Update in Obstructive Sleep Apnea 2016

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Learning Objectives

• To identify the risk factors for the increasing prevalence of obstructive sleep apnea (OSA)
• To outline the diagnostic criteria for OSA
• To list the indications and contraindications for home sleep apnea testing
• To describe the adverse health effects of OSA
• To explain the efficacy and benefits of the medical and surgical therapies for OSA
Question 1

1. Which of the following statements regarding the prevalence of OSA is true?
   A. The prevalence of OSA decreases with age
   B. The prevalence of OSA decreases with increasing body mass index (BMI).
   C. The prevalence of OSA is higher in men than women regardless of female menopausal status.
   D. The prevalence of OSA is higher in postmenopausal women on hormone replacement therapy.
1. C. The prevalence of OSA is higher in men than women regardless of female menopausal status.
Prevalence of OSA by Age

Young T et al. *Arch Intern Med* 2002;162:893–900
### Wisconsin Sleep Cohort: Prevalence of OSA

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI ≥ 5/hr</td>
<td>24%</td>
<td>9%</td>
</tr>
<tr>
<td>AHI ≥ 5/hr plus hypersomnolence</td>
<td>4%</td>
<td>2%</td>
</tr>
</tbody>
</table>

- AHI = no. of apneas and hypopneas/hr of sleep
- Hypopneas
  - 50% reduction in respiratory effort by RIP or
  - Discernible reduction in effort plus 4% O2↓

Young T et al. *NEJM* 1993; 328:1230-1235
Prevalence of Moderate-to-Severe (AHI ≥ 15/h) OSA

Sex and Age Categories

# Prevalence of OSA in Women

<table>
<thead>
<tr>
<th></th>
<th>Prevalence of OSA per 1000 (CI)</th>
<th>Odds Ratio (CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premenopausal</td>
<td>0.6 (0.2, 1.8)</td>
<td>1</td>
</tr>
<tr>
<td>women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-menopausal</td>
<td>1.9 (1.0, 3.6)</td>
<td>-</td>
</tr>
<tr>
<td>women</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postmenopausal</td>
<td>0.5 (0.1, 3.8)</td>
<td>0.5 (0.04, 5.6)</td>
</tr>
<tr>
<td>women with HRT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postmenopausal</td>
<td>2.7 (1.4, 5.3)</td>
<td>1.9 (0.4, 8.7)</td>
</tr>
<tr>
<td>women without HRT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bixler EO et al. *Am J Respir Crit Care Med* 2001; 163:608-13
Question 2

2. A 55-year-old man was brought by his wife to your office for his constant, loud snoring. The patient denies any sleepiness, fatigue, inattention, memory problems, or other symptoms. His wife has not observed any pauses in his breathing during sleep. Epworth Sleepiness Scale score is 8 (normal <10). His only known medical history is childhood asthma, which resolved when he was a teenager. His only medication is ibuprofen taken as needed for pain. Physical examination shows a BMI of 24 kg/m², a Mallampati score of 2 (part of the uvula seen above the tongue), a neck circumference of 16 inches, and a normal cardiopulmonary examination.
Question 2 (cont’d)

What is the next step in the management?
A. Advise weight loss via healthy eating and exercise.
B. Order a sleep study.
C. Order an automatic continuous positive airway pressure machine.
D. Order an oral appliance (i.e., mandibular advancing device).
E. Advise the patient and his wife that the risk of sleep apnea is low and that there is nothing to worry about at this time.
Answer 2

2. B. Order a sleep study
## Epworth Sleepiness Scale

<table>
<thead>
<tr>
<th>Situation</th>
<th>Chance of dozing (0–3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting and reading</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Watching television</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Sitting inactive in a public place—for example, a theater or meeting</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>As a passenger in a car for an hour without a break</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Lying down to rest in the afternoon</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Sitting and talking to someone</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Sitting quietly after lunch (when you’ve had no alcohol)</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>In a car, while stopped in traffic</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td></td>
</tr>
</tbody>
</table>

0 = would never doze  
1 = slight chance of dozing  
2 = moderate chance of dozing  
3 = high chance of dozing

ESS total score \( \geq 10 \) indicates need for further evaluation to determine cause of excessive sleepiness.

