocardial ischemia(5).
- Unplanned ICU transfer(20)/control(6)
- No association in severity of OSA and complications
- Patients not using CPAP at home (milder OSA) than those on CPAP had worse outcomes.

OSA and the Surgical Patient

- Postoperative complications
  - Higher reintubation rates
  - Hypoxemia / Hypercarbia
  - Arrhythmias
  - Myocardial ischemia
  - Increased transfers to higher level of care
  - Increased length of hospitalization
  - Delirium

OSA and the Surgical Patient

- Malpractice cases involving Obstructive Sleep Apnea
  - Intubation complications (20%)
  - Extubation difficulties (10%)
  - Post operative catastrophes (70%)

OSA and the Surgical Patient

- Post operative catastrophes ("Dead in bed")
  Characteristics of typical malpractice patient
  - Severe OSA
  - Morbid obesity
  - Isolated ward room
  - No monitoring
  - Receiving narcotics
  - Off O2/PAP

Jonathan L. Benumof, M.D.

OSA and the Surgical Patient

- Prevalence of obstructive sleep apnea appears to be increasing in association with the increase in obesity. The prevalence of both known and unknown obstructive sleep apnea in the surgical population will be increasing in the future.
- These patients are at increased risk for post operative complications and death that may be reduced with appropriate screening and post operative monitoring.

OSA and the Surgical Patient

- OSA patients will present for surgery in one of four ways:
  - Known OSA on PAP therapy
  - Mild OSA on no therapy currently
  - SUSPECTED OSA
    - Goal: Provide appropriate monitoring and access to post operative evaluation; if needed longitundinal care.
  - UNRECOGNIZED OSA
    - Goal: Minimize the number of these patients presenting for surgery

OSA and the Surgical Patient

- Know moderate/severe OSA on therapy:
  - Primary focus: assess status
    - Compliance with therapy
    - Resolution of symptoms
    - Development of comorbid conditions
    - Continue PAP therapy postoperatively
      - Pressure requirements may transiently increase postoperatively

OSA and the Surgical Patient

- Mild OSA
  - No active therapy
  - Asymptomatic or minimally symptomatic
  - May become symptomatic postoperatively
    - Gupta et al. study. Complication rate not related to severity of OSA
- These are the most dangerous patients:
  - SUSPECTED OSA
  - COMPLETELY UNRECOGNIZED

OSA and the Surgical Patient

- Questions to ask:
  - How do you screen patients preoperatively?
  - What do you do with patients that screen positive?
  - How do you monitor these patients?
  - How and when do you treat patients that screen positive?
  - What happens after discharge?

OSA and the Surgical Patient

- Clinical management strategy
  - Preoperative Screening (Identification)
  - Monitoring (Keeping the patient safe)
  - Discharge (Longitudinal evaluation and care)

ASSESSMENT

&

SCREENING

OSA and the Surgical Patient

- Purpose of OSA Screening (Identification)
  - Eliminate or markedly reduce the unrecognized OSA patient presenting for surgery
  - Heightened awareness of which patients may be at increased postoperative risk
  - Opportunity to identify poorly compliant PAP patients
  - Limitation: Screening does not discriminate between mild and moderate/severe OSA. Does not identify true "at risk" patients.

OSA and the Surgical Patient

- Potential methods of screening pre-operatively
  - Screening Questionnaires/Clinical Prediction Algorithms
  - Questionnaire alone
  - Questionnaire (+) then nocturnal oximetry
  - Questionnaire (+) then limited channel testing
  - Questionnaire (+) then in lab polysomnography

OSA and the Surgical Patient

- Screening Questionnaires
  - Berlin questionnaire
  - ASA Checklist
  - STOP and STOP-BANG questionnaire
  - Sleep Apnea Clinical Score (SACS)

OSA and the Surgical Patient

Validation of the Berlin Questionnaire and American Anesthesiologists Checklist as Screening Tools for OSA in Surgical Patients.

Chung, F. et al. Anesthesiology V 108 No 5 May 2008, 822-830.

Preoperative pts 18 yrs or older and without previously diagnosed OSA.

