Obstructive Sleep Apnea and Stroke

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Overview

- Sleep apnea (OSA)
- Stroke
- How OSA/Stroke are connected
- Supporting Evidence
- Prevention/therapy
- Summary
Sleep In Modern Society

- Irrevocably altered by the industrial revolution
  - Around the clock operations
    - Shift work
    - Siesta now looked down upon (except in Spain)
    - Sleep deprivation (less than 8 hours of sleep) leads to sleep debt now the norm instead of the exception

- Substandard levels of wakefulness
  - Sleepiness related human errors
    - Three Mile Island Nuclear disaster
    - Exxon Valdez oil tanker
    - Challenger disaster
    - Human error causes 60-90% of all industrial and transportation accidents
Sleep In Modern Society

- Sleep now less valued
  - Daily sleep loss manifests as accumulative sleep debt
    - Increased tendency to fall asleep
    - Decreased psychomotor performance
    - “Micro sleep” – brief lapse in vigilance
  - Study of long-haul truck drivers
    - Averaged 4.8 hrs sleep per day
    - 2 fold increase in motor vehicle accidents
    - Also commonly have little insight to the risks of sleep deprivation
    - Also have tendency toward obesity and increased incidence of OSA
Famous faces with a sleeping disorder

Population

Name their sleep disorder.

SLEEP APNEA

How many in the population share this disorder?
12 to 18 million Americans; 1 to 3% of children 2-18

50 % ARE UNDIAGNOSED
Daytime Hypersomnolence

- Sleep Deprivation
- Insufficient Sleep Syndrome
- Poor Sleep Hygiene
- Circadian Rhythm Disorders

- Sleep Fragmentation Syndrome
- Obstructive Sleep Apnea
- Central Sleep Apnea
- Periodic Limb Movements in Sleep

- Primary Hypersomnolent Syndromes
  - Narcolepsy
  - CNS Hypersomnolence
  - Post Traumatic Hypersomnolence
Epworth Sleepiness Scale

• Chance of dozing in certain situations (rank low to high chance (1-3) – normal is < 10
  – Sitting and reading
  – Watching TV
  – Riding as a passenger in a car
  – Sitting, inactive in a public place
  – Lying down to rest in the afternoon
  – Sitting and talking with someone
  – Sitting quietly after lunch without alcohol
  – Sitting at a stop light
Sleep Apnea

- > 18 million affect (1 in 15 Americans)
- Prevalence (Men 24%, Women 9%)
- 10 - 20% are children
- Untreated or undiagnosed > 80%
- Health cost for individual with untreated sleep apnea is about $1,336/yr

National Sleep Foundation
Types of Sleep Apnea

- **Obstructive** (Apnea and Hypopnea)
- Central Sleep Apnea
- Mixed Sleep Apnea
What is Obstructive sleep apnea

- Recurrent episode of airway obstruction during sleep
- lasting at least 10 seconds
- can be associated with arousal or decrease in oxygen level
How is OSA measured

AHI (Apnea/hypopnea index) or RDI (Respiratory Disturbance Index)

- AHI < 5 (normal)
- AHI 5 - 15 (mild)
- AHI > 15 - 30 (moderate)
- AHI > 30 (severe)
Symptoms/signs of OSA

- Snoring
- Gasping or choking from sleep
- Excessive daytime sleepiness
- Daytime fatigue
- Cognitive dysfunction (memory, concentration)
- Change in mood (irritable)
- Unrefreshed sleep
Obstructive Sleep Apnea

• Prevalence (Wisconsin Cohort Study)
  – Highly prevalent disorder
    • Ages 30 – 60
      – Men

  – Women
    • 9.4% - significant OSA (RDI > 5)
    • 2% - OSA with reported hypersomnolence
Components of the Upper Airway

- Nose
- Nasopharynx
- Oropharynx
- Laryngopharynx
- Larynx
Large Tonsils and Airway Narrowing

• Compromised pharynx on exam

• Polysomnography results:
  – Heavy snoring
  – Airway occlusion
  – OSA
  – Desaturations
  – Cardiac arrhythmias
Obstructive Sleep Apnea

Intraluminal Pressure

- Pharyngeal Anatomic Abnormalities
  - Loss of activity in pharyngeal muscles at sleep onset

- Pharyngeal Narrowing
  - Change in “tube law”
  - Muscle Pressure

- Obstructive Sleep Apnea
  - Sleep Fragmentation
Obstructive Apnea A complete blockage of the airway despite efforts to breathe. Notice the effort gradually increasing ending in airway opening.