Berlin Questionnaire©
Sleep Apnea

Height (m) ______ Weight (kg) ______ Age ______ Male / Female

Please choose the correct response to each question.

Category 1

1. Do you snore?
   □ a. Yes
   □ b. No
   □ c. Don’t know

   *If you answered ‘yes’:

2. You snoring is:
   □ a. Slightly louder than breathing
   □ b. As loud as talking
   □ c. Louder than talking

3. How often do you snore?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month

Category 2

6. How often do you feel tired or fatigued after your sleep?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month
   □ e. Rarely or never

7. During your waking time, do you feel tired, fatigued or not up to par?
   □ a. Almost every day
   □ b. 3-4 times per week
   □ c. 1-2 times per week
   □ d. 1-2 times per month
   □ e. Rarely or never

8. Have you ever nodded off or fallen asleep while driving a vehicle?
   □ a. Yes
   □ b. No

Berlin Questionnaire (cont’d)

8. Have you ever nodded off or fallen asleep while driving a vehicle?
  □ a. Yes
  □ b. No

If you answered ‘yes’:

9. How often does this occur?
  □ a. Almost every day
  □ b. 3-4 times per week
  □ c. 1-2 times per week
  □ d. 1-2 times per month
  □ e. Rarely or never

Category 3

10. Do you have high blood pressure?
  □ Yes
  □ No
  □ Don’t know

Berlin Questionnaire

• Category 1: Snoring
• Category 2: Hypersomnolence
• Category 3: Hypertension

• High risk: If 2 or more categories are positive
• Low risk: If 0 or 1 category is positive

STOP-BANG Scoring System

- S = Snoring
- T = Tiredness
- O = Observed apnea
- P = Pressure (systemic hypertension)
- B = BMI > 35 kg/m$^2$
- A = Age > 50 yrs
- N = Neck circumference > 16 inches (40 cm)
- G = Gender (male)

High risk for OSA $\geq 3$
Low risk for OSA $< 3$

## Sensitivity and Specificity of STOP-BANG

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>AHI &gt; 5/hr</th>
<th>AHI &gt; 15/hr</th>
<th>AHI &gt; 30/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOP</td>
<td>65.6%</td>
<td>74.3%</td>
<td>79.5%</td>
</tr>
<tr>
<td>STOP-BANG</td>
<td>83.6%</td>
<td>92.9%</td>
<td>100%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Specificity</th>
<th>AHI &gt; 5/hr</th>
<th>AHI &gt; 15/hr</th>
<th>AHI &gt; 30/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>STOP</td>
<td>60.0%</td>
<td>53.3%</td>
<td>48.6%</td>
</tr>
<tr>
<td>STOP-BANG</td>
<td>56.4%</td>
<td>43.0%</td>
<td>37.0%</td>
</tr>
</tbody>
</table>

Chung F et al. *Anesthesiology* 2008; 108: 82230
2. B. Order a sleep study
   S – (+) snoring
   A - Age = 55 years old
   G – Gender: Male

   STOP-BANG score = 3
Question 3

3. For the patient with OSA in question 2, you ordered in-laboratory polysomnography (PSG) but his health insurance denied coverage for this test. What should be the next step in his management?

A. Order an overnight oximetry
B. Order a home sleep apnea test (HSAT)
C. Order an arterial blood gas (ABG) determination.
D. Advise the patient to switch to a health insurance company that will cover his in-laboratory PSG
E. Advise the patient to pay out-of-pocket for his in-lab PSG
Answer 3

3. B. Order a home sleep apnea test (HSAT)
Oximetry Tracing Pre and Post-CPAP
Overnight Oximetry To Screen for OSA

Specificity ranges from 41 – 100%
Sensitivity ranges from 31 – 98%

### Table 2—Sensitivity and Specificity of Pulse Oximetry When Used To Screen for OSA Compared to NPSG: Results From 11 Published Studies*

<table>
<thead>
<tr>
<th>Author/Year</th>
<th>Study Population, No.</th>
<th>AHI/ODI Cutoff Point</th>
<th>Screening Specificity, %</th>
<th>Screening Sensitivity, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ryan et al(^{27}/1995)</td>
<td>69</td>
<td>≥ 15</td>
<td>100</td>
<td>31</td>
</tr>
<tr>
<td>Levy et al(^{29}/1996)</td>
<td>301</td>
<td>≥ 15</td>
<td>94</td>
<td>77</td>
</tr>
<tr>
<td>Rodriguez Gonzalez-Moro et al(^{10}/1996)</td>
<td>96</td>
<td>NA</td>
<td>69</td>
<td>91</td>
</tr>
<tr>
<td>Schafer et al(^{41}/1997)</td>
<td>114</td>
<td>NA</td>
<td>41 (92(^{†}))</td>
<td>94</td>
</tr>
<tr>
<td>Lacassagne et al(^{42}/1997)</td>
<td>329</td>
<td>≥ 15</td>
<td>57.8</td>
<td>89</td>
</tr>
<tr>
<td>Sano et al(^{89}/1998)</td>
<td>40</td>
<td>≥ 15</td>
<td>83.3</td>
<td>73.5</td>
</tr>
<tr>
<td>Olson et al(^{45}/1999)</td>
<td>113</td>
<td>≥ 15</td>
<td>70</td>
<td>88</td>
</tr>
<tr>
<td>Golpe et al(^{43}/1999)</td>
<td>116</td>
<td>≥ 15</td>
<td>97</td>
<td>84</td>
</tr>
<tr>
<td>Brouillette et al(^{46}/2000)</td>
<td>349</td>
<td>NA</td>
<td>96</td>
<td>58</td>
</tr>
<tr>
<td>Nuber et al(^{42}/2000)</td>
<td>70</td>
<td>NA</td>
<td>77.8</td>
<td>85.2–91.8(^{‡})</td>
</tr>
<tr>
<td>Vazquez et al(^{39}/2000)</td>
<td>246</td>
<td>≥ 15</td>
<td>88</td>
<td>98</td>
</tr>
</tbody>
</table>

*NA = not available.

\(^{†}\)Combined with questionnaire.

\(^{‡}\)Higher sensitivity after rereading unclear desaturations.
Limitations of Pulse Oximetry

• Artifacts from interruption of the pulse signal due to body movements, vasoconstriction, and hypotension
• Changes in the Hb structure (MetHb and COHb) and quantity (anemia) may affect accuracy
• Do not reliably predict OSA in obese patients
• Inability to detect other forms of SRBD where oxygen desaturation does not occur
  – Upper airway resistance syndrome
  – Sleep-related hypoventilation

Loube DI. *Chest* 1999; 115:1519–1524
Indication for Home Sleep Apnea Testing (HSAT)

- “[in conjunction with a comprehensive sleep evaluation]..portable monitoring may be used as an alternative to PSG for the diagnosis of OSA in patients with a high pretest probability of moderate to severe OSA.”

Home Sleep Apnea Monitor

Minimum requirement:
1. Airflow
2. Respiratory effort
3. Blood oxygenation

Other parameters:
1. Pulse rate
2. Body position
3. Peripheral arterial tone
4. Actigraph
5. EEG

Portable Monitoring Task Force of the American Academy of Sleep Medicine (Collop NA et al).
J Clin Sleep Med 2007;3(7):737-747
# HSAT Medicare Volume

## Table 1: HSAT Medicare Volume

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>95800</td>
<td>-</td>
<td>-</td>
<td>3,761</td>
<td>5,532</td>
<td>7,602</td>
</tr>
<tr>
<td>95801</td>
<td>-</td>
<td>-</td>
<td>132</td>
<td>274</td>
<td>179</td>
</tr>
<tr>
<td>95806</td>
<td>7,422</td>
<td>8,205</td>
<td>8,250</td>
<td>11,145</td>
<td>18,267</td>
</tr>
</tbody>
</table>


## Sleep Services Payment 2016*

<table>
<thead>
<tr>
<th>Component</th>
<th>HSAT (95806)</th>
<th>Diagnostic PSG (95810)</th>
<th>PSG with CPAP (95811)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Global</td>
<td>$170.18</td>
<td>$630.57</td>
<td>$662.46</td>
</tr>
<tr>
<td>Technical</td>
<td>$107.76</td>
<td>$506.61</td>
<td>$533.48</td>
</tr>
<tr>
<td>Professional</td>
<td>$61.98</td>
<td>$123.96</td>
<td>$128.98</td>
</tr>
</tbody>
</table>

*Based on conversion factor of $35.8279.

## Cost of Home-based vs Laboratory-based Diagnosis of OSA

<table>
<thead>
<tr>
<th></th>
<th>Laboratory-based ($)</th>
<th>Home-based ($)</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Payer</strong></td>
<td>1,840</td>
<td>1,660</td>
<td>.02</td>
</tr>
<tr>
<td><strong>Provider</strong></td>
<td>1697</td>
<td>1736</td>
<td>.66</td>
</tr>
<tr>
<td><strong>Margin</strong></td>
<td>+142</td>
<td>-161</td>
<td>&lt;.01</td>
</tr>
</tbody>
</table>

Question 4

4. Which of the following patients is a home sleep apnea test indicated?

A. A 23-year-old woman with excessive daytime sleepiness, hypnagogic hallucinations, and sleep paralysis

B. A 45-year-old man with decompensated congestive heart failure with waxing and waning breathing pattern

C. A 65-year-old woman with chronic obstructive pulmonary disease, stage 4 (very severe), on nocturnal oxygen therapy

D. A 34-year-old woman with insomnia and restless legs syndrome

E. A 28-year-old man who underwent uvulopalatopharyngoplasty (UPPP) for OSA
4. E. A 28-year-old man who underwent uvulopalatopharyngoplasty (UPPP) for OSA
Additional Indications for Home Sleep Apnea Testing

• “for the diagnosis of OSA in patients for whom in-laboratory PSG is not possible by virtue of immobility, safety, or critical illness.”

• “to monitor the response to non-CPAP treatments for OSA, including oral appliances, upper airway surgery, and weight loss.”

Contraindications for Home Sleep Apnea Testing

- Significant comorbid medical conditions that may degrade the accuracy of portable monitoring, including, but not limited to, moderate-to-severe pulmonary disease, neuromuscular disease, or CHF
- Suspicion of having other sleep disorders, including central sleep apnea, periodic limb movement disorder (PLMD), insomnia, parasomnias, circadian rhythm disorders, or narcolepsy
- General screening of asymptomatic populations

Question 5

5. A 46-year-old man brings you the result of his recent polysomnogram which shows as following results:
Total sleep time = 427.5 minutes
Sleep efficiency = 81%
Apnea-hypopnea index = 6/hour
Respiratory effort-related arousal index = 3/hour
Respiratory disturbance index = 9/hour
Minimum oxygen saturation = 85%
Time spent with oxygen level $\leq 88% = 3$ minutes
Question 5 (cont’d)

Which of the following comorbid conditions will indicate the need for CPAP therapy in this patient with mild OSA?

A. Asthma
B. Atrial fibrillation
C. Chronic kidney disease
D. Multiple sclerosis
E. Schizophrenia
5. B. Atrial fibrillation
Diagnostic Criteria for Mild OSA

A. ≥ 1 of the following:
   1. Sleepiness, nonrestorative sleep, fatigue, or insomnia
   2. Awakening with breath holding, gasping, or choking.
   3. Habitual snoring, breathing interruptions during sleep
   4. Hypertension, mood disorder, cognitive dysfunction, CAD, stroke, CHF, atrial fibrillation, or type 2 DM.