2,467 patients were screened:

OSA and the Surgical Patient

- Classified as high risk of OSA
  - Berlin Questionnaire 33%
  - ASA Checklist 27%
  - STOP Questionnaire 28%
- No significant difference in the questionnaires in the ability to identify patients with OSA.
- Approximately 30% of general surgical patients will screen positive for OSA.

OSA and the Surgical Patient

Screening Questionnaires

	Berlin	ASA	STOP/BANG
# items	11	12/14	4/8
# categories	3	3	1
Format	mlt choice	checklist	yes/no

OSA and the Surgical Patient

- STOP and STOP-BANG
  - 4 questions or 8 questions (yes/no)
  - S-snoring; T-tired; O-observed you stop breathing; P-blood pressure.

  Addition of the BANG

  B-BMI>35 kg/m2; A-Age> 50 years; N-neck circumference > 40cm (15.75 in); G-gender (male).

  YES to three or more questions suggests a high risk for OSA (STOP-BANG).

OSA and the Surgical Patient

- Sensitivity (STOP-BANG Questionnaire)
  - AHI>5 STOP 65.6% STOP-BANG 83.6%
  - AHI>15 STOP 74.3% STOP-BANG 92.9%
  - AHI>30 STOP 79.5% STOP-BANG 100%
- Negative Predictive Value (NPV)
  - AHI>5 STOP 44.0% STOP-BANG 60.8%
  - AHI>15 STOP 76.0% STOP-BANG 90.2%
  - AHI>30 STOP 89.3% STOP-BANG 100%

OSA and the Surgical Patient

- Data suggests that the use of screening questionnaires can reliably identify patients at risk for obstructive sleep apnea.
  - Sensitivity and negative predictive value good.
  - False positive rate is 15%-20%.
  - Majority that screen positive will have mild obstructive sleep apnea.
    - Roughly 50% mild OSA; 33% mod/severe OSA; 13% severe OSA

OSA and the Surgical Patient

- Screen positive for OSA. Now what?
  - Monitor perioperatively
  - Intervene with PAP therapy for cardiopulmonary difficulties.
  - Evaluate and treat after discharge.
  - Evaluate and treat prior to surgery.
    - Choice of diagnostic study.
    - Who do you treat?
    - Mode of treatment?
    - Process has to be completed in a timely fashion.

OSA and the Surgical Patient

- Diagnostic testing:
  - In lab full polysomnography
  - Limited channel testing (portable sleep testing)
  - Autonomic measures of sleep disordered breathing
    - Peripheral arterial tone (PAT)
    - Heart rate variability
    - Cardiopulmonary coupling (CPC)

OSA and the Surgical Patient

- Use of Screening Questionnaire (Berlin) and ApneaLink portable sleep test in identifying at risk patients for OSA.
  - Forsyth Hospital (personal communication)
  - Population: Neurology and Orthopedic patients
  - 891 patients screening positive for risk of OSA (Berlin) underwent portable sleep testing using the ApneaLink.
  - Results:
    - 132 pts with RI 0-5.
    - 445 pts with RI 5-15.
    - 193 pts with RI 15-30. 33% screened moderate/severe OSA
    - 121 pts with RI >30. 13% screened severe OSA

OSA and the Surgical Patient

- False positive 132/891 (14%). Consistent with other studies.
- Conclusion: The ApneaLink added little additional value in the identification of patients at risk for OSA over the screening questionnaire alone in this hospital population.
- Caveat: No data on false negatives, i.e. Patients who screened negative on the Berlin Questionnaire but would have beeen positive on portable sleep test.

OSA and the Surgical Patient

- Decision if made to treat who do you treat:
  - Level of AHI (Normal < 5/hr)
    - AHI > 5/hr
    - AHI > 15/hr
  - Degree of oxygen desaturation (ODI, SpO2 nadir)
  - Patients that experience arrhythmias, ischemia, oxgen desaturation postoperatively (PACU)
  - Presence and severity of comorbid conditions

OSA and the Surgical Patient

- Treatment Preoperatively
  - CPAP level based on titration study
  - APAP or Auto-Bilevel
  - Bilevel if intolerant of CPAP or CPAP does not correct abnormality.
- Potential benefit of preoperative PAP therapy
  - Reduction in upper airway edema
  - Improved PAP compliance ?

