The Impact of Sleep Disorders: Recognition and Treatment

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Disclosure statement:
We have no financial relationships with a commercial interest/interests producing healthcare related products and/or services
Objectives

- Describe normal human sleep
- Define common sleep disorders
- List common comorbidities
- Evaluate the need for testing and treatment

What is normal human sleep?
# Sleep Drive (Process S & C)

**Process S**
- Instinctive desire for sleep
- Sleep debt occurs during the day
- Sleep debt is repaid once sleep occurs
- If not adequately repaid, it accumulates resulting in poor daytime function and potential metabolic abnormalities

**Process C**
- Determines the timing of sleep
- Regulated by light exposure, thus light exposure near bedtime delays sleep
- Circadian regulation occurs via the hypothalamic suprachiasmatic nucleus and is synchronized by light via the retino-hypothalamic tract. (thus light exposure near bedtime delays sleep)

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Sleep Optimization and Diabetes Control: A Review of the Literature
Diabetes Ther 2015 Dec 6(4) 425-468
Teresa Arora and Sharard Taheri
Department of Medicine, Weill Cornell Medical College, New York, USA
Sleep Architecture

**Sleep Latency**: “time to fall asleep”
Starts when you close your eyes and ends when you fall asleep.

**Stage 1**: light sleep

**Stage 2**: brain waves slow, resting the parts you use while awake

**Stage 3 & 4**: deep sleep, restores and recharges the body

**REM**: rapid eye movement, body is motionless, dreaming, brain is as active as it is while thinking

Typical hypnogram
Patient with OSA

Sleep –Wake Disorders

Sleep deprivation - inadequate opportunity and/or circumstances for sleep

Tiredness, loss of concentration, irritability, decreased productivity

Insomnia - dissatisfaction with sleep

Circadian rhythm sleep disorders -
  • Advanced Sleep Phase Disorder
  • Delayed Sleep Phase Disorder
Insomnia

- Difficulty falling asleep
- Difficulty staying asleep throughout the night
- Waking too early in the morning

- Resulting in significant daytime symptoms

Short term insomnia – last up to 3 months and occurs in 15-20% of people
Chronic insomnia – occurs at least 3 times per week and lasts for a least 3 months. This occurs in about 10% of people.

Before prescribing pharmacologic options, consider an integrated behavioral approach.

Look for causes...

Patient Symptoms

- Hypersomnia or fatigue
- Non-restorative sleep
- Insomnia with frequent awakenings
- Loud snoring
- Witnessed apnea
- Awakening with choking or gasping
- Nocturnal restlessness
- Cognitive Deficits
- Morning headaches
- Strange, vivid or threatening dreams
- Nocturia
- Restless leg
- Bruxism
- Mood changes
- Poor concentration
- Nocturnal angina
Respiratory Events

- **Apnea**: cessations of airflow for at least 10 seconds

- **Hypopnea**: airflow decreases for at least 30% and lasts for at least 10 secs. This event is associated with either a 4% oxygen desaturation or arousal.

- **Respiratory effort-related arousal (RERA)**: increasing respiratory effort for 10 secs leading to an arousal from sleep that does not fulfill the criteria for a hypopnea or apnea.
Types of apneic events

- **Obstructive event**: partial or complete obstruction of airflow despite continued thoraco-abdominal effort.

- **Central event**: cessation of airflow in the absence of thoraco-abdominal effort.

