JANUARY 2018
VOL. 18, ISSUE 1

IU Health Physicians

# ADVANCED praxis CME

A JOURNAL OF CURRENT TRENDS IN MEDICINE FROM IU HEALTH PHYSICIANS, A PARTNERSHIP OF IU SCHOOL OF MEDICINE AND INDIANA UNIVERSITY HEALTH

## CASE MANAGEMENT

# Obstructive Sleep Apnea in Adults

A 52-year-old female is referred to Indiana University Health Sleep Disorders Center because of non-restorative sleep. She retires to bed at 7:00 pm nightly, watches television for about two hours, then sleeps for 12 hours. Her loud snoring has forced her husband from the bedroom. She currently is taking amlodipine for hypertension; rosuvastatin for hyperlipidemia; and aripiprazole for schizophrenia. She drinks a six-pack of beer daily and reports no family history of sleep apnea. (*continued on page 2*)

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**OBJECTIVES**
*After reading this article, the reader should be able to:*

- Summarize the cause and consequences of obstructive sleep apnea (OSA).
- Discuss the risk factors for OSA.
- Identify the tools used for OSA screening and diagnosis.
- Delineate the role of patient education and behavioral strategies in OSA management.
- Describe the treatment options for OSA.

**Date of original release:** January 2018

**Date of expiration:** January 2019

**COMMERCIAL SUPPORT**
This CME activity does not have any commercial support.

On physical examination, the patient is morbidly obese, weighing 132 kg with a body mass index (BMI) of 44.3 kg/m$^2$. Her blood pressure is 119/75 mm Hg, heart rate is 95 bpm, and respiration rate is 16 bpm. She is edentulous, has a high arched palate, no tonsillar enlargement, and a class IV Mallampati score *(Table 1)*. Her neck circumference is 18 inches.

A portable sleep study is ordered and demonstrates an apnea-hypopnea index *(AHI; Table 2)* of 36.5 events/hr (80 events/hr in the supine position), with the lowest recorded oxygen saturation at 78 percent. A total of 124 minutes are spent at an oxygen saturation below 88 percent. The patient is diagnosed with obstructive sleep apnea (OSA).

## Overview of Obstructive Sleep Apnea

***OSA is a common disorder characterized by repetitive collapse of the upper airway (Figure 1) during sleep that results in hypoxemia, hypercapnia, increased sympathetic activation, and sleep fragmentation.*** Affected individuals also experience altered sleep architecture, spending more time in rapid eye movement sleep than deep sleep.[1] The estimated US prevalence of moderate to severe OSA, defined as an AHI ≥15, is 14 percent in males and five percent in females.[2] Cardinal features of the disorder in adults include loud snoring, gasping, and choking during sleep; excessive daytime sleepiness; fatigue; poor concentration; and decreased quality of life. Severe OSA (AHI ≥30) is consistently associated with motor vehicle crashes, depressed mood, cardiovascular and cerebrovascular morbidity, cognitive impairment, metabolic dysfunction, and accelerated mortality.[3]

The strongest risk factor for OSA in both males and females is obesity, with prevalence rising as the BMI and associated markers, such as neck circumference (>17 inches for men; >16 inches for women[4]), increase. In a population-based study of more than 1000 adults who underwent polysomnography (PSG), moderate to severe OSA was present in 11 percent of men of normal weight, 21 percent of overweight men (BMI 25-30 kg/m$^2$), and 63 percent of those who were obese (BMI >30 kg/m$^2$).[5] Other risk factors for OSA include nasal congestion, linked to a twofold-increased prevalence; smoking, which may elevate risk nearly threefold; physical inactivity (independent of body weight); and excessive alcohol use. Genetics and certain medical conditions also predispose to OSA, in particular coronary heart disease (CHD), type 2 diabetes mellitus, and stroke/transient ischemic attack,* as well as end-stage renal disease, chronic lung disease, and pregnancy.

*Prevalence of OSA in individuals with: CHD = 30-60 percent;[6] type 2 diabetes mellitus = ≤83 percent;[7] stroke = 50-70 percent.[8]

## Screening and Diagnosis

"The STOP-Bang questionnaire *(Table 3, see page 4)* is used to screen adults with suspected obstructive sleep apnea," explains Shalini Manchanda, MD, associate professor of clinical medicine at Indiana University School of Medicine and sleep medicine specialist at IU Health. "While screening is generally reserved for persons reporting sleep-associated issues (e.g., snoring, daytime sleepiness), every patient who has suffered a cerebrovascular or cardiovascular event or who has cardiovascular disease—including hypertension*—should undergo such screening because of the very high likelihood of concomitant obstructive sleep apnea."

When an increased risk for OSA is identified on screening, a comprehensive sleep history is obtained, which involves questioning both the patient and sleep partner. The physical examination includes an assessment of the respiratory, cardiovascular, and neurologic systems, paying special attention to obesity, enlarged neck circumference, crowded oropharynx (Mallampati III to IV), and large tongue.

Overnight PSG performed in a sleep laboratory is the gold standard for the diagnosis of OSA. Testing involves electroencephalography, chin electromyography, and electrooculography to stage sleep and record arousals; pulse oximetry; pressure sensors to monitor nasal and oral airflow; and chest and abdominal belts and leg sensors to track respiratory efforts and leg movements, respectively. OSA is diagnosed when the number of obstructive events (apneas, hypopneas, and respiratory event arousals) on PSG exceeds five per hour. Treatment is offered when the AHI: 1) is greater than 15 per hour, or 2) more than five per hour in a patient reporting symptoms of sleepiness and/or with comorbidities.

*Prevalence of OSA in individuals with hypertension = 30 percent.[9]

**TABLE 1. MALLAMPATI SCORE**

| Class | Description |
|---|---|
| I | Complete visualization of the soft palate |
| II | Complete visualization of the uvula |
| III | Visualization of the base of the uvula only |
| IV | No visualization of the soft palate |

**TABLE 2. APNEA-HYPOPNEA INDEX**

| Score* | Description |
|---|---|
| <5 | Normal |
| ≥5 – <15 | Mild sleep apnea |
| ≥15 – <30 | Moderate sleep apnea |
| ≥30 | Severe sleep apnea |

*Events per hour.

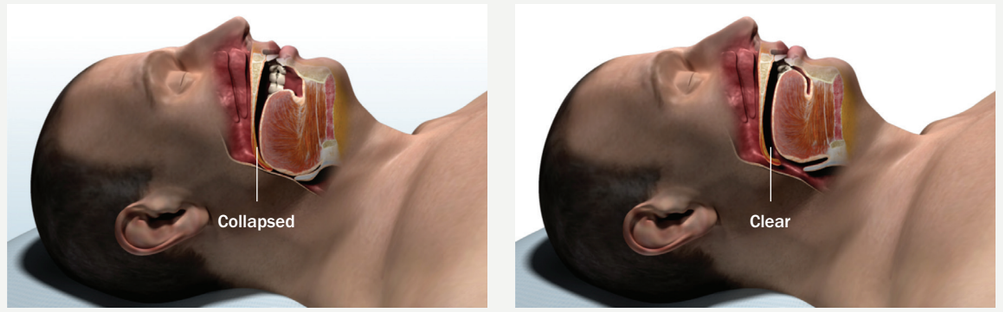
Home sleep testing has gained popularity because of its convenience and lower cost, as compared with standard PSG. Per the American Association of Sleep Medicine, home testing is appropriate solely for adults with a high pretest probability for moderate to severe OSA and no significant medical comorbidities (e.g., congestive heart failure, chronic obstructive lung disease) or other suspected sleep disorders, such as periodic limb movement during sleep or central sleep apnea.

## Treatment

### *Patient Education and Behavioral Strategies*

"The management of obstructive sleep apnea begins with patient education about the condition and behavioral strategies to mitigate its impact, including achieving and maintaining a BMI less than 25 kg/m$^2$, exercising regularly, avoiding alcohol before bedtime, eliminating the use of sedatives/hypnotics, and practicing good sleep hygiene *(Table 4, see page 5)*," Dr. Manchanda says. "In addition, because sleeping in the supine position can decrease airway size and patency, patients are urged to use a positioning device, such as an alarm, pillow, or tennis ball, to maintain a non-supine position in bed."

***Figure 1. Collapse of airway as compared to a clear airway***




Source: Inspire Medical Systems, www.inspiresleep.com

Positive airway pressure (PAP) administered through a nasal mask and usually delivered continuously (CPAP)* is the treatment of first choice for moderate to severe OSA. By providing pneumatic splinting of the upper airway, CPAP reduces apneas and hypopneas, improves sleep architecture, and reduces daytime sleepiness, thus enhancing quality of life.[10] Initial patient acceptance is high—up to 80 percent[11]—but data from sleep clinics indicates that long-term adherence to treatment, defined as CPAP use for ≥4 hours/night, drops to 17 to 71 percent.[12] This decline is concerning, as the ability of CPAP to prevent cardiovascular events appears to be linked to adequate adherence. In the Sleep Apnea Cardiovascular Endpoints (SAVE trial) that enrolled more than 2700 adults with moderate to severe OSA and established cardiovascular disease, CPAP therapy failed to reduce cardiovascular events when used for a mean of 3.3 hours per night.[13] Among patients who used the device at least four hours nightly, however, a nonsignificant trend in favor of CPAP was observed.

"In our experience, long-term acceptance of CPAP is enhanced by patient education, working with the individual to find the best type of mask for him or her *(Figure 2)*, and maintaining close communication during the first few weeks of therapy to obtain feedback and adjust treatment as necessary," emphasizes Dr. Manchanda. "Patients who do well during this period are likely to continue to do well over time."

### *Oral Appliances*

Oral appliances advance the lower jaw forward to increase upper airway volume and reduce pharyngeal collapse.[14] Mandibular repositioning devices cover both the upper and lower teeth, whereas tongue-retaining devices hold only the tongue in a forward position.

Although not as effective as CPAP for monotherapy, oral appliances are helpful for some individuals with mild to moderate OSA and may be used in conjunction with CPAP for severe OSA, according to Dr. Manchanda. Candidates require healthy teeth upon which to seat the appliance, no significant temporomandibular joint (TMJ) dysfunction, and adequate jaw range of motion. A thorough dental examination and review of dental records and radiographs is necessary before the oral appliance is custom-fabricated and fitted. (Dr. Manchanda strongly cautions against buying oral appliances over-the-counter or on the internet because of the potential for malocclusion and TMJ problems.) Follow-up with a dentist is recommended every six months for the first year and annually thereafter to monitor adherence, oral health, device deterioration, and maladjustment.[4]

### *Surgery*

A variety of surgical procedures may be used for the treatment of OSA *(Table 5)*. Evaluation for primary operative intervention is appropriate for patients with OSA and severe airway-obstructing anatomy that is surgically correctable, such as enlarged tonsils. Secondary surgical treatment may be considered in patients with moderate to severe OSA who are intolerant of PAP or when such treatment is unsuccessful.[4]

*Bilevel and autotitrating PAP are options for CPAP-intolerant patients in whom high pressure is needed but the individual experiences difficulty exhaling against a fixed pressure or has coexisting central hypoventilation.[4]

**TABLE 3. STOP-BANG QUESTIONNAIRE[16]**

| | |
|---|---|
| Yes/No | **S**noring<br>Do you **snore loudly** (loud enough to be heard through closed doors or cause your bed partner to elbow you)? |
| Yes/No | **T**ired<br>Do you often feel **tired, fatigued, or sleepy** during the daytime (e.g., falling asleep while driving or talking)? |
| Yes/No | **O**bserved<br>Has anyone observed you **stop breathing or choking/gasping** during sleep? |
| Yes/No | **P**ressure<br>Do you have or are you being treated for **high blood pressure**? |
| Yes/No | **B**ody mass index >35 kg/m²? |
| Yes/No | **A**ge >50 years? |
| Yes/No | **N**eck size large (measured at the level of the cricothyroid membrane)? |
| Yes/No | **G**ender = male? |

**Low risk:** Yes to 0–2 questions

**Intermediate risk:** Yes to 3–4 questions

**High Risk:** Yes to 5–8 questions

*or*

**Yes to** ≥2/4 STOP questions + male gender, or

**Yes to** ≥2/4 STOP questions + BMI > 35 kg/m², or

**Yes to** ≥2/4 STOP questions + neck circumference = 17 inches/43 cm in male or 16 inches/41 cm in female

***Figure 2. Nasal CPAP apparatus***

*A. Nasal pillow mask.*

*B. Nasal mask.*

*C. Full-face mask.*

**TABLE 4. IMPROVING SLEEP HYGIENE[17]**

- Limit daytime naps to 30 minutes
- Avoid
  - Stimulants (e.g., caffeine, nicotine) and foods that disrupt sleep close to bedtime
  - Sedatives and other medications that interfere with normal sleep patterns
- Regular aerobic exercise (but not close to bedtime)
- Ensure adequate exposure to natural light
- Establish a regular relaxing bedtime routine
- Optimize the sleep environment
  - Comfortable mattress and pillows
  - Keep bedroom cool (60-70 degrees)
  - No television or electronic devices (e.g., computer, cell phone) in the bedroom
  - Other
    - Blackout curtains
    - Eye shades
    - Ear plugs
    - "White noise" machine
- Get sufficient sleep: 7 to 9 hours per night

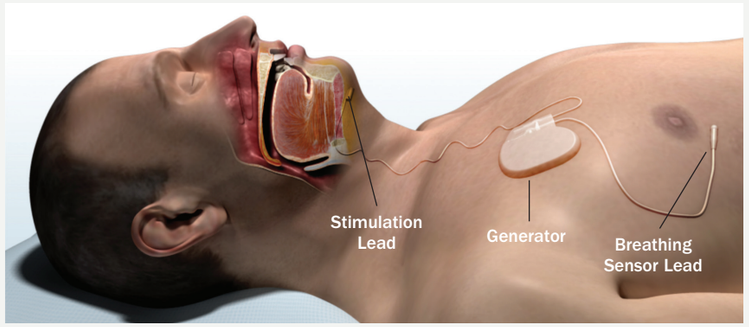
**TABLE 5. COMMON SURGICAL PROCEDURES FOR ADULT OSA[4]**

| | |
|---|---|
| Upper airway bypass procedure | • Tracheotomy |
| Nasal procedures | • Septoplasty<br>• Functional rhinoplasty<br>• Nasal valve surgery<br>• Turbinate reduction<br>• Nasal polypectomy<br>• Endoscopic procedures |
| Oral, oropharyngeal, and nasopharyngeal procedures | • Uvulopalatopharyngoplasty and variations<br>• Palatal advancement pharyngoplasty<br>• Tonsillectomy and/or adenoidectomy<br>• Tori mandibularis excision<br>• Palatal implants |
| Hypopharyngeal procedures | • Tongue reduction<br>• Tongue advancement/ stabilization |
| Laryngeal procedures | • Epiglottoplasty<br>• Hyoid suspension |
| Global airway procedures | • Maxillomandibular advancement |
| Other procedures | • Bariatric surgery |

"Hypoglossal nerve stimulation, in which an implantable pacemaker *(Inspire®; Inspire Medical Systems; Figure 3)* unilaterally stimulates the hypoglossal nerve to maintain multilevel airway patency during sleep, is a new alternative for patients with severe obstructive sleep apnea who are unable to use or obtain consistent benefit from CPAP,"[15] Dr. Manchanda reports. "When performed at high-volume sleep centers like IU Health, this outpatient surgery has proven highly effective in improving both polysomnographic and quality of life measures, and patients are very happy with the results. While insurance coverage has been problematic, the situation is improving as payers recognize the benefits of the procedure."

The patient is advised to reduce her alcohol intake, lose weight, and sleep in a non-supine position. Because she is edentulous, an oral mandibular advancement device is not an option, and she is not interested in undergoing surgery at this time. She agrees to a trial of CPAP, and titration is started at 12 cm $H_20$. She initially struggles to find a comfortable mask, ultimately settling on a nasal mask. After eight weeks of CPAP treatment, the residual AHI dropped to 3.4 events per hour. She wears the mask for an average of 6.4 hours and reports feeling better rested the next morning. A smartphone app* allows her to access data regarding how many hours she uses the CPAP machine nightly, how well her OSA is controlled, and whether the mask continues to fit properly. She will be seen at IU Health Sleep Disorders Center in four months (six months after starting treatment) and followed annually thereafter.

***Figure 3. Upper airway stimulation***




*The breathing sensor lead senses breathing patterns, the generator monitors breathing patterns, and the stimulation lead delivers mild stimulation to maintain multilevel airway patency during sleep.*

Source: Inspire Medical Systems, www.inspiresleep.com

"Obstructive sleep apnea is a chronic disease, and affected patients should receive regular, ongoing follow-up to monitor adherence to therapy, treatment side effects, and continued resolution of symptoms," Dr. Manchanda concludes.

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Dr. Manchanda received her medical degree from Christian Medical College in Vellore, India and completed a residency in internal medicine and a fellowship in pulmonary and critical care medicine at the University of Wisconsin in Madison. Her clinical interests focus on the care of advanced heart failure patients and the management of their complex sleep-disordered breathing. Her research activities include investigating the effects of OSA on skull-base thickness, the use of magnetic resonance imaging to assess the distensibility of the upper airway as it relates to OSA and CPAP use, and the impact of early OSA diagnosis on the management of diabetes mellitus.

A fellow of the American College of Chest Physicians and the Academy of Sleep Medicine and a member of other professional organizations, Dr. Manchanda is a reviewer for the *Journal of Sleep Medicine* and the *Journal of Clinical Sleep Medicine*. She is the author of numerous peer-reviewed publications and is frequently invited to lecture.

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