SLEEP & WAKE DISORDERS

Raj Mulpuri, MD
Sunrise Medical Center

Learning Objectives:
- Brief overview of normal sleep and diagnosis, management and treatment of sleep disordered breathing.
- Medical conditions that are affected by sleep disorders.
- Common parasomnias and dysomnias that interfere with sleep.

DISCLOSURE OF COMMERCIAL SUPPORT
Raj Mulpuri, MD does not have a significant financial interest or other relationship with manufacturer(s) of commercial product(s) and/or provider(s) of commercial services discussed in this presentation.
Overview on SLEEP & SLEEP APNEA

Raj Mulpuri, MD
Diplomate of the American Board Of Sleep Medicine
Board Certified in Sleep Medicine (American Board Of Medical specialties)

OBJECTIVES
• Normal sleep and age rel. Changes
• Sleep apnea - Clin. Features and Assoc.
• Pathophysiology and Diagnosing sleep Apnea
• Treatment
• CSA and COPD
• Ensure no one falls asleep in the first 15 mins. of my talk

Sleepiness is serious business

Prior Lake track star returning from college meet dies in car crash

Sleepiness is serious business

The information in this document may not be reproduced or disclosed to unauthorized parties without the prior consent of the Arizona Geriatrics Society.

2014 Arizona Geriatrics Society All Rights Reserved
Normal Sleep

- Average human need is 8.3 hours
- Normal sleep latency: 10-20 minutes
- Normal sleep structure
  - 5% stage 1
  - 50% stage 2
  - 15-25% stages 3 and 4 (slow wave sleep)
  - 25% REM
- Napping occurs at the beginning and the end of life
Sleep Changes with Age

- Increased awakenings and arousals
- Decreased REM sleep (Percentage remains the same)
- Decreased SWS
- Increased stage shifts
- Fewer “cycles”
- Reduced sleep efficiency
- Phase advancement
Summary: Sleep Changes

- Sleep during the night changes with increasing age:
  - Less deep sleep and more lighter sleep
  - More difficulty maintaining sleep due to arousals and awakenings
  - Sleep is less efficient and more fragmented

- The internal biological clock shifts to earlier bed and wake times

- Older persons experience a higher prevalence of medical conditions and take meds that interrupt sleep and are associated with sleep problems/disorders

- Older persons experience a higher prevalence of sleep disorders

Summary: Consequences of Sleep Changes

- Tendency to stay in bed longer to get a sufficient amount of sleep results in worse sleep

- More likely to take more naps to meet sleep need—may result in worse sleep

- Inadequate or poor sleep results in daytime sleepiness and fatigue

- Ability to function well, enjoy life and overall quality of life is affected
Restless, fitful sleep
Periods of silence terminated by loud, resuscitative snoring
Moodiness
Lack of concentration/cognitive defects
Morning headaches
Decreased libido and impotence
Awakening with angina pectoris
Nocturia

OSA Clinical Features
✓ Loud disruptive snoring
✓ Awakenings with gasping &/or choking
✓ Morning dry mouth &/or headaches
✓ Excessive sleepiness (including involuntary dozing & “asleep at wheel”)
✓ Witnessed apnea
✓ Awakens unrefreshed
✓ May be unaware!
History of hypertension especially difficult to control
Cardiovascular disease
Cerebrovascular disease
Renal disease
Type 2 diabetes mellitus
Gastroesophageal reflux disease
Cor pulmonale, Pulmonary HTN
Polycythemia
Obesity
Menstrual irregularities

Association

Association SDB & Hypertension

*P=0.005 vs < 1.5

Sleep Health Heart Study in JAMA 2000;283:1829-1836
Sleep Heart Health Study:
Relative Odds of CVD According to Quartile of SDB