B. PSG or OCST demonstrates:
   1. Respiratory disturbance index (RDI)* ≥ 5/hr
   
   *RDI = (apneas + hypopneas + RERAs)/total sleep time

International Classification of Sleep Disorders 3rd edition
Question 6

6. Which of the following conditions is least likely to be associated with OSA?

A. Motor vehicle accidents
B. Cardiovascular disease
C. Diabetes mellitus
D. Cancer
E. Gluten sensitivity
6. E. Gluten sensitivity
OSA and Risk for Motor Vehicle Collisions

Review of 40 published studies

• 2 to 3 times increased risk of crashes in noncommercial drivers with sleep apnea

• 1 of 3 studies showed an increased crash risk in commercial drivers

• Sleep apnea treatment improved both noncommercial and commercial driver performance

Ellen RL, et al. JCSM 2006.2:193
# Sleep Heart Health Study: Prevalence of Cardiovascular Diseases

<table>
<thead>
<tr>
<th>Quartile AHI</th>
<th>I &lt;1.3</th>
<th>II 1.3-4.3</th>
<th>III 4.4-11</th>
<th>IV &gt;11</th>
<th>$\rho$</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAD</td>
<td>1.0</td>
<td>1.01</td>
<td>1.2</td>
<td>1.22</td>
<td>0.08</td>
</tr>
<tr>
<td>CHF</td>
<td>1.0</td>
<td>1.19</td>
<td>1.96</td>
<td>2.20</td>
<td>0.008</td>
</tr>
<tr>
<td>CVD</td>
<td>1.0</td>
<td>1.24</td>
<td>1.38</td>
<td>1.55</td>
<td>0.06</td>
</tr>
</tbody>
</table>

## OSA and Incidence of Systemic Hypertension

<table>
<thead>
<tr>
<th>AHI (1/hr)</th>
<th>Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>0.1-4.9</td>
<td>1.42 (1.13 - 1.78)</td>
</tr>
<tr>
<td>5-14.9</td>
<td>2.03 (1.29 - 3.17)</td>
</tr>
<tr>
<td>≥15</td>
<td>2.89 (1.46 - 5.64)</td>
</tr>
</tbody>
</table>

OSA and Arrhythmias

Mehra R et al. *Archives of Internal Medicine* 2009; 169:1147-55
OSA is associated with diastolic dysfunction in patients with coronary artery disease with preserved ejection fraction even after controlling for age, gender, obesity, smoking hypertension, and diabetes mellitus (OR = 1.90, CI: 1.13, 3.18)

## OSA and Stroke

<table>
<thead>
<tr>
<th>Author Year</th>
<th>Type of Study</th>
<th>Subjects</th>
<th>SDB Prevalence</th>
<th>Risk Estimate (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arzt 2005</td>
<td>Population-based</td>
<td>30-60 years old</td>
<td>7%</td>
<td>OR = 4.48 (1.31-15.33)</td>
</tr>
<tr>
<td>Yaggi 2005</td>
<td>Clinic-based</td>
<td>Suspected SDB</td>
<td>66%</td>
<td>HR = 1.97 (1.12-3.48)</td>
</tr>
<tr>
<td>Munoz 2006</td>
<td>Clinic-based</td>
<td>Non-institutionalized 70-100 years old</td>
<td>25%</td>
<td>HR = 2.25 (1.04-6.1)</td>
</tr>
<tr>
<td>Valham 2008</td>
<td>Clinic-based</td>
<td>Symptomatic angina and CAD</td>
<td>54%</td>
<td>HR = 2.89 (1.37-6.09)</td>
</tr>
</tbody>
</table>

Moderate-to-Severe OSA and Diabetes Mellitus

Moderate-to-severe OSA is associated with a 63% increased incidence of diabetes mellitus

The incidence of cancer, even when adjusted for traditional cancer risk factors, is increased by 40% in patients with OSA.

6. Which of the following is true regarding the association between sleep apnea and death?

A. The odds of death in patients with sleep apnea is similar to that of the general population.

B. Death from cardiovascular disease is increased in patients with sleep apnea compared to controls.

C. Non-cardiovascular death rates are similar between sleep apnea patients and controls.

D. CPAP therapy is not effective in reducing cardiovascular death rates in patients with OSA.
Answer 7

6. B. Death from cardiovascular disease is increased in patients with sleep apnea compared to controls.
Busselton Health Study: OSA and Survival

Severe OSA: Fully adjusted hazard ratio = 6.24 (2.01-19.39)

Severe OSA: All-cause mortality adjusted hazard ratio $= 3.0 (1.4-6.3)$
Sleep apnea syndrome corresponds to a 61% higher risk of total mortality (OR=1.61; CI: 1.43 - 1.81; p < 0.00001)

Sleep Apnea and Cardiovascular Mortality

The risk of death from cardiac causes was 2.52 times higher in OSA patients (OR = 2.52; CI: 1.80 - 3.52; p < 0.00001).

Mortality from other causes is increased 68% in patients with sleep apnea syndrome (OR = 1.68; CI: 1.08 - 2.61; p = 0.02).

Question 8

8. A 45-year-old man with metabolic syndrome (obesity, diabetes mellitus, and hypertension) underwent in-laboratory PSG which showed an RDI of 33/hr. You inform him that he has severe OSA and explain to him the adverse health consequences of untreated OSA. You recommended CPAP therapy but he is somewhat reluctant to adhere to your advice.
You want to educate him about the health benefits of CPAP therapy so that he can make an informed decision. Which of the following is true regarding the salutary effects of CPAP therapy for OSA?

A. CPAP therapy helps patients with OSA lose weight
B. CPAP therapy reduces blood pressure only in OSA patients with systemic hypertension
C. CPAP therapy does not reduce the risk of cardiovascular events in patients with cardiovascular disease
D. CPAP therapy reduces the HbA1c level in diabetics
E. CPAP therapy reduces the recurrence of atrial fibrillation
8. E. CPAP therapy reduces the recurrence of atrial fibrillation
Cardiovascular Effects of CPAP in Patients with OSAS

- ↓ systemic hypertension
- ↑ LV systolic and diastolic function
- ↓ LV end-diastolic diameter
- ↓ pulmonary hypertension

Arias MA et al. *Eur Heart J* 2006; 27:1106-1113

**CPAP and BP in OSA**

Bratton DJ et al. *JAMA* 2015; 314(21):2280-2293
CPAP was associated with:

- ↓ SBP of 2.5 mm Hg (95% CI, 1.5 to 3.5 mm Hg; \( p < .001 \))
- ↓ DBP of 2.0 mm Hg (95% CI, 1.3 to 2.7 mm Hg; \( p < .001 \))
A 1 hour/night ↑ in mean CPAP use was associated with:

- ↓ SBP of 1.5 mm Hg (95% CI, 0.8 to 2.3 mm Hg; \( p < .001 \))
- ↓ DBP of 0.9 mm Hg (95% CI, 0.3 to 1.4 mm Hg; \( p = .001 \))
CPAP and Atrial Fibrillation in OSA

CPAP is associated with a 44% ↓ in risk of recurrence of atrial fibrillation.

Qureshi QT et al. Am J Cardiol 2015;116:1767-1773)
CPAP for OSA and BMI

CPAP promoted significant increase in:

- BMI (Hedges’ $g = 0.14$, 95% CI 0.07 to 0.21, $I^2=16.2\%$)
- Weight (Hedges’ $g = 0.17$, 95% CI 0.10 to 0.24, $I^2=0\%$)

Drager LF et al. Thorax 2015; 70:258-64.
CPAP for Diabetes Mellitus Type 2: HbA1c

There was no significant effect of CPAP on HbA1c ($\Delta = -0.071$, 95% CI = $-0.245$, 0.103; $p = 0.421$)

Feng Y et al. NPJ Prim Care Respir Med 2015; 25:15005
9. Despite being informed about the health benefits of CPAP therapy for OSA, a patient still refuses to use her CPAP machine because she just cannot sleep with a mask on her face. She asks you about alternative therapies for OSA.
Question 9 (cont’d)

9. Which of the following statements about alternative medical therapies for OSA is true?

A. The vast majority of OSA patients who undergo intensive lifestyle intervention (diet and exercise) will lose enough weight and will not require CPAP therapy

B. Positional therapy is more effective than CPAP therapy in reducing the AHI

C. Oral appliance therapy does not reduce the blood pressure in patients with OSA.

D. Compression stockings reduce the AHI by decreasing daytime leg fluid accumulation and overnight fluid shift.

E. Although combination therapy with topiramate and phentermine is effective for weight reduction, it does not reduce the AHI in obese patients with OSA.
Answer 9

9. D. Compression stockings reduces the AHI by decreasing daytime leg fluid accumulation and overnight fluid shift.
Compression Stockings for OSA

Compression stockings:
32.4±20.0 → 23.8±15.5

Control:
31.2±25.0 → 30.3±23.8

White LH et al. *Sleep Med* 2015; 16:258-64

*Fig. 2.* Changes from baseline to follow-up in the apnea–hypopnea index (AHI) in the compression stockings and control groups. There was a significantly greater reduction in the AHI in the compression stockings group than in the control group.
Intensive Lifestyle Intervention for OSA

Weight reduction programs were associated with a ↓ in AHI ($\Delta = -6.04$ events/h [95% CI: -11.18, -0.90])

Positional Therapy
Positional Therapy for Positional OSA

Oral Appliances and OSA

Mandibular advancing device

Tongue-retaining device

Oral Appliance Therapy Effects on the Upper Airway

- Repositions the mandible into a more anterior position
- Lifts the tongue away from the posterior pharyngeal wall
- Expands the cross-sectional area of the oropharynx as well as the velopharynx
- Elevates the hyoid bone

Ferguson KA et al. *Sleep* 2006; 29:244-62.
Walker-Engström M et al. *Chest* 2002;121:739-746
Oral Appliances for OSA: AHI

Oral appliance therapy was associated with a ↓ in AHI ($\Delta = -10.26$ [95% CI: (-12.59, -7.93)]).  

Mandibular advancing devices (MADs) were associated with:

- ↓ SBP of 2.1mmHg (95%CI, 0.8 to 3.4mmHg; \( P = .002 \))
- ↓ DBP of 1.9 mmHg (95%CI, 0.5 to 3.2mmHg; \( P = .008 \))
Phentermine and Topiramate for OSA

Winslow DH et al. Sleep 2012; 35:1529-1539
Phentermine and Topiramate for OSA

![Graph showing the comparison of mean AHI (Events/h) between Placebo and Phentermine 15 mg plus extended-release topiramate 92 mg at different time points: Baseline, Week 8, and Week 28 (LOCF). The graph indicates a decrease in mean AHI with Phentermine and Topiramate treatment compared to Placebo.]

Winslow DH et al. Sleep 2012; 35:1529-1539
10. A 23-year-old military man was diagnosed moderate OSA with a RDI of 16/hour and a BMI of 28 kg/m². He uses his CPAP machine nightly for an average of 6 hours and 34 minutes. He will be deployed to Afghanistan and is inquiring about surgical therapy for his OSA since he may not be able to use his CPAP regularly while deployed in combat.
Which of the following statements regarding surgical therapies for OSA is true?

A. The majority of OSA patients who undergo uvulopalatopharyngoplasty will normalize their AHI.

B. Bariatric surgery for severe obesity (BMI > 35 kg/m²) is not effective in ameliorating OSA despite reducing the BMI.

C. Nasal surgery increases the required therapeutic CPAP level.

D. Hypoglossal nerve stimulation is partially effective in reducing the AHI in patients who refuse or cannot tolerate CPAP therapy.

E. Tracheostomy is associated with increased mortality in OSA.
10. D. Hypoglossal nerve stimulation is partially effective in reducing the AHI in patients who refuse or cannot tolerate CPAP therapy.
Hypoglossal Nerve Stimulation for OSA

Eastwood PR et al. SLEEP 2011; 34:1479-1486
Hypoglossal Nerve Stimulation for OSA

Eastwood PR et al. SLEEP 2011; 34:1479-1486
Hypoglossal Nerve Stimulation for OSA

Eastwood PR et al. *SLEEP* 2011; 34:1479-1486
Overall, the AHI was reduced between 50% and 57%, and the ODI was reduced between 48% and 52%
Surgical Therapies for OSA

“More Efficacious”
• Bariatric surgery
• Tonsillectomy and adenoidectomy (T&A)
• Uvulopalatopharyngoplasty (UPPP)
• Uvulopalatal flap +/-tonsillectomy
• Maxillomandibular advancement (MMA)
• Pillar Procedure
• Distraction osteogenesis (DOG)
• Tracheotomy

“Less Efficacious”
• Nasal reconstruction
• Laser-assisted uvulopalatoplasty (LAUP)
• Radiofrequency surgery of the soft palate, tonsils, or base of the tongue
• Hyoid suspension
• Laser midline glossectomy
• Tongue suspension
• Genioglossus advancement
• Multi-level surgery

Nasal Surgery and CPAP Level

Nasal surgery (septoplasty and/or turbinoplasty) was associated with a ↓ CPAP level (-2.66 cmH2O, CI: -3.65 to -1.67; p < 0.0001)

Camacho M et al. Sleep 2015; 38(2):279-86
Uvulopalatopharyngoplasty

Long-term success rate = 33%

### UPPP for OSA: AHI

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>Ratio of Means [95% CI]</th>
<th>Ratio of Means [95% CI]</th>
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<tbody>
<tr>
<td>Berger, 2003</td>
<td>0.72 [0.42, 1.23]</td>
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<tr>
<td>Cahali, 2004</td>
<td>0.87 [0.53, 1.41]</td>
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<td>Doghramji, 1995</td>
<td>0.79 [0.62, 1.01]</td>
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<td>Friedman, 2002</td>
<td>0.75 [0.61, 0.92]</td>
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<td>Fujita, 1985</td>
<td>0.54 [0.43, 0.69]</td>
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<td>Gislason, 1988</td>
<td>0.56 [0.35, 0.88]</td>
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<tr>
<td>Han, 2005</td>
<td>0.40 [0.32, 0.49]</td>
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<tr>
<td>Han, 2006</td>
<td>0.91 [0.69, 1.20]</td>
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<td>Katsantonis, 1990</td>
<td>0.68 [0.55, 0.83]</td>
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<td>Miljeteig, 1994</td>
<td>1.03 [0.74, 1.44]</td>
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<td>Millman, 2000</td>
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<td>Myatt, 1999</td>
<td>0.58 [0.44, 0.76]</td>
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<td>Walker Engstrom, 2000</td>
<td>0.48 [0.44, 0.52]</td>
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<td>Walker, 1989</td>
<td>0.85 [0.61, 1.19]</td>
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<tr>
<td>Zohar, 1991</td>
<td>0.59 [0.38, 0.92]</td>
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</tbody>
</table>

**Total [95% CI]**

- **Heterogeneity:** $\tau^2 = 0.06$; $\chi^2 = 112.53$, df = 14 ($P < 0.00001$); $I^2 = 88$
- **Test for overall effect:** $Z = 5.57$ ($P < 0.00001$)

- UPPP was associated with a ↓ AHI of 33% (95% CI 23% to 42%)
- Postoperative residual AHI remained elevated, averaging 29.8/hour

Caples SM et al. *Sleep* 2010; 33:1396-1407
Tracheostomy for OSA

- Mean AHI decreased from $92.0 \pm 34.8$ to $17.3 \pm 20.5$/h ($p < 0.0001$)
- Mortality with tracheostomy (1.7%) compared with untreated OSA subjects (13.8%, $p = 0.019$)

ODI : $78.2 \pm 25.8$/h $\rightarrow$ $20.8 \pm 25.5$/h

Camacho M et al. *Laryngoscope* 2014;124(3):803-11
Summary

• The increasing prevalence of OSA may be attributed to the aging of the population and growing obesity epidemic.

• The diagnosis of mild OSA requires the presence of neurocognitive symptoms, mood disorder, insomnia, cardiovascular disease or diabetes mellitus.

• While in-lab PSG is the reference standard for diagnosing OSA, HSAT is an alternative in patients with high probability of moderate-to-severe disease and without significant comorbid cardiopulmonary, neurologic, or non-respiratory sleep disorders.

• While CPAP therapy is still the most effective treatment for OSA, lifestyle interventions, non-PAP devices and certain surgical procedures may be offered as alternative therapies for those who are intolerant or non-adherent to CPAP.