MONITORING

OSA and the Surgical Patient

- Postoperative monitoring
  - Who should be monitored?
  - What level of monitoring is appropriate?
  - Where should the monitoring take place?
  - How long should monitoring be continued?

OSA and the Surgical Patient

- Monitoring based on:
  - Severity of Obstructive Sleep Apnea(AHI)
  - Positive Screening Questionnaire (suspected OSA)
  - Severity of oxygen desaturation on diagnostic test
  - Type of surgery and type of anesthesia
  - Use of post operative narcotics
  - Clinical course in PACU
  - Presence of comorbid conditions

OSA and the Surgical Patient

- CoMorbidities: should they be considered in the assessment of level of monitoring?
  - Higher Risk:
    - Atrial fibrillation
    - Congestive heart failure
    - Severe COPD
    - Coronary artery disease
    - Obesity (?) BMI > ?
  - Lower Risk:
    - Mild COPD
    - Hypertension
    - Diabetes Mellitus
    - Cerebrovascular disease

OSA and the Surgical Patient

- Monitoring Post operatively
  - Level of care (ward, step down unit, ICU)
  - Monitoring in room and central
  - Type of monitoring
    - Oximetry, ECG
    - Oximetry, ECG plus capnography
  - Duration of monitoring
    - Time: First 24 hours
    - During use of narcotics postoperatively
    - Ability to maintain SaO_2 > 90 % room air (with sleep?)

OSA and the Surgical Patient

- Monitoring in the postoperative period
  oximetry or oximetry with capnography

No studies which have demonstrated superiority of either monitoring strategy in:
- Reduction in postoperative complications
- Reduced length of stay
- Reduction in transfers to higher level of acuity of care.

Nonrandomized studies in individual institutions have suggested reductions in complications and reductions in transfers to higher levels of care with monitoring.

OSA and the Surgical Patient

- How long should monitoring be continued in the postoperative period?
  - Based on time from surgery?
  - Based on presence of post operative narcotics?

OSA and the Surgical Patient

- Monitoring
  - Most studies show majority of complications occur within the first 72 hours esp. the first 24 hours.
  - Results of pilot study showing increase in AHI maximum 72 hours postoperative.
  - Concept of REM rebound. Recovery of REM sleep may take 5-7 days post surgery.
- Recommendation
  - Minimum of 24 hours postoperatively demonstrating the ability to maintain oxygen saturation greater than 90% on room air with period of sleep. (ASA)

OSA and the Surgical Patient

- Law of unintended consequences:
  - Monitoring capability / Costs
  - Logistics/flow process
  - Increased demand for RCP services
  - Education
    - New technology i.e. capnography
    - New terms: AHI, ODI etc
    - New skill sets
  - False alarms: "alarm fatigue"
  - False sense of security

OSA and the Surgical Patient

- What should you do?
  - Minimum:
    - Screen preoperatively
    - Those that screen positive – special identification
    - Notification to primary care physician upon discharge of positive screen.

OSA and the Surgical Patient

- What should you do?
  - Maximum
    - Screen preoperatively
    - Those that screen positive: evaluation and those with moderate/severe OSA: treatment.
      - Evaluation: consultation; in lab and/or limited channel testing
      - Treatment: in lab titration and/or APAP.
    - Monitoring post operatively with use of PAP with sleep
    - Discharge: Notification of primary care physician
      Follow up with sleep physician for longitudinal care

OSA and the Surgical Patient

- What should you do?
  - Or something in between
- What are we doing?

OSA and the Surgical Patient

- Monitoring based on:
  - Severity of OSA
  - Type of surgery and anesthesia
  - Post operative narcotics

PROTOCOL FOR PREOPERATIVE SCREENING AND MANAGEMENT OF OBSTRUCTIVE SLEEP APNEA IN SURGICAL PATIENTS

SCREENING:Use of a modified STOP questionnaire to identify patients at risk for Obstructive Sleep Apnea. RN to perform pre-operatively.

OSA SCORING SYSTEM (defined by the ASA):

A) Severity of Obstructive Sleep Apnea

	Point score of 0-3.
AHI < 5/hr.	0
AHI 6-15/hr.	1
AHI 16-30/hr.	2
AHI >30/hr.	3

If SaO2 < 80% on sleep study, score as 2 (if AHI lower score).
Positive screening questionnaire (suspected OSA) score as 1/2.