Airway opens

- EKG
- Airflow (gradually increases)
- Abdominal Effort (paradoxing)
- Thoracic Effort
- SaO2
Clinical Features

- Obesity (BMI > 28 Kg/m2)
- Neck Circumference (> 17 inches)
- Dental Overbite
- Retrognathia
- High/narrow hard palate
- Elongated uvula
- Low riding soft palate
- Enlarged tonsils
- Macroglossia
- Deviated nasal septum with increased air flow resistance
- Polycythemia
OSA and Hypertension

- Peppard et al, NEJM 342: 1378, 2000 (709 pts)

<table>
<thead>
<tr>
<th>Baseline AHI</th>
<th>Adjusted odds ratio</th>
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<tbody>
<tr>
<td>0 events/hr</td>
<td>1.0 (reference)</td>
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<tr>
<td>0.1 – 4.9 events/hr</td>
<td>1.42</td>
</tr>
<tr>
<td>5.0 – 14.9 events/hr</td>
<td>2.03</td>
</tr>
<tr>
<td>&gt; 15 events/hr</td>
<td>2.89</td>
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4 year follow up

\[ p < .002 \]
Obstructive Sleep Apnea

- **Sleep Heart Health Study (Nieto et al, JAMA 283: 1829, 2000)**
  - 6132 patients underwent home unattended polysomnography

- **Findings**
  - Increased risk of hypertension (RDI > 5)
  - Increased risk of cerebral vascular disease (RDI > 5)
  - Increased risk of CHF (RDI > 5)
Obstructive Sleep Apnea

• Diagnosis
  – Overnight Polysomnography *(level I)*

Measurements

<table>
<thead>
<tr>
<th>Sleep state</th>
<th>Respirations</th>
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<tbody>
<tr>
<td>EEG</td>
<td>Respiratory airflow</td>
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<tr>
<td>EOG</td>
<td>Respiratory effort</td>
</tr>
<tr>
<td>EMG</td>
<td>Oxygen saturation</td>
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<tr>
<td></td>
<td>Snoring</td>
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Other Variables

• ECG
• Tibialis EMG
• Body position
Obstructive Sleep Apnea

• Diagnosis
  – Portable Sleep Monitors (hospital studies)
    • Level III
      – Airflow
      – Respiratory effort
      – SaO2
      – ECG

• Level IV (poor sensitivity and specificity)
  – SaO2
  – Respiratory effort
Untreated OSA increases your Risk

- High blood pressure
- Heart disease (abnormal heart rhythm, heart failure)
- Stroke
- Depression
- Diabetes
- Accidents
- Death
Stroke (cerebrovascular disease)

- 2nd - cause of death (worldwide)
- 3rd - cause of death (USA, #1 heart & #2 cancer)
- #1 leading cause of disability in US
- Affects 700,000 individual; annually
- 150,000 people die per year
- Stroke health care cost >$40 billion/year
Stroke - Definition

• Reduction or loss of blood flow to a particular region of the brain and it is associated with a neurological deficit (transient or permanent).
Types of Stroke

• Ischemic stroke (clogged pipe)
  – TIA (transient ischemic attack)- AKA (Mini-stroke)
    – Mostly seen in OSA patients

• Cerebral Hemorrhage - bleeding into brain and surrounding tissue (Busted pipe)
Ischemic Stroke

Blood clot stops the flow of blood to an area of the brain

© Heart and Stroke Foundation of Canada
Hemorrhagic stroke
Symptoms of stroke

• Weakness
• Numbness
• Language disturbance
• Visual changes
• Dizziness
• Headache
• Unsteadiness
Risk factors for stroke

- High blood pressure
- Heart disease (abnormal heart rhythm)
- Diabetes
- High cholesterol
- Smoking
- Age
- Sleep apnea (OSA)
- Obesity
Stroke

• OSA is common in Stroke patients (70%)
• Stroke occurs in early morning (4am and 12 pm)
• Increase risk with higher AHI/RDI
• Increase risk with age
• Increase risk in people who have sleep apnea and heart disease
• OSA worsens after stroke (esp acute phase)
What connects OSA to stroke

• Sleep apnea increase your risk
  High blood pressure
  Heart disease
  Abnormal heart rhythm
  Diabetes

