OSA

Prevalence

- Young et al. NEJM 1993
  - Middle aged cohort (30-60 years)
  - Diagnosed by PSG, in laboratory
  - AHI ≥ 5  
    - Women 3%  Men 24%
  - AHI ≥ 5  
    - Women 2%  Men 4%
    - w/ sleepiness

Definitions (and therefore prevalence vary).
Population is aging, and growing, w/ more comorbidities
Risk factors

- Obesity (70%), also neck circumference >17in
- Age (40-70 years)
  - Anatomic primarily if younger
- Male
- Postmenopausal
- Family history (2-4X)
- Medications/alcohol/smoking
- Anatomic abnormalities
- Thyroid disease, acromegaly

Symptoms

- Ask bed-partner!
OSA: Symptoms

- Loud snoring
- Witnessed apneas
- AM headaches
- Enuresis
- Nocturnal choking
- EDS

- Fatigue
- Depression
- Depressed libido
- Cognitive impairment
- Restless sleep

Questionnaires

From mayleelim.blogspot
**Epworth scale**

STOP (simple yes/no)
- Snoring
- Tired
- Observed (apneas)
- Pressure (Have or being treated for BP)

High risk OSA: ‘yes’ to 2 or more questions
Low risk OSA: ‘yes’ to fewer than 2

*Anesthesiology* 2008;108:812

**STOP-BANG**

- STOP questions, plus:
  - BMI (>35)
  - Age (over 50)
  - Neck circumference (>40cm) (15.7 in)
  - Gender (Female)

High risk OSA: yes to 3 or more
Low risk OSA: yes to fewer than 3
Screening questionnaires

Exam---50/50

Mallampati
Basic sleep

- NREM (N1-N3)
- REM (majority of dreaming)
- Normal night in normals proceeds cyclically through stage 1-REM and back with periodicity of 60-120 minutes
- REM increases as night progresses
  - "active brain in paralyzed body"

Sleep is active!
Diagnosis

- Underestimation of patient’s risk for OSA, underdiagnosis is still very common
- Most patient’s understanding of risks/complications of OSA is minimal

OSA is Treatable!!!

Undiagnosed OSA
Medical Staff Recognition of Risk for OSA in Hospitalized Medical Patients Without Dedicated Screening Tool
Andrew Hameroff; Tiffany Dumont; Tejpreet Lamba; Daniel Shade

Author and Funding Information: Allegheny General Hospital, Department of Pulmonology and Critical Care, Pittsburgh, PA

Chest 2014;146:A963

Only 4% medicine admissions identified as ‘at risk’
Only 57% patients with history of OSA were identified

Polysomnogram

Montage: 10-20
Montage

Montage, during REM sleep (30 seconds)

Obstructive sleep
Central apnea

Obstructive apnea

Upper Airway
Pathophysiology

- **Multiple mechanisms**
  - Anatomy (airway size, abnormalities)
  - Lung volume/obesity mass loading
  - Pharyngeal dilator muscle activity
    - Genioglossus, etc.
  - Arousal threshold
  - Neuromuscular factors (to pharyngeal muscles)

Balance of forces

- **Promote collapse**
  - Negative airway pressure (e.g., inspiration)
  - Positive pressure outside airway (fat deposition)

- **Promote patency**
  - Dilator muscles (over 20 upper airway muscles)
    - Hypoglossal neural (genioglossus) modulated by many factors; state-dependent (only obstruct during sleep/speech, etc.)
  - Increases in lung volumes (longitudinal traction by trachea)—but obesity reduces lung volume...

Pathophysiology: over time...

- **Pharyngeal occlusion and hypoxia:**
  - Free radical generation
  - Muscle and neuronal fiber injury, endothelial damage
  - Release proinflammatory/prothrombotic mediators
  - Surges in sympathetic system/BP
  - Changes in preload/afterload
    - CBF
Snoring

- ½ patients who snore have OSA
- 20% women
- 40% men

Snoring and Stroke risk

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Odds ratio</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial hypertension</td>
<td>2.99</td>
<td>1.36–5.34</td>
</tr>
<tr>
<td>Current heavy smoker</td>
<td>2.55</td>
<td>1.33–5.70</td>
</tr>
<tr>
<td>Excessive snoring habitually</td>
<td>2.13</td>
<td>1.29–3.52</td>
</tr>
<tr>
<td>Heavy drinking (&gt;80 g/day)</td>
<td>1.60</td>
<td>1.06–2.89</td>
</tr>
</tbody>
</table>

Snoring

- Increased RR (relative risk) 3.2 for stroke!