- **Mixed events**: both obstructive and central features are present. Events usually begin without thoraco-abdominal effort and end with several thoracoabdominal efforts in breathing.
Central Sleep Apnea

Central apnea is either idiopathic or secondary

- The respiratory center of the brain does not fire during sleep causing periodic apnea
- Seen during both diagnostic and titration portion of study.
- Generally seen in the non-REM sleep and uncommon during REM sleep

Often found in those with:
- neurological disease process or injury such as CVA
- chronic pain conditions on opioid medications
- CHF

May also be seen “treatment emergent central apnea” upon PAP initiation.
Effects of Sleep Apnea on the Cardiovascular System

- Obesity
- Hypoventilation syndrome
- Hypertension
- CV disease (heart failure)
- Cardiac arrhythmia (A. Fib)
- CVA, TIA
- Pulmonary hypertension
- End-stage renal disease
- Cor Pulmonale
- Type 2 DM
- Chronic lung disease
- Pregnancy
- Acromegaly
- Hypothyroidism
- GERD
- Secondary polycythemia
- Floppy eyelid syndrome
- Polycystic ovary syndrome
- Parkinson’s disease

Obstructive Sleep Apnea Diagnosis

Apnea Hypopnea Index (AHI) = apneas + hypopneas / total sleep time in hours

- Mild : 5 – 15 events / hour
- Moderate : 15 – 30 events / hour
- Severe : 30 or greater events / hour

Respiratory disturbance index (RDI) = average number of respiratory disturbances (obstructive apneas, hypopneas, and respiratory event-related arousals (RERAs) per hour

Source:
Risk factors associated with OSA

- Male gender
- 40-70 years of age
- Obesity
- Large neck girth
  - > 17 inches in a male
  - > 16 inches in a female
- Craniofacial abnormalities

Suspected risk factors include genetics, smoking, menopause, alcohol consumption and nocturnal nasal congestion

Structural clues to potential risk of sleep apnea

Difficult Airway in Obstetrics - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Difficult-laryngoscopy-and-intubation-Modified-Mallampati-classification-Class-I-IV_fig1_286352925 [accessed 16 Sep, 2019]
OSA is the most common sleep-related breathing disorder

**Epidemiology**

- When defined broadly as AHI greater than 5 measured by PSG, estimated prevalence in North America is approximately 20-30% of males and 15% of females.
- When more stringent definitions are used, either combining an AHI >=5 events per hour with report of one symptom of disturbed sleep or using AHI >=15 alone the prevalence is approximately 15% of men and 5% of women.
- In the United States prevalence is increasing due to rising rates of obesity.
- Prevalence in U.S children: 2-3%.
- Male-to-Female ratio:
  - Children: 1:1
  - Adulthood: 2:1 or more
- African Americans and Hispanics > Caucasian.
- Prevalence in Asia is similar to that of the United States, despite lower rates of obesity, possibly related to craniofacial anatomy.

*Prevalence estimates vary according to the way in which OSA is defined and distribution of risk factors in population being studied. Source: UptoDate as of September 2019*
Who & How do we screen for SDB?

MY FAMILY SAYS I SNORE BUT NO ONE HAS COMPLAINED ABOUT IT AT WORK!

Enhanced STOP-Bang questionnaire

- Snoring?
- Tired?
- Observed?
- Pressure?
- Body mass index more than 35 kg/m²?
- Age older than 50 years old?
- Neck size larger (measured around Adam’s apple)
- Gender = Male?

Scoring criteria:

Low risk of OSA: Yes to 0 to 2 questions
Intermediate risk of OSA: Yes to 3 to 4 questions
High risk of OSA: Yes to 5 to 6 questions

This is an enhanced version of the STOP-Bang questionnaire. Patients who initially score at intermediate risk of OSA can be further stratified based on the specific STOP-Bang questions that are positive. Simpler STOP-Bang scoring is shown in the UpToDate graphic STOP-Bang questionnaire.

OSA: obstructive sleep apnea.