• Stroke risk factors are
  High blood pressure
  Heart disease
  Atrial fibrillation
  Diabetes
How does sleep apnea lead to stroke

- Decrease cerebral blood flow during apnea
- Hypoxemia (low oxygenation)
- Sympathetic activation (increase BP/HR)
- Abnormal heart rhythm and rate
How does sleep apnea lead to stroke

- Coagulation (increase blood clot formation)
- Disruption of lining of blood vessels
- Inflammatory markers (CRP, IL6)
- Metabolic deregulation (Insulin, leptin)
Portela et al, cerebrovascular diseases
Study

- Conducted at Yale Medical Center
- 1022 participants enrolled but only 842 completed
  - 573 with OSA (AHI- 35), 325 w/o OSA (AHI<2)
- Mean age - 60yrs old
- Follow up of 2-4yrs
- Adjusted for age/sex/race, smoking, alcohol intake, BMI, DM, HTN, AF, high cholesterol.
Results

- OSA group - 22 stroke, 50 death
- Control group - 2 stroke, 16 death

Hazard ratio 1.97; (95% CI 1.12-3.48), P=0.01

Yaggi et al, NEJM, 2005
More evidence

• Another study of 1189 subjects from the general population

• Individuals (#99) with Sleep apnea (AHI>20) was associated with increased risk of having a stroke

(OR 4.31; 95% CI 1.31-14.15; P=0.02)

Arzt et al, AM J Respir Crit care Med, 2005
Who snores more, Men or women?
Snoring

• Studies suggest it is a risk factor for ischemic stroke

• Multiple Studies show it increases blood pressure

• Vibration from snoring increase plaque formation in the carotid artery.
Pieces of plaque can break free, travel to the brain, and block blood vessels that supply blood to the brain.
Snoring

• Study from Japan
• 167 patients with OSA
• mean age - 47
• After control for High BP, DM, high cholesterol
• Results shows patients with
  – High AHI have increase carotid artery thickness (measured by ultrasound)
  – Decrease thickness after CPAP therapy

Suzuki et al, Sleep, 2004
Brain scan in OSA patients

- Brain MRI shows silent brain infarct in 25% of patient with moderate to severe OSA
  
  Minoguchi et al, AM J Respir Crit care Med, 2007

- Higher prevalence of sleep apnea in patients with vascular dementia compared with patients with Alzheimer’s disease or control of similar age
  
  Erkinjuntti et al, sleep, 1987
How does the Presence of OSA Affect Stroke Recovery?

• Studies suggest that stroke patients with OSA have
  – Reduce motivation
  – decrease cognitive capacity
  – Prolong rehab stay
  – May increase the risk of recurrent stroke and death.
How can you decrease your risk of stroke if you have obstructive sleep Apnea?
Lifestyle changes

- Weight loss
- Sleep with head elevated with wedge or pillow
- Avoid sleeping supine
- Avoid alcohol consumption at night
Positive pressure therapy

CPAP or Bilevel devices
Use of CPAP and stroke risk

• Successful treatment of sleep apnea with CPAP lowers blood pressure.
  (indirectly lowers the risk of stroke)
• Improves blood flow to the brain
• CPAP therapy reduces mortality, especially after stroke.
CPAP Study

- 5yr follow study from Spain
- 166 patients with stroke
- CPAP treatment offered to patient with AHI > 20
- Patient followed for 1, 3, 6, then q6 months for 5 yrs
Figure 2. Accumulated survival curve for study groups of patients with stroke, by apnea–hypopnea index (AHI) cutoff point and continuous airway pressure (CPAP) tolerance. The group of patients with stroke with an AHI of 20 or greater and poor tolerance of CPAP showed more mortality than the rest of the patients after 5 years of follow-up. Cum = cumulative.
Issues of CPAP compliance

- Study of 105 pts shows only about <70% of patient with OSA and stroke actually adhere to CPAP therapy
- CPAP compliance is poor
- Difficulty using mask
- Motor deficit (facial weakness)
- Difficulty understanding

Wessendorf et al
Other OSA treatments

• But no studies to justify efficacy

• Oral appliances (may decrease snoring)

• Surgery (Jaw advancement, soft tissue)
Cure for OSA

- Tracheotomy
Summary

- OSA is a risk factor for Stroke
- OSA patients have an increase of stroke and death
- OSA needs to be treated
- Some evidence shows CPAP decreases the risk of stroke and mortality in OSA patients
References: