Introduction to Sleep Medicine

Eilis Boudreau MD, PhD
What is Sleep?

• Alternates with waking
• Associated with postural change (recumbent in humans)
• Decreased response to sensory stimuli
• Low levels of motor activity
• Rebound if deprived of sleep

Phyllis Zee, Update on the Science, Diagnosis, and Management of Insomnia, International Congress and Symposium Series 262, 2006, pg 4
2-Process Model of Sleep Regulation (Borbely 1982)

[Diagram showing the 2-process model of sleep regulation with labeled axes and key features such as 'S' and 'C' for arousal and circadian rhythms, and phases for waking and sleep.]
Sleep Architecture

- N1 (5%)
- N2 (50%)
- N3 (20%)
- R1 (25%)
Sleep Cycles

• Approximately 90-110 minutes
• 4-6 cycles per night
• During first cycles R1 (REM) only a few minutes
• First 2 cycles have significant N3
• Later cycles dominated by R1
Sleep Staging is based on which of the following?

- Breathing Patterns
- Arousal Patterns
- Electroencephalogram (EEG) Patterns
- Oxygen Saturation Patterns
- EKG Patterns
Sleep Requirements Vary with Age
(National Sleep Foundation)
Sleep Patterns with Aging

- substantial ↑ in variability from individual to individual
- ↓ total sleep time
- ↓ sleep efficiency
- ↓ time to REM onset
- ↑ sleep fragmentation
- N3 (slow-wave sleep) may ↓
## Physiologic Changes During Sleep

<table>
<thead>
<tr>
<th></th>
<th>Non-REM</th>
<th>REM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular</td>
<td>↓ HR, ↓ BP, ↓ variability</td>
<td>↑ HR, ↑ variability</td>
</tr>
<tr>
<td>Respiratory</td>
<td>↓ RR, ↓ variability</td>
<td>↑ RR, ↑ variability</td>
</tr>
<tr>
<td>Neuromuscular</td>
<td>tonic</td>
<td>atonic</td>
</tr>
<tr>
<td>Endocrine</td>
<td>↓ urine output</td>
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Most Common Sleep Disorders

• Sleep Disordered Breathing
• Sleep Related Movement Disorder (ex. Restless Leg Syndrome)
• Insomnia
• Parasomnia
• Central Disorders of Hypersomnia (ex. Narcolepsy)
• Circadian Rhythm Sleep-Wake Disorders
What is Sleep Apnea?

Snoring and Obstructive Sleep Apnea

Normal Anatomy

Nasal cavity
Soft palate
Uvula
Tongue
Pharynx (airway)

Normal Sleep
Snoring
Obstructive Sleep Apnea

Normal breathing open airway, Tongue relaxed (falling slightly back)
Snoring partially blocked airway, When the constricted airway causes vibration
Fully blocked airway

https://www.sleepwell.org/snoring/
Sleep Apnea: Physiology

**Increased upper airway collapsibility**
- Oxygen level can drop (but not always)
- CO$_2$ level increases

**Increased effort to breath**
- Increased sympathetic activity (fight or flight reaction)
- Blood vessels constrict $\rightarrow$ increased blood pressure (BP)
- Increased BP $\rightarrow$ reflex bradycardia (decreased heart rate)
- Tachycardia (increased heart rate) with recurrent arousals
Why is Sleep Apnea a Problem?

- Poor daytime functioning
- Increased risk of accidents
- Irritability → poor social interactions
- Increased risk of hypertension
Obstructive Sleep Apnea

Risk Factors
• Increased body weight
• Age
• Large neck circumference
• Airway
• M > F
• Menopause

Presenting Symptoms
• Snoring (but many people snore and DON’T have apnea)
• Witnessed apneas
• Excessive daytime sleepiness
• AM headaches
• Dry mouth
Sleep Apnea and Performance

• Chronic partial sleep deprivation
• Decreased attention
• Individual often has poor insight into impaired performance
  2°sleep apnea
• Even brief lapses in attention can lead to injury (eg. when driving)
Sleep Apnea Treatment

• Continuous Positive Airway Pressure (CPAP)
• Mandibular Advancement Device
• Surgery
  • Palate/oral surgery
  • Inspire™ (implanted breathing stimulation device)
• Other
  • Weight loss
  • Avoid alcohol
How is Sleep Measured?

• In-Lab Sleep Study
• Breathing, EEG, EMG (monitoring muscle activity), O2, EKG

• Home Sleep Study
• Breathing, O2, +
In-lab Polysomnography vs Home Sleep Testing

In-Lab
- Measures of breathing, EEG, oxygenation, position, video, movements
- 1 technician per every 2 patients
- Inconvenient
- Expensive

Home Sleep Testing
- Large # of different devices, with varying # of signals
- Patient takes device home
- Much cheaper
- Fewer signals and data
- Not appropriate for everyone
National Sleep Research Resource (NSRR)

• Collection of de-identified data from well characterized sleep cohorts
• Includes clinical data elements and physiologic signal data (ex. Polysomnography data), tools for analysis
• Purpose is to make data available for secondary analysis, teaching
• Supported by National Heart, Lung, Blood Institute at NIH
• https://sleepdata.org
Sleep Heart Health Study

• Multi-site cohort study
• Designed to determine whether sleep-disordered breathing is associated with hypertension (high blood pressure), cardiac disease, stroke, and all cause mortality
• 6441 individuals 40 years or older were enrolled between 1995 and 1998
• Participants were evaluated at three time points over study period (1995 – 2003)
Sleep Heart Health Study

• Patients recruited from 9 epidemiologic cohorts in which cardiovascular outcomes had been collected:
  ➢ Framingham Offspring Cohort
  ➢ Hagerstown & Minneapolis/St. Paul sites of Atherosclerosis Risk in Communities (ARIC) study
  ➢ Hagerstown, Sacramento & Pittsburgh sites of Cardiovascular Health Study (CHS)
  ➢ Strong Heart Study sites in South Dakota, Oklahoma, & Arizona
  ➢ Respiratory & Hypertension (HTN) disease studies in Tucson & New York
Sleep Heart Health Study

• Data collected included:
  • In-home sleep studies at the 1\textsuperscript{st} & 3\textsuperscript{rd} study visits
  • Demographic data
  • Cardiovascular outcomes data
Sleep Heart Health Study

• Data was extracted from the SHHS using the NSRR website
• Exercises for the course use this extracted data
• Your completion of data use request through NSRR site is good example of data use agreement
Questions?