References:
STOP-Bang OSA risk assessment in the general population

High risk
STOP-Bang 5-8

Intermediate risk
STOP-Bang 3-4

Low risk
STOP-Bang 0-2

Epworth Sleepiness Scale
How likely are you to doze off or fall asleep in the following situations?
Use the following scale to choose the most appropriate number:

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Watching television</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sitting inactive, in a public space</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Lying down to rest in the afternoon when circumstances permit</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sitting quietly after a lunch without alcohol</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>As a passenger in car for an hour without a break</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>In a car, while stopped for a few minutes in traffic</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Score:
ESS INTERPRETATION

1 – 6 = Normal level of sleepiness
7 – 8 = Average sleepiness
9 – 24 = Abnormal (possibly pathologic) sleepiness


Part 1: Case Presentation

• 70 year old female
• CC: fatigue, referral from rheumatology due to fibromyalgia
• PMH: A. Fib
• Occupation : retired teacher
• Social History: Married, 2 grown children, Life-long non-smoker, no history of illicit drug use, rare ETOH, 3 cups of coffee per day (no other caffeine intake)
Case Presentation

Sleep history: 2200-0700 or 0730, frequent arousals due to pain.
  • She wears a night guard every night due to nocturnal bruxism.
  • Snoring noted only when not wearing night guard.

Current Outpatient Prescriptions:
  ✔ diltiazem (CARDIZEM CD) 240 mg 24 hr capsule, 1 daily
  ✔ metoprolol (TOPROL-XL) 25 mg 24 hr tablet, Take 100 mg by mouth 1 (one) time a day.
  ✔ nortriptyline Take 25 mg by mouth at bedtime.
  ✔ warfarin (COUMADIN)

Complains of poor quality of life. Pain and fatigue prevent her from enjoying family events or even spending more than a few hours away from home. She naps every day for an hour or so.

Epworth Sleepiness Scale: 10 / 24

STOP-BANG : 3
positive for Snoring (when not wearing night guard), Tired, Age > 50
Case Presentation: Exam

Physical exam:

- BP 103/64
- Pulse 92
- Temp 36.6 °C (Oral)
- Resp 16
- Ht 5' 8" (1.727 m)
- Wt 130 lb (59 kg)
- SpO2 99% RA
- BMI 19.77 kg/m²
- Neck circumference 9.5 in

Recommend in-lab PSG due to low STOP-BANG

Testing for sleep disordered breathing

- In-lab Polysomnography remains the first-line diagnostic study for suspected OSA.

- Home sleep apnea testing (HST or HSAT) is an acceptable alternative for patients with strong suspicion of OSA.
In-lab Polysomnography (PSG)

Home Sleep Test (HST) Apnea-Link 4 channel
Four Channel HST
- Airflow
- Oximetry
- Pulse
- Effort

Home Sleep Test
Respiratory data only (estimated AHI, REI, ODI) calculated from recording time
- Can underestimate AHI as recording time > time asleep

No EEG
- Unable to determine sleep and arousal (sleep time is estimate)
- No information on sleep stages (REM / non-REM)

Higher risk of technical failure

Cannot diagnose central sleep apnea

Best used for high likelihood OSA & no other sleep disorders or respiratory/cardiac disease.
SLEEP ARCHITECTURE & STAGING: The sleep period lasted 396.0 minutes and the total sleep time (TST) was 312.5 minutes, which resulted in a sleep efficiency (TST÷TRT) of 78.1%. The sleep latency (SL) was 4.0 minutes, and the latency to the first occurrence of Stage R was 267.5 minutes. There were 1 Stage R periods observed on this study night, 36 awakenings (i.e. transitions to Stage W from any sleep stage), and 118 total stage transitions.

Wake after sleep onset (WASO) time accounted for 83.5 minutes, while the time spent is each sleep stage was 35.5 minutes (Stage N1); 247.5 minutes (Stage N2); 1.5 minutes (Stage N3); and 28.0 minutes (Stage R). The percentage of Total Sleep Time in each stage was: 11.4% (Stage N1); 79.2% (Stage N2); 0.5% (Stage N3); and 9.0% (Stage R).
Part 2: In-lab PSG

RESPIRATORY: The overall apnea-hypopnea index (AHI) was 39.2 events/hr, while the AHI during Stage R sleep was 49.3 /hr. AHI results by body-position showed: supine AHI = 65.4 /hr; right-side AHI = 19.5 /hr; left-side AHI = 23.1 /hr; and prone AHI = N/A /hr. For other respiratory disturbances, there were 0 occurrences of Cheyne Stokes breathing, and 91 respiratory effort-related arousals (RERAs). The RERA index was 17.5 events/hr, and the total respiratory disturbance index was 56.6 events/hr.