<table>
<thead>
<tr>
<th>Apnea Hypopnea Index</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Univariate</td>
<td>1.6</td>
<td>1.3</td>
<td>2.03</td>
<td>2.5</td>
</tr>
<tr>
<td>Age Adjusted</td>
<td>1.11</td>
<td>1.61</td>
<td>1.96</td>
<td></td>
</tr>
<tr>
<td>Sex Adjusted</td>
<td>1.23</td>
<td>1.87</td>
<td>2.18</td>
<td></td>
</tr>
<tr>
<td>BMI Adjusted</td>
<td>1.24</td>
<td>2.12</td>
<td>2.03</td>
<td></td>
</tr>
<tr>
<td>Hypertension Adj.</td>
<td>1.25</td>
<td>1.89</td>
<td>2.25</td>
<td></td>
</tr>
<tr>
<td>HDL Adjusted</td>
<td>1.23</td>
<td>1.83</td>
<td>2.15</td>
<td></td>
</tr>
<tr>
<td>Percent of Time O2 ≤ 90%</td>
<td>1.6</td>
<td>1.17</td>
<td>1.57</td>
<td>2.15</td>
</tr>
</tbody>
</table>

The greatest improvement in ISI was achieved by patient 3 (highest black circle), who achieved the greatest weight loss.

The Effect of Continuous Positive Airway Pressure Treatment on Insulin Sensitivity in Patients with Obstructive Sleep Apnoea Syndrome and Type 2 Diabetes

Igor Alexander Harsch, Simin Pour Schahin, Kerstin Brückner, Martin Radespiel-Tröger, Florian S. Fuchs, Eckhart Georg Hahn, Peter Christopher Konturek, Tobias Lohmann, Joachim Hans Ficker
SDB and Arrhythmias

- Cyclical brady / tachycardia is a sensitive (95%) but not specific (48%) for OSAHS
- Sinus arrest occurs in 10% with OSAHS
- AV block occurs in 5% with OSAHS
- VT occurs in 3-13% of those with SDB
- Severe OSA, morbid obesity, severe O2 desats predict heart block, arrhythmias
- O2 and CPAP reduce arrhythmias

Ischemic Events

- Cardiac death has its nadir at night
- In cardiac patients, death in sleep occurs primarily in REM
- Mechanism of cardiac ischemia at night
  - “Demand” increase due to increased sympathetic activity in REM
  - “Non-demand” increase due to hypotension, reduced cardiac output of nonREM sleep
  - Nocturnal nadir in endogenous thrombolytic activity
  - Endothelial dysfunction

Sleep - Disordered Breathing and cognition in older Adults

18 studies reviewed by Molly Zimmerman and Mark Aloia
- SDB adversely impacts cognition and cognitive impairment in domains of attention, executive function and memory
- Presence of APOE4 allele and previous mild cognitive impairment confer greater vulnerability
- Hypoxia associated with SDB is thought to be the most likely etiology
25 studies reviewed by Beebe et al (1092 pts and 899HC)
- Also found a substantial impact on vigilance & exec.func.
- Conclude: OSA Should be considered in patients with declines in vigilance, exec. functioning and coordination
**Association Between AI & Mortality**

- Untreated Sample
- AI- Apnea Index
- All Age Groups
- Group Differences within 5 years

*He et al, 1998*

Consequences include hypertension, heart disease, stroke, sexual dysfunction, depression & sleep-related accidents.

---

**ANATOMY**

---

**OSA Risk Factors & the Upper Airway**

- Obesity
- Being middle-age or older
- Being male
- Small or crowded airway
- Tonsillar hypertrophy
- Palatomegaly
- Large tongue
- Retrognathia
- Micрогnathia
Pathogenesis of OSA

- Anatomical abnormality
  - Obesity (increased neck circumference) or craniofacial abnormality (retrusion)
- Dysfunctional regulation of pharyngeal dilator muscle activation (genioglossus muscle)
- Unstable ventilatory control (determines the degree of CO2 retention/hypoxemia)
Pathogenesis of OSA

- Alcohol, Benzodiazepines, muscle relaxants make OSA worse by relaxing upper airway muscle and also by increasing arousal threshold.
- Weight loss, smoking cessation and alcohol consumption reduction are beneficial for persons with sleep disordered breathing. Even 10% weight loss can relieve mild sleep disordered breathing.

Sleep Disordered Breathing

Severity of OSA

Apnea Index + Hypopnea Index = AHI

- Mild: AHI 5-15
- Moderate: AHI 15-30
- Severe: More than 30.
- Hypopnea—30% reduction (from baseline) in airflow or chest wall movement for more than or equal to 10 seconds with oxygen desaturation more than equal to 4%.
- Apnea—Complete cessation of airflow for more than/equal to 10 seconds using a valid measure of airflow.

