

nervous system injury, [strokes](#), [congestive heart failure](#), and opioid intoxication.

- **Mixed sleep apnea** is a combination of obstructive and central sleep apnea.
- **Obesity hypoventilation syndrome:** morbid obesity with BMI > 30 kg/m² leads to hypoventilation, retention of carbon dioxide during the day and during sleep with [hypoxemia](#).

Epidemiology and Etiology of Obstructive Sleep Apnea

It is estimated that in the United States, **2-6% of the women and 4-13% of the men**, especially in middle age, have sleep-disordered breathing with excessive daytime somnolence. Approximately 50% of the men in a Swiss community sample were reported to have OSA.

This **increasing incidence** may be partly due to the **obesity pandemic, modern lifestyle**, improvements in diagnostic methods, awareness about the importance of the disorder and several other factors.

Etiology

The cause of OSA can be multifactorial, ranging from **anatomic neuromuscular factors** to associated **genetic predisposition**. Congenital or acquired craniofacial abnormalities (e.g., micrognathia, retrognathia, large tongue or tonsils, neck circumference > 17 inches), aging, alcohol, use of sedatives, postmenopausal status, acromegaly, and [hypothyroidism](#) are some of the risk factors associated with OSA. A common risk factor for OSA is **obesity**, and it often co-exists with **hypoventilation syndrome**.

During sleep, the individual is recumbent, and muscle activity is diminished, leading to the **collapse of the upper airway**. Repeated episodes of this lead to cessation and diminished airflow. The apneic and hypopneic episodes stimulate respiratory efforts against the narrowed upper airway until the individual is awakened.

Studies have reported EMG patterns in OSA patients suggestive of **genioglossus neuromuscular dysfunction** similar to denervation–reinnervation. This may be related to systemic inflammation, intermittent hypoxia or vibrational trauma during snoring.

Signs and symptoms of Obstructive Sleep Apnea

The majority of patients with OSA are unaware of their symptoms. Often it is their sleep partners and spouses who alert them about their disruptive sleep and apnea. Symptoms may include:



Image: "Illustration of obstruction of ventilation," by English:
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based on: http://topnews.in/health/files/sleep-apnea_0.jpg.
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- Snoring, choking or gasping while asleep
- Restlessness during sleep
- Interrupted sleep

- Waking up feeling tired and/or with a dry or sore throat/mouth
- Daytime sleepiness
- Diminished ability to concentrate
- Irritability
- Fatigability

Diagnosis of Obstructive Sleep Apnea

The diagnosis of OSA is based on a **thorough history** from the individual as well as their partners, spouses or roommates. The history should include the **age and weight** of the patient, other **medical co-morbidities**, **daytime sleepiness**, and **fatigue**.

Physical examination should rule out **nasal obstruction**, **tonsillar enlargement**, **craniofacial anomalies** and **features of acromegaly/hypothyroidism**.

Routine laboratory tests such as **complete blood count**, **blood sugar levels** and glycosylated hemoglobin **levels** as well as **thyroid-stimulating hormone levels** are recommended based on clinical findings.

The gold standard for diagnosis of OSA is the **polysomnography**. It assesses the respiratory, cardiac and sleep parameters of the individual during sleep, either at home or in a hospital.

During sleep, the patient is monitored and ECG-recorded to determine the number of apneic episodes and arrhythmias if any, Other variables such as body position (supine position may predispose to apnea) and limb muscle activity. **Restless leg syndrome** and **periodic lung movement disorder** should also be evaluated.

Drug-induced sleep endoscopy (DISE): This procedure is used to evaluate the dynamic upper airway in a sleeping patient with OSA. It is especially helpful prior to surgical intervention to detect the level of obstruction and tailor the surgery for the individual patient.

Radiological investigations like lateral radiographic cephalometry, computed tomography (CT) and magnetic resonance imaging (MRI) which are static tests are **not of much value** in diagnosing the level of obstruction in patients with OSA.

Degrees of OSA

The **severity of OSA** can be determined from the **Apnea/Hypopnea index (AHI)**, which is calculated as the **number of apneic episodes per hour of sleep**. The AHI values can be calculated for the different sleep stages.

AHI > 5 = OSA

AHI > 15 = moderate OSA

AHI > 30 = severe OSA

If EEG monitoring is used, then the **arousal index (AI)** can be calculated as the number of arousals per hour of sleep. Although AI can be correlated with AHI, approximately 20% of apneas are not associated with arousals.