B) **Invasiveness of surgery and anesthesia requirements**

Point Score 0-3

Type of surgery and anesthesia

Superficial surgery under local or peripheral nerve block anesthesia without sedation	0
Superficial surgery with moderate sedation or general anesthesia	1
Peripheral surgery w/spinal or epidural anesthesia (no more than moderate sedation)	1
Peripheral surgery with general anesthesia	2
Airway surgery with moderate sedation	2
Major surgery, general anesthesia	3
Airway surgery, general anesthesia	3

C) **Requirement for Postoperative Opioids**

Point score 0-3

Opioid requirement	
None	0
Low-dose oral opioids	1
High-dose oral opioids, parenteral or neuraxial opioids	3

Estimation of perioperative risk:

Score of A plus the GREATER score from either B or C
Total OSA RISK SCORE (0-6) : _____

OSSA and the Surgical Patient

- Recommendations for Monitoring
  - Monitoring based on OSA RISK SCORE
  - Protocols for use of PAP in patients with known OSA
  - Protocols for institution of APAP in suspected OSA patients that experience postoperative complications

OSA and the Surgical Patient

- Monitoring to include oximetry / ECG
  - OSA RISK SCORE 5-6
    - ASA – may be at significantly increased perioperative risk from OSA
  - OSA RISK SCORE 3-4
    - ASA may be at increased perioperative risk from OSA
  - Known OSA on CPAP therapy
    - Studies demonstrate desaturations occurring postoperatively even with PAP in place. Bolden et al. Journal of Clinical Anesthesia 2009
  - OSA RISK SCORE 2 or less
    - No specific monitoring required
  - Higher level on monitoring at the discretion of physician.
  - No role for capnography in current strategy
    - (?) patients with Obesity Hypoventilation (OHS) plus OSA

OSA and the Surgical Patient

- Known Obstructive Sleep Apnea
  - Home PAP and CPAP mask
  - RCP to assess compliance
  - Monitor with oximetry if OSA RISK SCORE > 2
  - Adjust PAP/oxygen if meets intervention criteria
  - D/C monitor when SpO2 > 90% on RA (NL FiO2) for 24 hours and 6 hours after last parenteral narcotic
  - Continue PAP therapy during hospitalization while asleep

OSA and Surgical Therapy

- Suspected OSA/ Mild OSA (no therapy)
  - Monitoring level based on OSA RISK SCORE
  - RCP to initate APAP therapy based on intervention criteria
  - RCP to change to auto-bilevel pressure if no response to APAP
  - Notify attending physician that APAP applied
  - D/C monitoring SpO2 > 90% on RA (NL FiO2) for 24 hours and 6 hrs after last parenteral narcotic
  - APAP continued during hospitalization in sleep

OSA and the Surgical Patient

- Intervention criteria
  - SpO2 < 90% despite supplemental O2
  - Transient desaturations SpO2 > 4 times per minute
  - Respiratory rate < 8 bpm
- Initiate APAP; notify attending physician

OSA and the Surgical Patient

- Intolerant/Noncompliant with PAP therapy
  - Behavioral therapy
    - Elevate Head of bed / Minimize supine position
    - Minimize narcotics / sedatives
  - O2 with sleep to maintain oxygen saturation > 90%
  - Discharge on O2
  - Follow up sleep consultation (out-patient)
    - Evaluation / Diagnostic testing
    - CPAP Clinic
    - Desensitization therapy
    - Discussion of alternative therapy for OSA

DISCHARGE ORDERS

OSA and the Surgical Patient

- Discharge recommendations
  - Establishment of protocols which ensure that individuals identified at high risk for OSA are referred for appropriate evaluation, treatment, and longitudinal care when appropriate.
  - Expedited referral for patients in which APAP was initiated during hospitalization.
  - Patients discharged on APAP if used during hospitalization.

OSA and the Surgical Patient

- Known OSA on PAP Therapy
  - Continue home PAP
  - If change in pressure or O2 added to be set up by Case Manager with DME
  - Appointment for patient follow up within 4 weeks with physician responsible for PAP management

OSA and the Surgical Patient

- Suspected OSA (Positive Screen)
  - Information regarding OSA and medical risks
  - Notification of positive screen to primary care physician
  - If PAP device used during hospitalization Case Manager to set up through DME for home use.
  - Sleep medicine referral for evaluation, treatment and if needed longitudinal care.