UARS – Upper Airway Resistance Syndrome

- Prevalence data for UARS not available.
- Increased respiratory effort (assessed by esophageal pressure, nasal pressure transducer or plethysmography) or flattening of nasal pressure waveform. Associated with arousal, duration of at least 10 seconds. No oxygen desaturation.
- Criteria for Apnea or Hypopnea not met.
Assessing Sleepiness

Measuring Self-Reported Sleepiness with the Epworth Sleepiness Scale (ESS)

Rate the likelihood of dozing in the following situations

<table>
<thead>
<tr>
<th>Situation</th>
<th>Rating</th>
<th>Chance of dozing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td>0</td>
<td>0 = would never doze</td>
</tr>
<tr>
<td>Watching TV</td>
<td>1</td>
<td>1 = slight chance</td>
</tr>
<tr>
<td>Sitting, inactive in a public place</td>
<td>2</td>
<td>2 = moderate chance</td>
</tr>
<tr>
<td>(e.g., a theatre or a meeting)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>As a passenger in a car for an hour</td>
<td>3</td>
<td>3 = high chance</td>
</tr>
<tr>
<td>without a break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lying down to rest in the afternoon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>when circumstances permit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitting quietly after a lunch without a nap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in traffic</td>
<td>4</td>
<td>4 = very high chance</td>
</tr>
</tbody>
</table>

Self-reported sleepiness can be unreliable

- Patient with manifest sleepiness
- When asked, sleepiness was denied
- ESS total score was 5
Objective Assessment of Sleepiness

- **Screening STOP.**
  - Snoring
  - Tiredness during daytime
  - Observed apnea,
  - High blood Pressure

Sleep Screen: “BEARS”

- **Bedtime**
- Excessive daytime sleepiness
- **Awakenings:** night wakings
  - Early morning waking
- Regularity and duration of sleep
- Snoring
When to Treat Sleep Apnea in the Elderly?

- Hypertension
- Cognitive dysfunction
- Nocturia
- High levels of sleep-disordered breathing

Polysomnography

Polysomnogram

- When do you need polysomnogram
  - Snoring with excessive daytime sleepiness, history of apnea
  - Snoring with physiological impairments – Pulmonary HTN, secondary polycythemia, difficult to control systemic HTN etc
  - Prior to considering surgical Rx options for snoring
Sleep study

• Split study is done
  – AHI more than 40/hour in the first 2 hours of sleep (not 2 hours in bed)
  – At least 3 hours remaining to conduct titration
• Repeat full night CPAP titration is recommended if optimal pressure not achieved by second portion of the test
Obstructive Apnea. A complete blockage of the airway despite efforts to breathe. Notice the effort gradually increasing ending in airway opening.
Positive Airway pressure

- CPAP
  - Fixed
  - Autotitrating
- Bi Level PAP
  - Back up rate
- ASV
- VPAP
Treatment of OSA

• CPAP Rx and Cardiovascular Disease
  – CPAP Rx may lead to small but statistically significant improvement in reduction in mean BP. Seen in patients with greater severity of disease/greater duration of CPAP use
  – Patients with CHF and moderate to severe OSA – LVEF improvement of 5% noted at 1 month and 9% at 3 months
  – Patients with severe OSA, AHI more than 30 per hour – increase in both fatal/non-fatal cardiovascular events noted
  – CPAP therapy more than 4 hours/night in severe OSA patients– reduced cardio-vascular risk to similar levels seen in non-snoring controls

Technological Advancements with PAP therapy in OSA Rx

• EPR (expiratory pressure release) during exhalation. C-Flex systems of Respironics
  • Somewhat similar algorithm to the Bi-Flex detailed above
  • Randomized controlled trial between Fixed CPAP and C-Flex technology showed no significant benefit with respect to compliance/other outcomes

Complex Sleep Apnea

Central Apnea emerges on patient with OSA and CPAP therapy on 7 cm H2O (zero with highlighted area)
BiPAP® autoSV™: Automatic Servo Ventilation

• Treatment for complicated breathing patterns such as:
  - Central apnea
  - Complex apnea
  - Periodic Breathing such as CSR

• Provides non-invasive ventilatory support to treat adult patients with OSA and Respiratory Insufficiency caused by central and/or mixed apnea and periodic breathing.

