Cardiovascular Consequences of Sleep Apnea

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Increased Mortality in OSA

He et al. Chest 94:9-14, 1988

Does Sleep Apnea Cause Cardiovascular Disease?

DIED. REGGIE WHITE, 43, retired star NFL defensive end; possibly the result of sleep apnea and a disease that affected his lungs, according to a preliminary autopsy report; in Huntersville, N.C. During 15 seasons with the Philadelphia Eagles,
Acute Hemodynamic Effects of OSA

- EEG
- EOG
- ECG
- FA Press (mm Hg)
- PA Press (mm Hg)
- SaO₂ (%)
- Abd Resp
- Time Code


OSA and the Pulmonary Circulation

- Obstructive Apnea
  - Pulmonary Artery Hypertension
  - Cor Pulmonale
  - RIGHT SIDED CHF (Pickwickian Syndrome)

Association of Nocturnal Arrhythmias with Sleep Disordered Breathing

- Nested group-matched exposed and non-exposed design
- Group frequency matching to obtain covariate distributions of age, sex, race/ethnicity and BMI

<table>
<thead>
<tr>
<th></th>
<th>AHI &lt; 5 n = 338</th>
<th>AHI ≥ 30 n = 228</th>
<th>Odds Ratio</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atrial fibrillation</td>
<td>0.9%</td>
<td>4.8%</td>
<td>4.02</td>
<td>1.03 – 15.74</td>
</tr>
<tr>
<td>Non-sustained ventricular tach</td>
<td>1.2%</td>
<td>5.3%</td>
<td>3.40</td>
<td>1.03 – 11.20</td>
</tr>
<tr>
<td>Complex ventricular ectopy</td>
<td>14.5%</td>
<td>25.0%</td>
<td>1.74</td>
<td>1.11 – 2.74</td>
</tr>
</tbody>
</table>

Mehra et al. AJRCCM 173:910-6, 2006
OSA Patients Have Increased Prevalence of Cardiovascular Disease

Shahar E et al., AJRCCM 163:19-25, 2001

Cardiovascular Outcomes in Men with OSAH with or without CPAP Treatment

Marin et al. Lancet 365:1046-1053, 2005

CPAP Treatment of Mild to Moderate OSA Reduces Cardiovascular Risk

Buchner et al. AJRCCM 176:1274-80, 2007

Effect of CPAP Treatment on Mean Ambulatory Blood Pressure

"Intermediate Mediators"
Linking OSA to CVD

- Obstructive Sleep Apnea
- Sympathetic Hyperactivity
- Inflammation
- HTN and Cardiovascular Disease
- Insulin Resistance
- Endothelial Dysfunction

CRP Levels Are Elevated in Patients With OSAS

Yokoe T. et al., Circulation 107:1129-34, 2003

CPAP Treatment Decreases CRP Levels in Patients With OSAS

Yokoe T. et al., Circulation 107:1129-34, 2003

CPAP Treatment Improves LVEF Patients with Heart Failure and OSA

Mansfield et al, AJRCCM 169:361-6, 2004
Central Sleep Apnea - Cheyne Stokes Respiratory Pattern

- O₂Sat (%)
- R-EOG
- L-EOG
- Chin EMG
- Airflow
- Thorax
- Abdomen

5 minute epoch

Post-Hyperventilation Apnea During NREM Sleep

- Central sleep apneas in wake-sleep transition states
- Cheyne Stokes resolves or is attenuated in REM sleep


Prevalence of Sleep Apnea in Patients with Heart Failure

- Javaheri 1998
- Chan 1997
- Sin 1999

Treatments for Central Sleep Apnea and Cheyne Stokes Respiration

- Medical therapy of heart failure
- Supplemental oxygen
- Theophylline
- CPAP
- Bilevel PAP
- Adaptive Servo-Ventilation
CPAP for Central Sleep Apnea and Heart Failure – the CANPAP Trial

Bradley et al. NEJM 353:2025-33, 2005

Observed Rate

Year

Time from Enrollment (mo)

No. at Risk
CPAP group 128 104 79 59 49 42 33 34 42 20 12 6
Control group 110 117 96 79 59 46 37 37 19 12 6

CPAP for Central Sleep Apnea and Heart Failure – the CANPAP Trial

Bradley et al. NEJM 353:2025-33, 2005

Post Hoc Analysis of CANPAP Results


CPAP – CSA suppressed

CPAP – CSA unsuppressed

Control group

Transplant-free survival (%)

Time from enrollment (mo)

No. at Risk
CPAP/CSA suppressed (n=57) 51 38 31 27 24 21 15 11 7 3
Control (n=30) 98 83 71 60 41 33 22 18 9 3
CPAP/CSA unsuppressed (n=45) 39 27 22 18 12 9 6 3 4 2

Observed Rate

Rate of Death or Heart Transplantation per 100 Person-Years

Year

Constant/Anticipated Rate
Conclusions – OSA and CVD

- Sinus brady-tachy arrhythmia and atrial fibrillation are common HR abnormalities
- Prevalence of cardiac ischemia during sleep in patients with OSA poorly studied
- OSA can lead to pulmonary artery hypertension
- Evidence suggests that CPAP treatment may decrease the incidence of CVD independent of HTN and other co-morbid conditions
- CPAP treatment improves LV function in patients with OSA and heart failure
- CSR-CSA may not be as prevalent in patients with heart failure as previously reported
- Does PAP treatment improve survival in CHF patients with CSR-CSA?