OSA and the Surgical Patient

- This program provides increased safety for our surgical patients as well as an additional opportunity to identify previously undiagnosed patients with obstructive sleep apnea, provide appropriate evaluation and long term care to reduce potential cardiovascular risk.

OSA and the Surgical Patient

- Opportunity for RCP to be a leader in the development and maintenance of PAP program
  - Protocol for PAP therapy
  - Compliance with PAP therapy in hospital / post operatively low.
    - Increase variety of PAP masks
    - Increase education regarding approriate mask fit
    - CPAP vs Bilevel.

OSA and the Surgical Patient

- Things to come?
  - Continuous Positive Airway Pressure: Evaluation of a Novel Therapy for Patients with Acute Ischemic Stroke.
    - Bravata, D. et al. Sleep Vol 34 No 9, 2011, 1271-1277.
    - Pts with acute ischemic stroke use of APAP to diagnose and treat OSA compared with control group.
    - Improvements in Stroke Scale in treated group.
  - Utilization in high risk medical patients.

Obstructive Sleep Apnea

- Marin, Lancet 2005
  - 10 year longitudinal study (n>1600)
    - Severe OSA (AHI>30,non-compliant), snorers, treated OSA, and healthy men.
    - Untreated OSA group higher risk of
      - Fatal and nonfatal cardiovascular events
      - 2.9-fold higher rate of fatal cardiovascular events
      - 3.2-fold higher rate of non-fatal cardiovascular events to include stroke and ischemic heart disease.

OSA and the Surgical Patient

- What is the role of capnography?
  - Capnography is the measurement of the maximum concentration of carbon dioxide at end exhalation (ETCO2).
  - ETCO2 direct correlation to PaCO2 (NL lung function)
  - Normal ETCO2 35-45mmHg.

OSA and the Surgical Patient

- Use of capnography:
  - Patients with a history of hypoventilatioin
  - Morbid obesity (BMI > 45)
  - History of Congestive Heart Failure (CHF)
  - Pediatrics
  - History of respiratory / cardiac difficulities in PACU
  - OSA RISK SCORE 6

OSA and the Surgical Patient

- Potential advantages for the addition of capnography to standard monitoring
  - Additional monitoring method in high risk patients
  - Detects respiratory changes sooner than pulse oximetry
  - Sensitive not only to changes in respiratory function but also circulatory and metabolic function.
  - Use of supplemental O2 therapy may reduce the sensitivity of pulse oximetry monitoring.

OSA and the Surgical Patient

- Potential disadvantages of capnography
  - Additional expense of monitoring
  - Learning curve associated with newer technology
  - No data to demonstrate use of capnography provides additional benefit over oximetry alone.

OSA and the Surgical Patient

- ASA Practice Guidelines for the Perioperative Management of Patients with Obstructive Sleep Apnea. Anesthesiology V104, No5, May 2006.
  - Literature insufficient to evaluate the efficacy of telemetry monitoring systems to reduce risk of postoperative events in patients with OSA.
  - Literature insufficient to examine the impact of monitored postoperative setting (stepdown unit vs. routine ward).
  - Literature is insufficient to offer guidelines regarding the appropriate duration of monitoring in patients with OSA.

OSA and the Surgical Patient

- ASA Practice Guidelines
  - Consensus that continuous oximetry in a stepdown unit or by telemetry decreases the likelihood of perioperative complications.
  - Consensus that oximetry should be continuously monitored while in bed.
  - Consensus that oximetry should be continued until RA oxygen saturation remains above 90% including a period of sleep.
  - Consensus that the supine position should be avoided if possible postoperatively if OSA present.

OSA and the Surgical Patient

- ASA Practice Guidelines
  - Equivocal regarding the efficacy of full monitoring in ICU
  - Equivocal regarding the efficacy of continuous monitoring by a dedicated observer in the patient's room.
  - Equivocal regarding continuous monitoring until patients are no longer receiving parenteral narcotics.