BiPAP® autoSV™: Automatic Servo Ventilation

• Automatic Pressure Support
  - Targets peak flow over a 4 minute moving window
  - Adjusts breath by breath when necessary

• Automatically calculated back-up breath rate OR fixed rate
  - Based on patient’s spontaneous breath rate OR
  - Standard rates of 4 – 30 bpm

• Variety of mode options that include Auto Servo Ventilation

• Pressure options: 4 – 30 cm H2O
Portable Monitoring

Type 1 monitoring devices are used for in-laboratory, technician-attended, overnight polysomnography.

Type 2 monitoring devices can perform full PSG outside of the laboratory. The major difference from type 1 devices is that a technologist is not present during the recording.

Type 3 monitoring devices do not record the signals needed to determine sleep stages or sleep disruption. Typically, four physiologic variables are measured including two respiratory variables (eg, respiratory movement and airflow), a cardiac variable (eg, heart rate or an electrocardiogram), and arterial oxyhemoglobin saturation.

Type 4 monitoring devices are defined by the American Academy of Sleep Medicine (AASM) as devices that record one or two variables (eg, arterial oxyhemoglobin saturation and airflow) and can be used without a technologist. These devices are called continuous single or dual bioparameter devices.

The CMS guidelines indicate that CPAP prescriptions will be covered by Medicare and Medicaid if OSAH is diagnosed by PM using a type 1, 2, or 3 device [1]. In addition, a type 4 device that measures at least three variables is acceptable.

Advantages and disadvantages of portable monitoring for obstructive sleep apnea

**Advantages**
- Increased accessibility
- Patient acceptance
- May be done in the home
- Convenience
- Decreased labor costs
- Can easily be done for more than one night

**Disadvantages**
- Absence of a trained technologist to correct and clarify artifacts and make ongoing equipment adjustment
- Inability to intervene in medically unstable patients
- Potential data loss or distortion
- Potential for misinterpretation of the results due to limited data
- Inability to perform subsequent multiple sleep latency testing according to standard protocol
- Varied sensor technology
- No measurement of sleep
- No published standards for scoring or interpretation

---

![Heart rate (BPM), Impedance, Thermistor, SaO2 percent graph](image_url)
Oral Appliances

The role of oral appliances in the management of obstructive sleep apnea

– Appropriate first-line treatment for mild OSA < primary snoring, upper airway resistance syndrome (UARS)
– Second line therapy for moderate-severe OSA
– Patient’s choice - Not tolerating/refuse to use CPAP, or are not surgical candidates

Oral Appliance Device

• Mandibular Repositioners —
  – Pulls mandible forward along with tongue
  – Varying degrees of advancement of mandible, adjustable
    • Custom made (superior, but expensive) versus
    • boil/bite type (one size fits all, made of thermoplastic, place in hot water before placing in mouth, inexpensive). Thermoplastic can lose effectiveness as it flows/changes shape
  – 40% success rates claimed

Tongue Retaining Device – suction on tongue by a bulb. No FDA approved

Oral Appliance Device

• Side effects
  – Dry mouth
  – Increased Salivation
  – Tooth soreness
  – Jaw muscle/joint discomfort. Pain can be severe
  – Bite mechanism can become permanently impaired sometimes
Surgical Treatment Options

- Tracheostomy
- UPPP and Laser assisted UPPP
- Oral and maxillo-facial surgery. MMA surgery
- Radio frequency volumetric tissue reduction
- Palatal implants
- Bariatric surgeries
“Welcome to the Weight Loss Forum. To lose one pound, double-click your mouse six million times.”

