Sleep Apnea

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Purpose

The purpose of this course is to provide nurses with an understanding of the different types of sleep apnea, their causes, symptoms, diagnostic procedures, and treatment options.

Goals

Upon completion of this course, the nurse should be able to do the following:

- Explain 3 changes that occur in the airways during sleep.
- List at least 4 factors that contribute to sleep apnea.
- Explain the differences among obstructive, central, and mixed sleep apnea.
- Describe 3 breathing patterns associated with obstructive sleep apnea syndrome.
- Describe the breathing pattern associated with central sleep apnea.
- List and describe at least 5 illicit substances or drugs and their effect on sleep.
- List at least 5 prescription drugs that can impair sleep.
- Describe elements used in polysomnography.
- Describe nocturnal PSG, sleep diary, multiple sleep latency test, and maintenance of wakefulness test.
- List and describe 3 assessment tools used to evaluate daytime sleepiness and/or fatigue.
- List and describe 4 types of positive airway pressure (PAP) devices.
- Discuss PAP titration.
- List and describe 4 common problems with PAP.
- List and describe 4 types of PAP interfaces.
- List and describe at least 6 other treatments used for sleep apnea.

Introduction

Dave began dozing off in the afternoon and evening and going to bed earlier but felt tired all the time. He woke up with a headache each morning and found it

harder and harder to concentrate. He argued with his wife and co-workers and became increasingly unhappy and withdrawn. He lost interest in sex and, already overweight, started packing on more pounds. His snoring was so loud that his wife complained, finally insisting Dave see a doctor, who referred Dave to a sleep center for polysomnography. Tests showed that Dave suffered from obstructive sleep apnea syndrome, characterized by loud snoring and periods of apnea. Dave's brain was not receiving adequate oxygenation during his sleep, resulting in physical and psychological changes. About 12 million Americans suffer from sleep apnea (primarily obstructive sleep apnea), and it is more common in males, especially those that are overweight, but by age 50, male and female rates are similar. Sleep apnea not only disrupts sleep, resulting in sleep deprivation and excessive daytime sleepiness (EDS), but also causes hypertension and other disease.

What is obstructive sleep apnea syndrome?

Obstructive sleep apnea syndrome (OSAS) is the most common type of sleep apnea. When a person is awake and in upright position, the airway is usually patent, but a number of changes take place when the person lies in supine position and falls asleep:

- The tonic dilator muscles of the upper airways relax, leaving the airway less stable.
- The tongue falls back, blocking airflow at the back of the mouth.
- The throat relaxes and the sides fall inward, further decreasing the airway.

These physical changes are exacerbated by a number of factors:

- Obesity: Increases pressure on the airways when the patient reclines.
- Micrognathia: Often reduces airway size.
- Enlarged tonsils: Increase obstruction and reduce airway diameter.
- Neuromuscular disease: Further reduces pharyngeal muscle tone.
- Drug/alcohol use: Sedation further impairs breathing.
- Allergies: May cause swelling of airways and increased mucous production.

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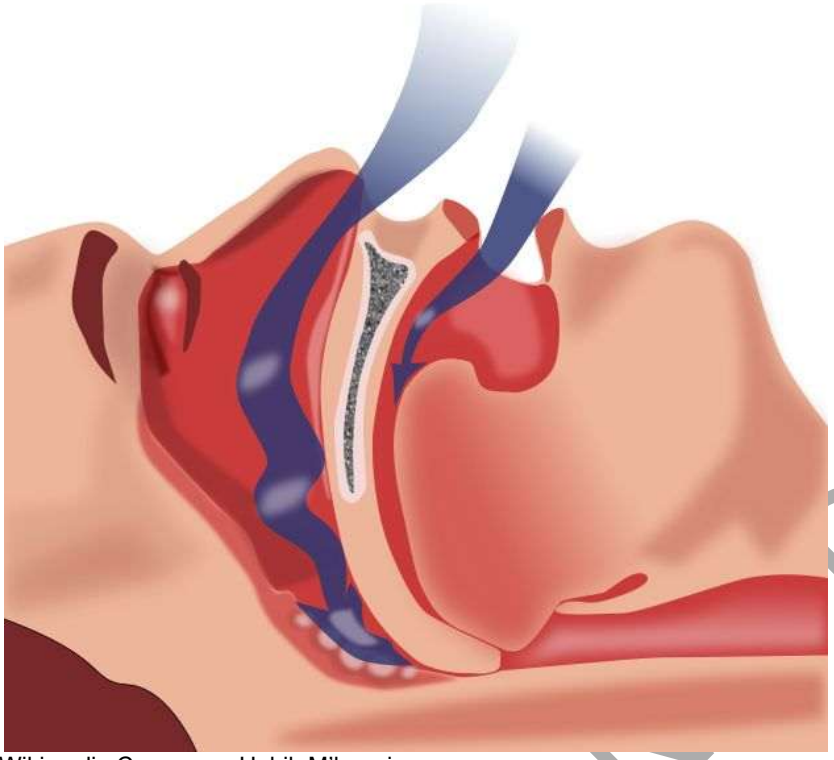