OSA and the Surgical Patient

- Monitoring: Anesthesia Patient Safety Foundation.
  - Recommends continuous postoperative monitoring of both oxygenation (pulse oximetry) and ventilation (capnography) in all patients that receive PCA or neuraxial opioids regardless of risks.
- Joint Commission
  - Postoperative monitoring not currently a Joint Commission safety goal. Recommends that "hospitals review postoperative monitoring procedures".

OSA and the Surgical Patient

Preoperative screening for OSA prior to elective surgery (n=172). Positive screen questionnaire for OSA then nocturnal oximetry obtained prior to surgery.

Oxygen desaturation index (ODI 4%) and percentage of time spent with oxygen saturation < 90% were determined.

Association of Sleep-Disordered Breathing With Postoperative Complications: Hwang, D. et al. Chest 2008; 133: 1128-1134

OSA and the Surgical Patient

- Results
  - 98 pts (57%) had ODI>5/hr.
  - 58 pts (33.7%) mild; 30 pts (17.4%) moderate; 10 pts (5.8%) severe. 23.2% moderate/severe
  - As a group ODI>5/hr: M>F; BMI>27(87.8%vs73%)
  - Complications: total 17 pts (9.9%)
    - 15/17(88%) ODI>5hr.
    - 2/17 (12%) ODI<5hr.
    - In this study the rate of complications increased with increase in ODI. Not seen in all studies.
    - 10/15 were respiratory complications. 2/15 required PAP.

OSA and the Surgical Patient

- Perioperative complications during use of an OSA Protocol following surgery and anesthesia. Bolden, N et al. Anesthesia Analgesia 2007; 105; 1867-70.
  - 434 know / suspected OSA both parenteral and oral opioids.
    - Initial 24 hours post op
      - 16% O2 desaturations < 90%
      - 7% O2 desaturations < 80%

    Majority 1-2 desaturations

    Use of PAP at level used at home does not prevent O2 desaturations. Transient increase in pressure requirement.

    Recommend oximetry monitoring on PAP

OSA and the Surgical Patient

- ASA Checklist
  - 14 items:
    - Category 1: Predisposing physical characteristics (5 questions).
    - Category 2: History of apparent airway obstruction during sleep (5 questions).
    - Category 3: Somnolence (4 questions)
  - Number of questions and complicated scoring

OSA and the Surgical Patient

- Berlin Questionnaire
  - 10 items: 5 questions regarding snoring; 1 sleepiness while driving; 1 presence of HTN.

    details of age, gender, wt, ht, neck circumference also recorded.

    Number of questions and complicated scoring system problematic.

OSA and the Surgical Patient

- Sleep Apnea Clinical Score (SACS)
  - Do you have high blood pressure or have you been told to take medication for hight blood pressure? Y/N
  - People who have shared my bedroom tell me that I snore:
    - Usually (3-5 times/wk)
    - Always (every night)
  - I have been told by other people that I gasp, choke, or snort while I sleep
    - Usually (3-5 times/wk)
    - Always (every night)
  - Neck circumference

OSA and the Surgical Patient

- Sleep Apnea Clinical Score (SACS)
  - Nomogram
    - Neck circumference
    - Presence or absence of HTN
    - Historic features: snore, choke/gasp
      - None, One or Both
  - High SACS > or equal to 15
  - Dr. Peter Gay: The SACS best predictor of moderate/severe OSA. More difficult to use.

- Consultation:
  - Template: symptoms, comorbid conditions, exam
  - Sleep physician
  - Physician extender
  - "Super nurse"
    - Antic, N.A. Am J Respir Crit Care Med vol 179. p 501-508, 2009
  - Sleep technician/Respiratory therapist

- Obstructive Apnea Systematic Intervention Strategy (OASIS). Gay, P. Respiratory Care vol 55 no 9, 1240-1254.
  - In patient sleep consultative service
  - Consultant determines evaluation process
    - Oximetry and ABG's on all
  - Empiric PAP therapy based on oxygenation and co morbidities.

