Sleep and Gastrointestinal Physiology

Dennis Auckley MD
## Esophageal Function in Sleep

<table>
<thead>
<tr>
<th>Physiologic Process</th>
<th>Sleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>Swallowing frequency</td>
<td>Decreases</td>
</tr>
<tr>
<td>Salivation</td>
<td>Decreases</td>
</tr>
<tr>
<td>Esophageal acid clearance</td>
<td>Prolongs</td>
</tr>
<tr>
<td>Lower and upper esophageal sphincter pressure</td>
<td>Decreases</td>
</tr>
<tr>
<td>Primary esophageal peristalsis</td>
<td>Decreases</td>
</tr>
</tbody>
</table>

Chokroverty, Review of Sleep Medicine, 3rd edition, 2012
Esophageal Acid Clearance: Wake vs. Sleep

Minutes

Wake
Sleep

Orr et al, Gastroenterology 1984; 86:814

(Generally consider Acid Contact Time as % time pH < 4.0, usually < 5%)
Gastroesophageal Reflux Disease (GERD)

- GER is defined as retrograde flow of gastric contents into the esophagus
- Transient lower esophageal sphincter (LES) relaxation is normal with swallowing, belching, and emesis
- When LES relaxation is prolonged, leads to symptomatic GER
- Mechanisms for clearance of acid:
  - swallowing
  - esophageal peristalsis
  - salivation
- Prolonged acid contact with mucosa leads to symptoms and damage = GERD
GERD and Sleep

- Though less frequent during sleep, reflux may result in prolonged acid exposure and proximal migration
  
  Orr et al, Am J Gastro 2000; 95:37

- Protective mechanisms include:
  - arousals from sleep lead to swallowing
    
    Orr et al, Am J Gastro 2000; 95:37
  - airway reflexes
    (swallowing/apneas in infants and cough/expiration reflex in adults)
**GERD and Sleep**

- GER is most frequently seen with the right lateral decubitus position > supine > left
  
  Khoury et al, Am J Gastro 1999; 94:2069

- Sleep Heart Health Study:
  15,314 completed a questionnaire and 3,806 (24.9%) reported nocturnal GER.

  Fass et al, Chest 2005; 127(5):1658
Sleep-related GERD: ICSD Definition

- Either A and B, or C:
  A. Recurrent awakenings from sleep with SOB or heartburn
  B. At least one of the following
     - sour brash upon awakening
     - sleep-related coughing or choking
     - awakening from sleep with heartburn
  C. PSG and esophageal pH demonstrate GERD during sleep associated with arousals

- Not better explained by another sleep / medical / neurologic / mental disorder, medication or substance use disorder.

*Note: This disorder may be associated with OSA...*
GERD on a Polysomnogram
GERD and Sleep

• Nocturnal GER is associated with sleep c/o:
  1,000 pts with weekly GER
  - 79% with nocturnal GER
  - 75% of these with sleep disruption
  - 40% with impaired daytime functioning


• Even after controlling for age, gender, tobacco use, obesity and socioeconomic status, GERD has been associated with insomnia and sleeplessness

  Jansson et al, Clin Gastroenterol Hepatol 2009; 7(9):960
Effects of Treatment of GERD on Sleep

• The treatment of GERD has been associated with improvements in GERD symptoms as well as sleep and QOL

• Systematic Review on the impact of PPI therapy on sleep disturbances found:
  - 8 RCT
  - 2 reported PSG outcomes = no significant changes
  - All 8 reported nonPSG outcomes
    -> 7 of 8 found statistically significant changes in QOL sleep disturbance-related outcomes

Regenbogen et al, Otolaryngol Head Neck Surg 2012 (epub)
GERD and OSA

• GERD and OSA share common risk factors
• GERD has been associated with symptoms of OSA (snoring, disruptive breathing and EDS)
• GERD is a common symptom in patients with OSA
• Some data suggests there is a temporal relationship between GER events and respiratory events in sleep apnea, though not all studies have found this association
• Of interest, use of CPAP reduces GERD symptoms
• More work is needed….
Gastric Function and Sleep

- Gastric acid production is increased at night and shows circadian variability
  Pasricha, Am J Med 2003;115:114
  (though there is significant night to night and individual variability)
- Gastric acid production peaks early in the night
  - typically between 2200 and 0200
- Following vagotomy, there is a loss of gastric acid secretion circadian variability
  McCloy et al, Gut 1978;19:664
- There is no correlation between sleep stage and acid production
  Orr et al, Arch IM 1976;136:655
Gastric Function and Sleep

- Gastric motility decreases during sleep
  - mostly seen in NREM sleep

- Gastric emptying is also circadian and is slower
  in the evening hrs
    Goo et al, Gastroenter 1987; 93:515

- The changes in gastric physiology seen in sleep may
  also be contributing factors to the development
  of nocturnal GERD
Intestinal Motility and Sleep

• Studies on small bowel motility in sleep have yielded conflicting results

• Colonic function during sleep is decreased due to:
  - inhibition of contractile activity
  - decreased colonic tone

• Fecal continence maintained during sleep by:
  - high internal anal sphincter pressure
  - relaxed external anal sphincter pressure
IBS, IBD and Sleep

• Irritable Bowel Syndrome has been associated with complaints of insomnia, frequent awakenings at night and EDS.
  - objective data has revealed inconsistent results

• Inflammatory Bowel Disease has been associated with sleep disturbances in small studies.
• Acute and chronic sleep deprivation has been shown to exacerbate colon inflammation in mouse models of colitis.