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The hypoxic drive remains intact and apnea is characterized by obvious attempts to breathe during periods of apnea, but obstruction of the airways interferes with respirations. The patient falls asleep, begins snoring, the airway collapses, and apnea occurs. As oxygen saturation drops, the patient arouses enough to restart breathing, either awakening completely or changing from deep sleep to shallow sleep. Because this pattern repeats throughout the night (at least 30 times), the patient is deprived of sleep and eventually signs of sleep deprivation occur. Periods of apnea and hypopnea trigger hypoxia and hypercapnia, which in turn triggers activation of the sympathetic nervous system.

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This sympathetic response to stress affects the entire body. The pituitary gland produces increased hormone to stimulate the adrenals to increase production of cortisol. Circulation to the gastrointestinal system decreases. Blood pressure, heart rate, and strength of contractions increase. Muscle twitching or shaking may occur. Sweating increases. Increased anxiety and restlessness impairs the ability to sleep, starting an unrelenting cycle of impaired sleep stimulating a response that further impairs sleep. Over time, obstructive sleep apnea can result in chronic hypertension and increased risk of heart attack and stroke.

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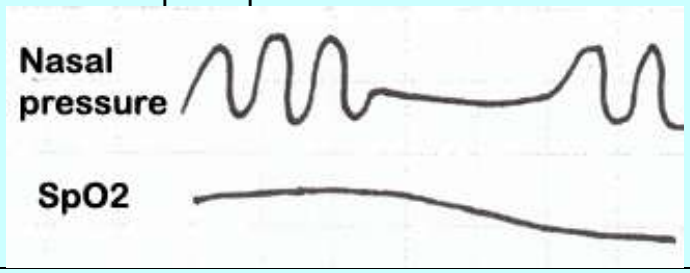
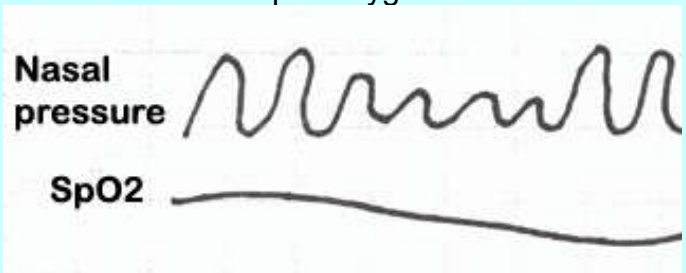
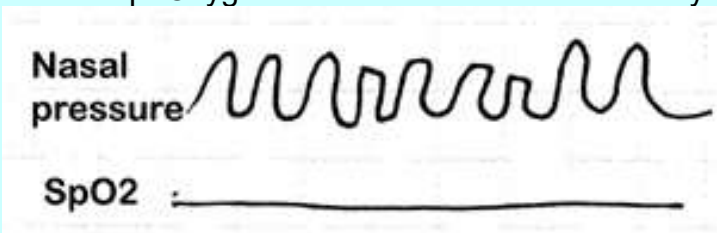
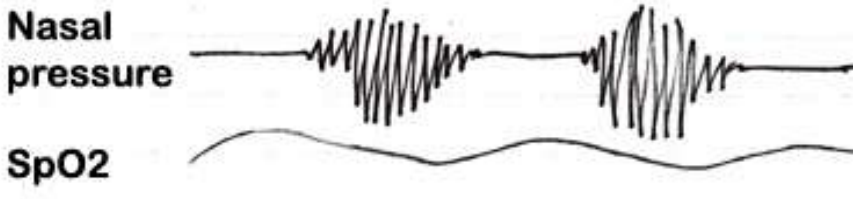
Breathing patterns associated with OSAS	
Apnea	Cessation of breathing or breathing decreased to <25% of normal for ≥10 seconds and/or ≥4% decrease in oxygen saturation related to apneic period. 
Hypopnea	Inadequate respirations with air exchange ranging from 25 to 70% of normal with hypopneic periods lasting ≥10 seconds associated with drop in oxygen saturation. 