OXIMETRY: Analysis of continuous oxygen saturations showed a mean SpO2 value of 93.5% throughout the study, with a minimum oxygen saturation during sleep of 66.0% and a mean value of 93.2% for the same period. Oxygen saturations were below ≤ 88% for 13.9 minutes of the time spent asleep.

Sleep Apnea Treatment

• Positive Airway Pressure (CPAP or BPAP)
  • 1st line treatment
  • Splints the airway open preventing collapse of the upper airway

• Lifestyle Modifications

• Alternative options
Most common types of PAP

CPAP – Continuous Positive Airway Pressure
  - Set pressure
  - Auto-titrating

BPAP - Bilevel PAP
  - Set Inspiratory and Expiratory pressure
  - Auto-titrating IPAP and EPAP
  - Spontaneous vs timed respirations

ASV – Adaptive Servo Ventilator
  - Form of bilevel pressure device that alternates between an expiratory pressure (which is constant or variable) and inspiratory pressure
  - Has variable pressure support – the greater the PS the greater the tidal volume that is delivered
  - Used to primarily treat Central Sleep Apnea
  - CONTRAINDICATED: in heart failure patients with EF less than 45% and symptomatic systolic heart failure.
Behavioral modification

- Weight loss
- Sleep position therapy – avoiding supine sleep
- Alcohol avoidance
- Avoidance of concomitant medications – such as benzodiazepines, opiates

Sustained improvement in mild obstructive sleep apnea after a diet- and physical activity–based lifestyle intervention: postinterventional follow-up

Am J Clin Nutr | © 2010 American Society for Nutrition
Alternative Therapy

- Oral appliances (mild – moderate OSA who fail or decline PAP)
- Upper airway surgery
- Nerve stimulator (Inspire)
- Provent

Surgical Options for Sleep Apnea

- Adenotonsillectomy
  - Curative in some instances
- Nasal procedures
  - As adjunct, no as a stand-alone therapy
- Uvulopalatopharyngoplasty (UPPP)
  - removal of uvula, posterior margins of the soft palate, and lateral pharyngeal wall mucosa via scalpel or laser ablation
- Tongue reduction procedure (midline partial glossectomy)
- Hypoglossal Nerve Stimulator
- Maxillomandibular Advancement (MMA) Surgery
- Tracheostomy
PAP compliance guidelines

- Must use the device **4 or more hours per night on 70% of nights** during a consecutive 30 day period in the first 3 months of initial use. **This must be documented in a face-to-face encounter.**
  - If not in compliance with above, the patient must have a face-to-face clinical re-evaluation by the treating physician to determine etiology of failure and repeat sleep test in a facility-based setting.

According to current Medicare guidelines 2019
Many styles of Masks
Troubleshooting and helping with CPAP adherence

- Eye Irritation
- Nasal congestion
- Dry Mouth or Throat
- Chest or Lung Pain
- Sore Nose
- Skin Irritation
- Air Leaks
- Stomach Bloating
Part 3: Treatment

Based on the results of the study you initiate CPAP 8-20 cmH2O

After mask changes to eliminate leak Overnight oximetry was performed and revealed persistence of nocturnal hypoxemia (> 5 minutes with sats less than 89%).

Pressure changes were made and based upon compliance download and consideration of intolerance to variable pressures she was set at fixed pressure of 18 cmH2O.

Part 3: Treatment & follow up

AHI is now less than 10 and hypoxemia has resolved.

At 1 year follow up ESS was down to 5 / 24 and patient reported improved sleep and quality of life.

At 2 year follow up ESS was 3 / 24. Patient is sleeping 2300-0700 without interruption. No longer napping. Enjoying life able to watch grandchildren at their home pain free.
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