Snoring

Complications/Overview

<table>
<thead>
<tr>
<th>Complication</th>
<th>Odds ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>HTN</td>
<td>1.4-2.9</td>
</tr>
<tr>
<td>CAD</td>
<td>1.3-23</td>
</tr>
<tr>
<td>CVA</td>
<td>1.6-6</td>
</tr>
<tr>
<td>CHF</td>
<td>2.4</td>
</tr>
<tr>
<td>MVA</td>
<td>7</td>
</tr>
</tbody>
</table>

Malhotra, Lancet 2002
Complications

Bradley, Lancet 2009

- Obstruction leads to cycles of hypoxia, exaggerated negative intrathoracic pressure, and arousals:
- Depress myocardial contractility
- Activate sympathetic nervous system
- Raise BP, HR (myocardial wall stress)
- Depress parasympathetic activity
- Provide oxidative stress, systemic inflammation
- Activate platelets and impair vascular endothelial function

Complications

From Lancet 2002;360:237-245
Inflammation

OSA and metabolic syndrome

Independent of obesity, OSA is a/w:
- Insulin resistance
- Glucose intolerance
- Type 2 DM

Intermediate hypoxia and/or recurrent arousals
CPAP may mitigate metabolic disturbance...
Mortality

- Over 750,000 suffer stroke/year in US
- 135,000 will die from stroke complications
- Long term care: $69 Billion/year
  - 30% stroke patients permanently disabled

Stroke

- Over 750,000 suffer stroke/year in US
- 135,000 will die from stroke complications
- Long term care: $69 Billion/year
  - 30% stroke patients permanently disabled

OSA and Stroke

From Shropshire.nhs.uk
OSA and Stroke

- OSA risk factor for stroke
- OSA (and CSA) common after stroke
  - OSA occurs in 60-96% of post-stroke patients
- Worse outcomes post-stroke
  - Early neurological worsening
  - Decreased functional recovery
  - Increased mortality

SDB and Stroke

AJRCCM 2010; 182:269-277
SDB and Stroke

- The Sleep Heart Health Study
- Community-based sample
  - 5400 patients followed for 9 years
  - 40 years or older
  - Excluded prior history of stroke
  - Excluded CPAP use

SDB and Stroke: findings

- Males w/ moderately severe OSA had 3X increased risk of ischemic stroke
- Risk increased as OSHI increased
- Females no association at midrange levels OSHI
  - ‡ Greater prevalence in women as age: missed them?
  - Did see increase in RDI ≥ 25

OSA and Stroke

- Share many risk factors
  - Male sex
  - Age
  - Obesity
  - Smoking/alcohol
- OSA causes/worsens:
  - HTN
  - DM
  - Atrial fibrillation
  - Carotid disease
  - Cardiac disease
SDB and Stroke

- OSA linked to metabolic syndrome, CAD, CAF
- All risk factors for stroke
- Also, higher prevalence PFO, mild hypercoagulable state
Higher prevalence AF, NSVT, and

Lower recurrence AF after cardioversion if CPAP used (82% vs. 42%)

Circulation 2003;107:2589

OSA: Direct and indirect effects (causes comorbidities)
4-6 higher odds of ischemic stroke if OSA

PFO

From Cleveland Clinic
What is prevalence of OSA/CVA?
Prevalence
Arzt AJRCCM;172:1447-1451

- 12 years, cross-sectional study, n=1400
- 30-60 years old (relatively young)
- Used AHI 20, in-lab studies → OR 4.3 for prevalent stroke; controlled for HTN and DM, age and gender, smoking, BMI, and ETOH

- AHI 20 is a/w highly increased probability of suffering a stroke in next 4 years (precedes)

Circ Cardiovasc Qual Outcomes 2012;5:720-728
Stroke more common during sleep vs early morning hours in controls.

Risk factors overlap: coincidence

- Smoking
- Hypertension
- Obesity
- Cardiac disease
  - Dysrhythmias/PFO
- Diabetes

Stroke remains an independent risk factor.

Outcomes are worse!
If have stroke and OSA diagnosed?