Respiratory effort-related arousal (RERA)	Airway narrows during sleep (usually indicated by snoring), but remains patent enough that apnea and hypopnea do not occur, but RERAs result in repeated brief periods of arousal that interfere with sleep. Polysomnography shows a sequence of respirations that show increased respiratory effort or flattening of nasal pressure waveform for ≥10 seconds, leading to an arousal from sleep. Oxygen saturation remains essentially stable. 

What is central sleep apnea and mixed sleep apnea?

Obstructive sleep apnea must be differentiated from **central sleep apnea** in which an underlying condition, response to high altitude, or drug reaction rather than obstruction causes sleep apnea. Conditions that may cause central sleep apnea include cardiovascular disease (such as heart failure), cerebrovascular disease, and congenital diseases. With central sleep apnea, the central nervous system fails to adequately trigger respirations in response to changes in oxygen levels in the blood. This is especially true with chronic hypercapnia caused by cardiopulmonary disease. In this case, carbon dioxide becomes the driving force for respirations instead of oxygen. As the patient takes deep breaths to blow off excess carbon dioxide, the carbon dioxide level drops and the drive to breathe decreases, so breathing slows or stops until carbon dioxide levels increase again, triggering an increased rate of respirations. This cycle results in a Cheyne-Stokes breathing pattern.

Cheyne-Stokes breathing is characterized by ≥3 consecutive cycles of crescendo/decrescendo breathing pattern and ≥5 periods of central apneas or central hypopneas per hour of sleep and/or cycles persist for ≥10 consecutive minutes. Pulse oximetry typically shows falling oxygen saturation (SpO_2) during apneic periods and rising oxygen saturation during and after periods of rapid respirations. The breathing pattern is measured during polysomnography by nasal pressure.



An important difference between OSAS and central sleep apnea is that with central sleep apnea, inspiratory effort is absent during apneic periods.

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Mixed sleep apnea
Some patients have periods of both obstructive sleep apnea and central sleep apnea. Typically, inspiratory effort is absent for the initial half of an apneic period but resumes during the second half.

Summary of sleep apneas and symptoms	
Type	**Symptoms**
Obstructive sleep apnea	• Excessive sleepiness during the daytime. • Loud snoring with apneic periods for up to 60 seconds (at least 30 times a night) despite movements of chest wall and abdomen, indication breathing attempt. • Apneic periods >10 seconds (often 20-40 seconds). • Hypopnea because of reduced airflow. • Decreased oxyhemoglobin saturation (related to apnea/hypopnea). • Hypoxemia, hypercapnia during daytime. • Headache (especially in the morning). • Frequent nocturnal awakening. • Cognitive impairment (gradual deterioration). • Depression. • Insomnia. • Increased irritability and personality changes. • Impotence • Systemic hypertension. • Increased obesity. • Cardiac dysrhythmias (bradydysrhythmia during apnea alternating with tachydysrhythmia as breathing resumes). • Pulmonary hypertension. • Polycythemia. • Enuresis.
Central sleep apnea	Similar general symptoms as obstructive sleep apnea with some differences: • Hypercapnia. • Cheyne-stokes breathing (more pronounced during the night) with periods of apnea followed by 20 to 60 seconds of hyperventilation. • Apneic and hypopneic periods without chest wall or abdominal movement, showing central nervous system is not triggering respirations.

Mixed	General symptoms are the same as for obstructive sleep apnea: • Shows both signs of obstructive sleep apnea and central sleep apnea in relation to breathing patterns and oxygen saturation. One or the other may predominate.

What drugs can contribute to sleep disorders?

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When patients present with signs of sleep disorders, a careful review of all medications and drug use is critical in helping to identify the underlying cause. Sometimes sleep disorders are related to substance abuse, including alcohol and illicit or prescription drugs. Drug use may also worsen underlying obstructive sleep apnea or central sleep apnea:

Alcohol	Sedation occurs early with acute intoxication but is later replaced by increased wakefulness and general restlessness. During alcohol withdrawal, people may experience sleep disturbances. In some cases, poor quality sleep, characterized by restlessness, may persist for weeks or years.
Amphetamines	Total sleep time decreases because of difficulty falling asleep and restless sleep with increased muscle activity. With amphetamine withdrawal, the patient sleeps more during the night and experiences sleepiness during the day as well.
Caffeine	In sensitive individuals, caffeine can cause increased wakefulness and difficulty falling asleep while withdrawal has the opposite effect with increased sleepiness at night and during the daytime.
Cocaine	Patients experience severe disruption of sleep and may only be able to sleep for short periods of time, so they can develop sleep deprivation. During withdrawal, patients may sleep excessively.
Opioids	Short-term use may increase sleepiness and prolong sleep

	time, but chronic use may cause insomnia and decreased total sleep time. With withdrawal, sleep is again prolonged.
Sedatives/ Hypnotics	Intoxication results in increased sleepiness and sleep time although REM sleep is decreased. With chronic use, tolerance results, and insomnia can occur. If the patient increases the dosage to compensate for tolerance, excessive sleepiness recurs. Withdrawal can cause insomnia and decreased total sleep time with disrupted sleep as well as tremor and anxiety.

Prescription drugs can also profoundly impair sleep and may increase sleep apnea or cause similar symptoms.

Antiarrhythmics	Drugs, such as quinidine and procainamide may increase insomnia by causing sleep disruption and increased sleepiness during the day.
Antihistamines	Some antihistamines, such as Benadryl®, have a sedative effect that cause the patient to sleep excessively and experience daytime sleepiness as well.
β-blockers	These drugs may cause insomnia with decreased total sleep time and disrupted sleep, sometimes with increased nightmares.
Bronchodilators	Some patients experience increased muscle activity and nervousness and sleep disruption from bronchodilators, such as theophylline.
Corticosteroids	Steroids may markedly disrupt sleep, causing difficulty falling asleep, decreased sleep time, restlessness, and daytime sleepiness.
Diuretics	Diuretics that cause potassium loss, such as furosemide, may result in leg cramps and nocturia, which both disrupt sleep.
Nicotine (patches, oral)	Nicotine, usually taken for smoking reduction, may cause difficulty falling asleep, vivid dreams, and decreased sleep time.
SSRIs	SSRIs, such as Prozac® and Zoloft®, may cause disruption of sleep and increased daytime sleepiness.
Thyroid hormone	Both natural and synthetic thyroid hormone in high doses may disrupt sleep because of increase nervousness, tremors, and heart palpitations.

How is sleep apnea diagnosed?

While obstructive sleep apnea is sometimes diagnosed based on symptoms, symptoms alone can be misleading without documented verification as different conditions may manifest similarly. Polysomnography (PSG) is most commonly used for diagnosis. Elements of polysomnography include:

- ECG (often 3 lead) to monitor heart rate and dysrhythmias.

- EEG to monitor electrical activity of the brain and identify seizure disorders related to sleep disturbance. Typically 6 leads (including 2 reference leads) are used.
- Chin electromyogram (EMG) to record muscle tone and activity and help identify REM sleep (tone decreases), teeth grinding, and snoring (which causes artifacts in recording).
- Anterior tibialis EMG (bilateral) to measure leg activity during sleep and help diagnose restless legs syndrome.
- Respiratory effort sensors indicate chest and abdomen movement to show attempts to breathe.
- Snore microphones show the extent and duration of snoring.
- Airflow sensors monitor the flow of air in and out of the nose and mouth.
- Pulse oximetry measures oxygen saturation.
- Synchronized videotaping helps to identify sleep disorders and to evaluate recordings in relation to activity.