- Obstructive Apnea Systematic Intervention Strategy (OASIS)
  - Criteria for empiric PAP
    - ODI (4%) > 20
    - O2 saturation < 75%
    - Mean O2 saturation < or equal to 88%
    - O2 saturation < than 90% > or equal to 15% of study
    - Presence of coronary artery disease, congestive heart failure, or arrhythmia
    - Reason to delay PSG

- Obstructive Apnea Systematic Intervention Strategy (OASIS)
  - Use of APAP monitoring oximetry
  - Bilevel for PaCO2 >50 mm Hg or pH < 7.35
  - O2 for patients non compliant with PAP
- OASIS used for both medical and postoperative patients
  - No consideration of type of surgery and use of narcotics

Obstructive Sleep Apnea

- Ventilatory instability – "loop gain"
  - A measure of the propensity of a negative feedback control system to oscillate
  - Ratio: response to disturbance / disturbance
  - Loop Gain > 1 destabilizes ventilation

Obstructive Sleep Apnea

- High Loop Gain occurs as a consequence:
  - Long transit time / distance between peripheral and central systems
  - High chemosensitivity (controller gain)
  - High ventilatory drive (plant gain)
- Individuals with high loop gain are prone to recurrent or cyclic obstructive events.
- Low loop gain does not show a cyclic pattern but if the response fails to correct the abnormality it may lead to a prolongation of the obstructive event.
- In addition to anatomic differences there are individual differences in both chemosensitivity (hypoxic and hypercarbic) and ventilatory drive (FRC, $PaCO_2$, metabolic rate) in patients with obstructive sleep apnea.

Obstructive Sleep Apnea

- Airway collapse
- Negative pressure on inspiration
- Extraluminal positive pressure
  - Fat deposition
  - Small mandible
- Airway patency
- Pharyngeal dilator muscle contraction
  - Genioglossus
  - Tensor palantini
- Lung volume
  - Increased lung volume stiffer airway

OSA and the Surgical Patient

- Additional factors affecting airway patency
  - Lung volume (Decreased FRC and ERV)
  - Vascular effects on the upper airway (increases extraluminal positive pressure)
  - Surface tension effects

OSA and the Surgical Patient

- Sleep deprivation impact on upper airway function
  - Reduces threshold for UA collapse due to decrease in genioglossus muscle activity
  - Prolonged time to arousal
  - Worsening oxygen desaturations
  - Reduced responsiveness to hypercapnea/hypoxemia
  - Potential for "REM rebound"

OSA and the Surgical Patient

- Concept of the critical closing pressure (Pcrit)
  - Pressure within the airway (intraluminal pressure) is subatmospheric during each inspiratory effort.
  - Pcrit is the pressure necessary to collapse the airway. It is the difference in pressure (transmural) between the pressures inside and outside the airway.
    - Large negative Pcrit favors airway patency
    - Positive Pcrit favors upper airway collapse

OSA and the Surgical Patient

- Critical closing pressure (Pcrit)
  - Pcrit will be higher (less negative)
    - Reduced activity of the upper airway muscles
    - Narrowed upper airway secondary to excess soft tissue
  - Pcrit
    - Normals usually -10 cm water
    - Snorers/mild OSA -3 to -5 cm water
    - Moderate to severe OSA +2 cm water
  - A positive Pcrit suggest an extremely unstable upper airway.

Gifford, A. et. al. Respiratory Function in an Obese Patient with Sleep Disordered Breathing. Chest 2010: 138 (3):704-715.

OSA and the Surgical Patient

Potential red flags

- Known Obstructive Sleep Apnea and CPAP at home prior to surgery. CPAP not used routinely post operatively.
- History of hypoventilation
- Prior history of respiratory difficulties with anesthesia or narcotic medication
- History of respiratory difficulties in RR/PACU
  - Patients with both high SACA scores (screen) and recurrent events in PACU identified patients at risk for oxygen desaturations post discharge from PACU

Gali, B. M.D. Jr. of Clinical Sleep Medicine Vol 3, 6, 2007, pgs 582-588.