Positioners
Wedgepillows
Buddy pillows
“Tennis Ball Technique”

Central Sleep Apnea
**OSA versus CSA**

**OSA**
- Obese
- Loud snoring
- EDS
- HTN
- Nocturia

**CSA**
- Normal to low BMI
- Little snoring
- Insomnia
- Fatigue

**Consequences of CSR-CSA in Heart Failure**

- Marker of increased mortality?
  - 56% in CHF with CSR-CSA
  - 11% in CHF without CSR-CSA
- Worse heart function.
- ↑ Sympathomimetic activity
  - ↑ diurnal and a.m. norepinephrine
  - ↑ ischemia and cardiotoxicity
  - related to hypoxia and arousals

**CHF Mortality Increase with SDB Severity**

![Graph showing CHF mortality increase with SDB severity](image)
**REM-related NOD in COPD**

- Pulmonary hypertension
  - brief hypoxia increased RV mass
- Cardiac arrhythmias (PVC's)
  - not clearly benefited by oxygen
- Polycythemia
  - higher red cell mass in NOD COPD
- Sleep disturbances
  - MSLT not low in NOD COPD
- Death
  - survival is worse in NOD COPD

**Consequences of NOD in COPD**

**Treatment of NOD in COPD**

- Oxygen
  - decreases diurnal pulmonary HTN
  - morning headache in OSA & COPD
  - trend towards improved survival
- Respiratory stimulants
  - Protriptyline (decreases REM)
  - Provera is inconsistent
  - Acetazolamide
  - Theophylline did not benefit NOD
- NPPV if hypercarbic
Medico-legal aspects

• Commercial Motor Vehicle license
  – Federal statues require examination every 2 years
  – Individuals with untreated/suspected OSA are not qualified to drive CMV
  – They are qualified only after they are treated successfully and driver agrees to continue un-interrupted Rx
  – They should undergo yearly MSLT/MWT

Medico-legal aspects

• MSLT (mean sleep latency test)
  – Test of an individual’s underlying physiologic tendency toward sleep.
  – 5 nap test, each nap 20 minutes duration, separated 2 hours apart
  – Eight minutes or less on MSLT testing is abnormal

Medico-legal aspects

• MWT (maintenance of wakefulness test)
  – Four 40 minute trials
  – Separated 2 hours apart
  – Generally healthy people have mean sleep latency of 30 minutes
  – Less than 8 minutes clearly abnormal
  – 8-40 minutes uncertain significance
  – People who remain awake all 40 minutes is a strong objective evidence they can stay awake
  – FAA requires pilots to pass MWT test if they have OSA
Medico-legal aspects

• Once the patient receives a diagnosis of OSA, one month of therapy is suggested before the driver can be certified to go back to work, with MSLT/MWT results in “normal range” or a repeated sleep study while receiving therapy showing resolution of OSA.

Medico-legal aspects

• Physician’s responsibilities
  – Warn all patients to avoid driving/operating heavy machines when sleepy.
  – Medications: Alcohol, Benzodiazepines, muscle relaxants, opioid analgesics cause excessive daytime sleepiness

Medico-legal aspects

• Physician reporting
  – Mandatory reporting: Any listed condition regardless of impairment
  – Functional reporting: Only if the physician believes that the condition could cause significant impairment of driving capacity.
  – Permissive reporting: Do not require any reporting, but do allow it if the physician considers the patient or the public to be at a significant risk of harm.
Restless Legs Syndrome (RLS)

- Uncomfortable leg sensations (that are)
- Worse at night (and)
- Worse with inactivity but relieved by activity (and are associated with)
- Motor hyperactivity

Restless Legs and Periodic Limb movements of Sleep

- Dopamine Deficiency
- Uncomfortable sensations with a strong urge to move
- Idiopathic
- Familial
- Secondary (Fe, Folate Def., CRF, PVD, RA, and pregnancy)

The information in this document may not be reproduced or disclosed to unauthorized parties without the prior consent of the Arizona Geriatrics Society.

2014 Arizona Geriatrics Society  All Rights Reserved
REM Behavior Disorder

• In this rare disorder, brain mechanisms that normally inhibit voluntary muscles fail, allowing the person to thrash around, sleepwalk, and even act out nightmares.

• During REM sleep the electrical activity in the brain is similar to the electrical activity that occurs when awake, but when in REM sleep, one experiences muscle paralysis. People with REM Behavior Disorder lack this muscle paralysis, permitting them to act out their dramatic or violent dreams.

Questions

• Sleep Apnea Can Present as Insomnia
  True/ False

Minimal amount of hrs. CPAP needs to be used to be effective
  a)2 hrs  b)4hrs  c)6 hrs  d)8 hrs
Some people talk in their sleep. Lecturers talk while other people sleep.

Albert Camus

“With wireless sleep technology, the people in my dreams can send e-mail and faxes to the people in your dreams!”