Nocturnal PSG	There are four different classifications of PSG: • Type 1 (gold standard): Completed in a sleep center (usually for at least 6 hours) and includes at least 12 channels of data, including EEG, ECG, electrooculogram (EOG), electromyogram (chin and lim), pulse oximetry, and respiratory effort and airflow sensors. Type 1 can be used to diagnose OSAS as well as other sleep disorders. Other types are modified and often done in the home environment with portable equipment. They can only be used to diagnose OSAS and cannot identify or differentiate central or mixed sleep apnea or other sleep disorders. • Type 2: Includes 7 channels of data, including EEG, ECG, EOG, EMG, and respiratory effort and airflow sensors. • Type 3: Includes at least 4 channels of data, including at least one ECG lead (heart rate monitor), pulse oximetry, and 2 sensors (respiratory effort and airflow). • Type 4: Includes at least 1-3 channels of date, including respiratory and airflow sensors. Some patients find it difficult to sleep in the sleep center, so test results may not always be accurate if patient is unable to sleep. Repeat testing may be necessary.
Sleep diary	Diary is usually kept for a 2-week period to show sleep habits. Patients assess mood (1-5 scale) before sleep and note any medications taken and time lights off. Upon awakening, patients estimate time to onset of sleep, number of arousals, time of awakening, and again assess mood. The sleep diary is a helpful tool to show a patient's perception, but it is often at odds with polysomnographic findings because patients may be unaware of arousals or be unable to accurately estimate onset of sleep.

Multiple Sleep Latency Test (MSLT)	This test is done during waking hours, often after a nocturnal polysomnogram with at least 6 hours of sleep, to determine the degree of hypersomnia (excessive sleepiness) or narcolepsy that occurs and the tendency of the person to fall asleep. Data channels include EEG, EOG, EMG, and ECG. The patient completes a 2-week sleep diary prior to testing. The MLST includes 5 nap periods with first beginning within 3 hours of completing nocturnal polysomnography and then at 2-hour spacings. Patients evaluate their degree of sleepiness 45 minutes before scheduled naptime and physiologic measurements are taken 5 minutes before the naptime. The average sleep latency (time to onset of sleep) is calculated based on the 5 naps.
Maintenance of Wakefulness Test (MWT)	This test is done during waking hours and commonly used to evaluate the effectiveness of treatment and the degree of sleepiness and ability to remain awake. It does not usually require a nocturnal polysomnogram (except for shift workers who sleep at unusual hours). The same data channels are used as for MSLT. The patient completes a two-week sleep diary and/or nocturnal polysomnogram prior to testing. During the test, the patient remains at rest, sitting in bed with light low for four 40-minute periods, spaced 2 hours apart, and told to try to stay awake but not to engage in any activities. If the patient falls asleep, sleep latency is measured (<8 minutes is abnormal). About half of normal sleepers manage to remain awake during all four periods. The patient is awakened after 90 seconds of sleep because duration of sleep is not measured.

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What assessment scales are used to assess sleepiness?

In addition to testing in the sleep center PSG, various assessments tools are used to assess degrees of sleepiness. Tools include:

Stanford Sleepiness Scale is used to assess excessive daytime sleepiness (EDS) and is completed a number of different times during the daytime. Patients evaluate their level of sleepiness on a scale of 1-7, with scores of 4 to 7 indicating sleepiness that interferes with ability to function.

Fully alert and awake	1
Functioning and concentrating well, but slightly sluggish.	2
Awake and functioning but not fully alert.	3
Slightly foggy.	4
Foggy, slightly drowsy.	5
Feeling sleepy and drowsy and having difficulty staying awake.	6
Nearing onset of sleep and awake dreaming.	7
Sleeping	X

Epworth Sleepiness Scale assesses the tendency of the patient to fall asleep during activities. The patient rates, the chance of falling asleep during each specific activity. Rating scale:

- O = None
- 1 = Slight
- 2 = Moderate
- 3 = High

Activity
Sit and read.
Watch TV.
Sit quietly in public place (meeting, theater, movie).
Sit as a passenger in an auto for ≥1 hour with no break.
Lie down for afternoon nap.
Sit and talk to someone.
Sit quietly after (non-alcoholic) lunch.
Sit in auto stopped in traffic for a few minutes.