Effects of OSA

Undiagnosed and untreated OSA has been linked to a high incidence of reduced workplace productivity, motor vehicle accidents, cognitive impairment, [hypertension](#), fatal and non-fatal cardiovascular events, [ischemic stroke](#), sexual dysfunction, and cancer mortality.

The nocturnal hypoxia can be severe enough to cause pulmonary or systemic hypertension, secondary polycythemia, [arrhythmias](#), and sudden death. The all-cause mortality of OSA is significantly higher in untreated patients with moderate to severe OSA.

Differential Diagnosis of Obstructive Sleep Apnea

- **Insomnia:** nocturnal inability to sleep, especially in depression or restless leg syndrome
- **Hypersomnia:** daytime sleepiness, e.g., narcolepsy
- **Paroxysmal nocturnal dyspnea:** dyspnea on lying in the supine position, especially at night when it presents in congestive cardiac failure and [asthma](#)

Treatment of Obstructive Sleep Apnea

The aim of treatment is to improve the quality of life and sleep by reducing the apneic episodes during sleep. OSA is considered to be cured when the AHI decreases to below threshold values, i.e., <10/hour of sleep.

The principles of managing OSA include:

Conservative Management

Initially, the treatment is directed towards improving the modifiable risk factors such as hypothyroidism, acromegaly, diabetes, obesity, sedatives/alcohol. It is often difficult for patients to lose weight, and the morbidly obese may require **bariatric surgery**. However, bariatric surgery or weight loss alone is not a cure for OSA.

CPAP or other devices



Image: "Continuous positive airway pressure machine," by PruebasBMA - Own work. License: [CC BY-SA 3.0](https://creativecommons.org/licenses/by-sa/3.0/)

Continuous positive airway pressure (CPAP) is the most effective method for managing OSA. It has been documented to improve sleep symptoms, snoring, cognition, daytime somnolence and quality of life. Unfortunately, most patients find its usage cumbersome, and compliance is often inadequate.

Other devices like the **mandibular advancement device**, or others which help to pull the tongue forward, are also available and may help to alleviate symptoms in mild to moderate OSA.

Surgery

The role of surgery in the treatment of OSA has always been **controversial**. Surgery aims to detect sites of redundant upper airway tissue and then surgically remove it to widen the upper airway. Common sites of airway obstruction are the nose (nasal polyps, deviated nasal septum), macroglossia, low hanging uvula, and enlarged tonsils. Depending upon the level of obstruction, diverse surgeries can be recommended.

Nasal septal deviation correction, reduction of hypertrophied inferior turbinate/s and polypectomy are recommended in OSA patients with nasal obstruction.

In children with OSA, **tonsil-adenoid removal** is used to alleviate the symptoms.

Uvulopalatopharyngoplasty (UPPP), either conventional or laser-assisted (LAPP), involves removal of the uvula, part of the soft palate and excess oropharyngeal tissue and is combined with tonsillectomy. Although post-procedure there is an improvement in snoring and AHI, the efficacy of the procedure decreases over time.

Maxillomandibular advancement is a surgical procedure recommended for OSA patients with retrognathia or micrognathia. Maxillary and mandibular osteotomies with their advancement help to displace the soft palate and tongue anteriorly, with the resultant widening of the oropharyngeal airway. This is a very effective treatment modality for selected patients.

Tracheotomy is the most effective surgical treatment for OSA but is only recommended for patients with severe refractory life-threatening OSA.

Hypoglossal nerve stimulation is a rescue treatment modality for patients with moderate to severe OSA. An implanted device stimulates the hypoglossal nerve.

Bariatric surgery is recommended for OSA patients with morbid obesity.

Prevention of Obstructive Sleep Apnea

Patient education, highlighting the **risk factors** and **intensive lifestyle changes** are important in the management of OSA. Patients should be advised to maintain optimal weight, avoid alcohol, sedatives (especially in the evening) and smoking. It is also important to inform patients about the adverse effects of untreated OSA and improve their compliance by educating them about the nocturnal use of CPAP.

References

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[Sleep Apnea](#) via sleepapnea.org

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[Obstructive sleep apnoea syndrome and its management](#) via nih.gov

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