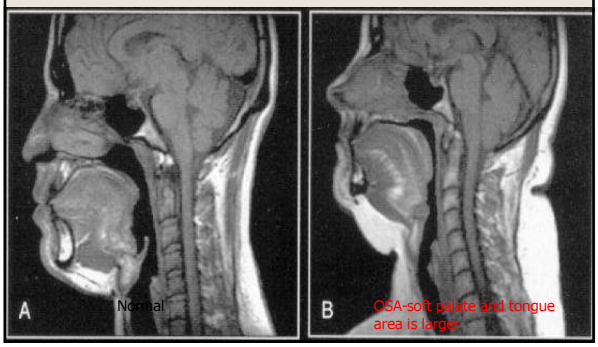
OSA and the Surgical Patient

Recommendation for preoperative screening

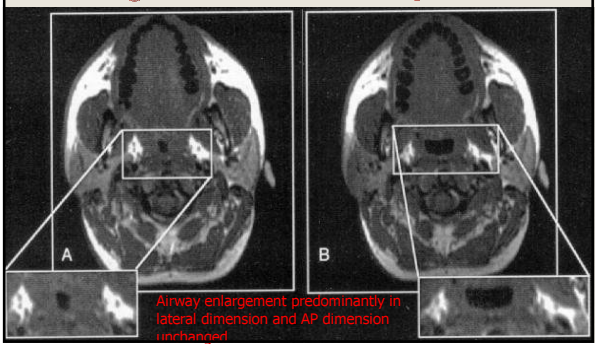
- Implementation of a screening questionnaire during preoperative evaluation to identify individuals at risk for obstructive sleep apnea.
- STOP-BANG questionnaire is a simple easy to use screening tool validated with a high degree of sensitivity (>90%) in identifying individuals with moderate to severe obstructive sleep apnea. Chung, F. Anesthesiology, vol 108, 5, May 2008, pgs 812-821.

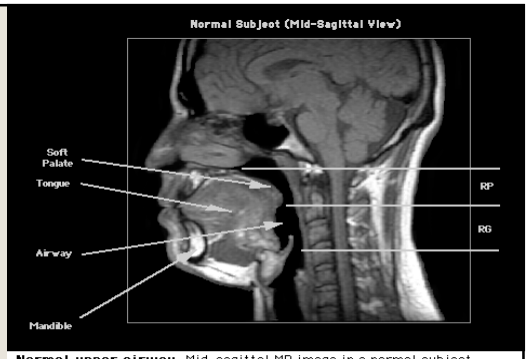
OSA ORDER SET

Midsagittal MRI b/w Nl and OSA
(Schwab R, 1998)



Effect of CPAP on retropalatal region of the airway (Schwab, 1998)





Normal upper airway Mid-sagittal MR image in a normal subject demonstrating the anatomic regions of the upper airway and relevant soft tissue structures. The retropalatal (RP) region is defined from the level of the hard palate to the distal margin of the soft palate; the retroglossal (RG) region is defined from the distal margin of the soft palate to the base of the epiglottis. Courtesy of Richard J Schwab, MD.

OSA and the Surgical Patient

- Factors contributing to post operative risk
  - Difficult airway
  - Anesthesia / post operative narcotics
  - Supine position
  - Co-morbid conditions

Obstructive Sleep Apnea

- Airway collapse
- Negative pressure on inspiration
- Extraluminal positive pressure
  - Fat deposition
  - Small mandible
- Airway patency
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  - Tensor palantini
- Lung volume
  - Increased lung volume stiffer airway

OSA and the Surgical Patient

- Monitoring Levels
  - Oximetry / ECG / Capnography

OSA RISK SCORE 5-6
ASA - may be at significantly increased perioperative risk from OSA.

Potential other indications
Known history of hypoventilation (i.e. OHS).
Approximately 20% of patients with OSA will have coexisiting OHS.
Previous history of anesthetic or narcotics complications
History of respiratory or cardiac complications in PACU

OSA and the Surgical Patient

- Monitoring Levels
  - Pulse oximetry, ECG
  - OSA RISK SCORE 3-4
    ASA- may be at increased perioperative risk from OSA
  - Known OSA on CPAP Therapy
    - Studies demonstrate desaturations occurring postoperatively even with positive pressure therapy in place.
      Bolden et. Al. Journal of Clinical Anesthesia (2009)
  - Potential other indications
    - Moderate to severe obstructive airways disease
    - Cardiac disease (esp. CHF)

OSA and the Surgical Patient

- Monitoring Levels
  - OSA RISK SCORE of 2 or less no specific monitoring recommended.
- Higher level of monitoring at the discretion of the physician.