Scores are totaled with 1 to 6 indicating the patient receives adequate sleep. Most people score between 7 and 8 but scores ≥9 indicate a high degree of sleepiness and indicates the need for further testing to determine the cause.

Fatigue Severity Scale contains 9 different statements about fatigue. The patient uses a scale of 1 to 7 (strongly disagree to strongly agree) to score each statement regarding the previous week:

My motivation is lower when I am fatigued.
Exercise brings on my fatigue.
I am easily fatigued.
My fatigue interferes with my physical functioning.
Fatigue causes frequent problems for me.
My fatigue prevents sustained physical functioning.

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Fatigue interferes with carrying out certain duties and responsibilities.
Fatigue is among my 3 most disabling symptoms.
Fatigue interferes with my work, family, or social life.

The scores are totaled with scores of 9 to 35 in the normal range and scores >35 suggesting a high degree of fatigue. An average score is obtained by adding the scores and dividing by 9. Patients whose fatigue is related to depression alone often score about 4.5 while patients with fatigue related to other physical conditions usual have an average score >6.5.

What treatments are used for sleep apnea?

Treatment depends on the type of sleep apnea and underlying causes. The most common treatment for OSAS is continuous positive airway pressure (CPAP) devices. Central sleep apnea requires treatment of the underlying cause. Positive airway pressure device (PAP) provide non-invasive ventilation (NIV). While there are different PAP devices, ranging from inexpensive machines to sophisticated computerized equipment, they all provide an air blower that delivers pressurized room air (although supplemental oxygen can be added if necessary) to an interface (mask). Air pressure usually ranges from 2 to 20 cm H_2O. The mask allows carbon dioxide to be expelled through a vent or non-rebreather valve.

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Types of positive airway pressure devices	
Continuous PAP (CPAP)	CPAP provides a continuous stream of pressurized air to essentially splint the airway to keep it open enough to ensure adequate ventilation. The pressure must be titrated individually for each patient, usually in the range of 4 to 16 cm H_2O for sleep apnea. CPAP is not effective for central sleep apnea alone. If OSAS is not controlled by CPAP, some patients can achieve better control with BIPAP. BIPAP is also indicated for neuromuscular diseases that impair ability to

	breathe, heart failure with pulmonary edema, and obesity hypoventilation syndrome (body mass index >30 kg/m^2 with impairment of muscles of respiration).
Bi-level PAP (BIPAP)	**BIPAP** provides 2 levels of pressure, which can be adjusted and preset. Inspiratory positive airway pressure (IPAP) is set at a higher level than expiratory airway pressure (EPAP) to allow pressure needed to open the airway during inspiration but to reduce pressure to facilitate expiration. BI-PAP can trigger central sleep apnea if the IPAP is set considerably higher than EPAP. **BIPAP ST** (spontaneous-timed) provides 2 pressure settings for each breath and settings for the number of respirations so that the machine can trigger inspiration if the respiratory rate falls below a preset level. This is especially useful for central sleep apnea. Settings include *spontaneous mode*, which triggers increased pressure after the patient attempts to breath, and *timed mode,* which triggers increased pressure to initiate respiration within a preset time. **Autotritrating BIPAP** can vary both IPAP and EPAP automatically as needed to promote adequate ventilation.
Autotritrating PAP (APAP)	APAP provides automatic technology to determine the correct pressure for the individual patient and includes software and downloadable memory for generation of reports about sleep events. APAP devices can detect upper airway obstruction and adjust pressure of both inspiration and expiration to compensate. APAP devices use different sensors, such as vibration sensors to detect snoring and can identify episodes of apnea and hypopnea.
Adaptive seroventilation device (ASV)	Provide baseline positive pressure to ensure ventilation of each breath to 90% of patient average.