RDI >15, PSG, 8d after CVA (mean)

Arch Intern Med 2008; 168(3):297-301

Outcomes: JCSM 2014

- 10 studies: 1200 stroke/TIA patients
- Evaluated patients after stroke/TIA

“dose-response” relationship between severity of SDB and risk of recurrent events and all cause mortality

Concluded: SDB is a Negative Predictor of all-cause mortality and recurrent vascular events following stroke or TIA
OSA probably precedes CVA in majority of cases
- No a/w location of stroke: Hemispheric or Brainstem
- Stability and similar rates of of OSA after TIA and stroke
- Functional status, ? Central apneas may improve, OSA may not
- Highest prevalence in:
  - Males
  - Recurrent strokes
  - Strokes of unknown etiology

Outcomes
- 61 CVA pts. in rehab
- 72% had OSA
- Lower functional scores
- LOS (hospital) longer
- Longer time in rehab
  - 45 vs 32 days
    - Indep. of stroke severity
    - Location of stroke did not matter

Table 3—Percentage of stroke or TIA patients with SDB stratified by AHI:

<table>
<thead>
<tr>
<th>Culpotent</th>
<th># Studies (n patients)</th>
<th>% (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI &gt; 0</td>
<td>9 (596)</td>
<td>72 (63–81)</td>
</tr>
<tr>
<td>AHI &gt; 10</td>
<td>24 (1580)</td>
<td>83 (53–80)</td>
</tr>
<tr>
<td>AHI &gt; 20</td>
<td>15 (1405)</td>
<td>38 (31–46)</td>
</tr>
<tr>
<td>AHI &gt; 30</td>
<td>10 (966)</td>
<td>29 (21–37)</td>
</tr>
<tr>
<td>AHI &gt; 40</td>
<td>3 (316)</td>
<td>14 (7–25)</td>
</tr>
<tr>
<td>Central</td>
<td>17 (1286)</td>
<td>7 (5–12)</td>
</tr>
</tbody>
</table>

*Percentage of patients who had primarily central apneas

Average BMI 26.4; 25% did not snore!
- Equal prevalence SA (Sleep Apnea) in TIA and stroke patients
- Suggests the SA precedes stroke

- 20-year follow-up, N=400
- Portable device used; ? Underestimation; no respiratory effort assessment
- OSA not treated, necessarily
- Subjects with moderate-severe OSA had a marked elevated risk of stroke (and mortality/cancer)
- HR = 3.7
OSA and CVA: specific mechanisms

- Increases HTN, sympathetic activity
- Endothelial damage/Hypercoagulability
- Increase R→L shunt through PFO
- Cardiac arrhythmias/CHF
- Reductions in CBF/oxygen saturations
- Increased VEGF
- Increased production reactive oxygen species


OSA: heightened SNA

- CIH (chronic intermittent hypoxia) and CO2 retention stimulate central and peripheral chemoreceptors
- Apnea eliminates reflex inhibition SNA from pulmonary stretch receptors
- OSA ↓SV and BP augment OSA
- Arousals augment SNA (also PLMs!)

More REM early AM

- Greatest circadian risk for stroke
- In general more events/longer
- Elevated SNA and SBP (even normally)
- CPP usually increases in REM, but OSA can increase intracranial pressure, and reduce CPP
Apnea and perfusion

During Apnea:

↓SBP, HR, CO, CPP

These increase at apnea termination

Stroke → SDB

Chest 2009;136:1668-1677
Treatment of OSA

- Maintain CPP (dependent on MAP)
- Vary dependent on stroke type
- Hemorrhagic more at risk if MAP higher
- Ischemic: penumbra: higher MAP desired

Positive pressure therapy

"Pneumatic splint"
Positive pressure therapy works!

Chest 2007;132

Multimodality therapy

JCSM 2012;8(5):565

Also: genioglossal stimulation/Inspire therapy

Outcomes on CPAP

Lancet 2005;365:1046
Unblinded, observational
Timer for CPAP compliance

Treated patients same incidence as normals (final CVS events).
10-year follow-up
Treatment

- Compliance may be more difficult after stroke
  - Large range in studies: 15-70%....
  - Improved with multidisciplinary efforts
  - Identify and treat prior to the event
  - Outcomes on patients treated after variable

Compliance only 37%

JCSM 2014;10(1):103-108

AJRCCM 2014;189:1544-1550
Need Sleep Medicine follow-up!

- 70% discontinued CPAP, BUT:
- No sleep evaluation
- Empiric pressures used

- Treatment in early phase of stroke may improve functional outcomes, NIHSS
- AHN Sleep Medicine
  - Multidisciplinary approach/sleep boarded physicians
  - Focus on screening, treatment, secondary options, outcomes
  - Call us: 412.442.2522