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PAP should be titrated by a sleep technologist or trained professional, ideally in a sleep center. Initial pressure (for adults) is usually set at 5 cm H_2O until the patient falls asleep and then increased 1 cm H_2O at a time about every 15 minutes until the optimal level is reached, indicated by lack of snoring, apnea, hypopnea, RERA, and oxygen desaturation. During titration, polysomnographic tracings are observed carefully.

If self-titrating APAP devices are used, then the settings should be reviewed by a sleep technologist to ensure they are correct. Because machines vary widely, some APAP machines cannot differentiate between apnea and hypopnea.

Sometimes settings are too low to be effective. They may alleviate snoring, suggesting to the patient's partner that the therapy is effective, but apnea and/or hypopnea may still be present. If settings are too high, they may cause or increase central sleep apnea. Additionally, the presumptive diagnosis of OSAS based on clinical observation without supporting polysomnography may be wrong.

PAP devices, such as CPAP, should be used for every sleep every time every day to prevent complications related to sleep apnea. However, compliance is the biggest problem with patients, and many patients are not taught properly how to manage PAP or are not fitted appropriately with comfortable interfaces, so taking extra time to educate and assist patients can markedly increase compliance, which is considered use of the device for ≥4 hours per night ≥70 percent of the time.

Common problems	**Results**
Lack of humidifier.	Nasal irritation.
Excess pressure setting	Air leaks, mouth leaks, air swallowing, difficulty sleeping, arousals, barotrauma, and pneumothorax.
Incorrect mask	Irritation, rash (allergic reaction), ulcerations (usually related to wrong size).
Social insecurity (including partner objections)	Embarrassment, treatment resistance.

Patients are often sent home with one type of mask and not advised of other choices or fitted properly. Patients should try a number of different interfaces and should be provided information about various types that are available. Most interfaces are secured with straps or headgear. Because there are so many different interfaces and fitting instructions vary, the healthcare professional should always read the instructions carefully before fitting the interface to the patient and ensure it is adjusted correctly and fits properly.

Types of interfaces for PAP	
Nasal mask	Fits over the nose but not into the nares and is useful for patients who are nasal breathers, but the danger of air leaks exists if people breathe through their mouths or are edentulous and if CPAP pressure is high. It is preferred for those with beards. There is little risk of aspiration.

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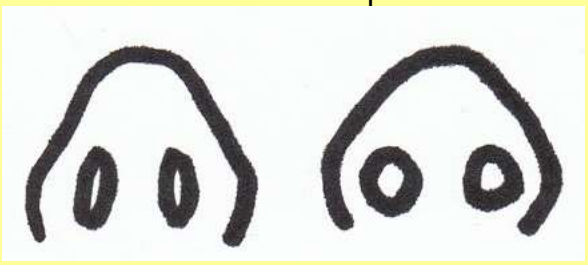
Oral mask	Fits only over the mouth but is rarely used and increases risk of aspiration. However, the oral mask may be indicated for those with nasal congestion or obstruction causing them to be primarily mouth breathers. A mouthpiece fits inside the mouth and a retractable cover that fits over the mouth to provide a seal. The mouthpiece should fit comfortably in the mouth. Nose plugs are used with this mask to prevent air leaks, especially for the first few weeks.
Orofacial mask	Covers the nose and mouth area but usually leaves the eyes free, but risk of aspiration is increased. There is more dead space than nasal mask and increased risk of leakage and claustrophobia. When fitting, it's important to ensure that the mask covers the area from above the nose to below the mouth.

Nasal pillow	This has “pillows,” often made of soft silicone, which fit into each nostril, providing a seal while leaving the bridge of the nose and the mouth exposed. This mask easily dislodges and may dry and irritate nasal passages but is less claustrophobic. Before fitting nasal pillows, the healthcare professional should examine the nares for shape.  Patients with round nostrils are more likely to be successfully fitted than those with slot nares, which may not allow for an airtight fit, and the nasal pillows may cause pain. Additionally, the nares should be examined for size as some people may require a different size of nasal pillow for each side. Typically, females require small to medium nasal pillows and males medium to large.

While positive airway pressure devices, such as CPAP, often provide relief of symptoms, it is rarely used alone. Clearly underlying conditions, such as cardiovascular disease and hypertension, must be treated, especially with central sleep apnea, but in almost all cases, other interventions are needed. In some cases, conservative treatment alone can suffice or can eliminate the need for PAP over time.

Other treatments for sleep apnea	
Lifestyle changes	Avoid use of alcohol in the evening or excess drinking. Stop smoking. Control obesity (diet, exercise, bariatric surgery). Sleep position changes (may alleviate symptoms in some patients).
Antihistamines	Used to control allergy symptoms (airway swelling) that may contribute to obstruction.
Medication modification	Substitutions or changes in dosages may be needed for drugs contributing to sleep apnea.
Oral/dental devices	Mandibular repositioning or tongue retaining devices may treat mild OSAS.
Tonsillectomy/ Adenoidectomy	Usually treatment of choice for children with OSAS rather than CPAP although surgery alone may not be adequate for children who are obese.
Nasal reconstruction	Repair of obstruction, such as deviated septum or tissue hyperplasia.
Uvulopalato-pharyngoplasty (UPPP)	Excess tissue removed from uvula, soft palate, tonsils, adenoids, and tongue as indicated. Usually indicated for those who cannot tolerate CPAP, but is associated with reflux of food and fluids through nose while swallowing and is a painful procedure.
Uvulopalatal flap (UPF)	Tonsils and some soft palate tissue removed to increase size of airway. Painful surgery but less invasive that UPPP and may be combined with other procedures (such as GA).
Genioglossus advancement	Used for those whose tongues fall back and obstruct airway. The tongue is reattached to a more anterior

(GA)	position.
Hyoid myotomy (HM)	Pulls the hyoid bone forward to enlarge the airway.
Maxillomandibular advancement (MMA)	Mandible and maxilla both fractured bilaterally and spacers placed between the bones to bring the face forward about 12 mm, sometimes changing facial appearance. Wikimedia Commons
Maxillomandibular expansion (MME)	Mandible and maxilla cut bilaterally and distractors placed to widen the jaw, leaving a gap between the teeth that requires orthodontic repair. This may also change the facial appearance.
Pillar® procedure	3 small inserts sutured into the soft palate to provide support (for mild to moderate OSAS only).
Tracheostomy	Used as last resort if patient unable to tolerate or does not benefit from other treatment.
Radiofrequency somnoplasty	Used to reduce size of nasal turbinates, tongue, or soft palate

Summary

Obstructive sleep apnea syndrome (OSAS) occurs during sleep with the airway becomes obstructed because of physiological changes that occur during sleep and positioning. OSAS is exacerbated by obesity, micrognathia, enlarged tonsils, neuromuscular diseases, drugs and alcohol, and allergies. OSAS is characterized by periods of apnea and hypopnea with the hypoxic drive intact and effort to breathe evident during apneic periods. Central apnea is characterized by Cheyne-Stokes breathing and lack of respiratory effort during apneic periods. Mixed apnea has characteristics of both OSAS and central apnea, with one type sometimes predominating. Sleep apnea can cause a wide range of symptoms related to sleep deprivation, including excessive daytime sleepiness, depression, and cognitive impairment. Physical changes include polycythemia, hypertension, and cardiac dysrhythmias. Sleep apnea may also

be affected or precipitated by alcohol and drugs, including both illicit prescription drugs.

Diagnosis of sleep apnea is by clinical evaluation and nocturnal polysomnography, preferably in a sleep center. Other tools include a sleep diary, the Multiple Sleep Latency Test (MSLT) to determine the degree of daytime sleepiness, and the Maintenance of Wakefulness Test (MWT), used primarily to assess the effects of treatment, the degree of sleepiness, and the ability to stay awake during the daytime. Other assessment scales include the Stanford Sleepiness Scale, the Epworth Sleepiness Scale, and the Fatigue Severity Scale.

The most common treatment for sleep apnea is positive airway pressure (PAP), usually delivered as continuous PAP (CPAP), bi-level PAP (BIPAP), autotitrating PAP (APAP), or adaptive seroventilation (ASV). Interfaces include nasal mask, oronasal masks, oral masks, and nasal pillows. Additional treatments include lifestyle changes, antihistamines, medication modification, oral/dental devices, and a number of surgical procedures to enlarge the airway.

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