Obstructive Sleep Apnea : An Overview

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Abstract

Obstructive sleep apnea is a disorder that has significant medical and psychosocial consequences. This is a common, underdiagnosed disorder that affects both adults and children. It is characterized by repetitive partial or complete cessation of airflow, associated with oxyhemoglobin desaturation and increased effort to breath. Because individuals with narrow airways and/or craniofacial anomalies may have increased risk for obstructive sleep apnea/hypopnea syndrome, dentistry can play a pivotal role in the identification and possible treatment of patients with this syndrome. This article reviews some of the basic aspects of this sleep related disorder, its diagnosis, treatment, and consequences.

Apnea is characterized by a cessation of airflow for 10 seconds or longer. Hypopnea, in contrast, is characterized by a reduction, without complete cessation, in airflow or respiratory effort.[1] Obstructive sleep apnea (OSA) is known to be a frequent clinical condition in the general population.

The morbidity of OSA relates principally to the cardiovascular system.[2] Rigorous epidemiologic studies have shown that sleep apnea is a risk factor for the development of arterial hypertension, independent of associated obesity, alcohol intake, sex, and age.[3-6] Animal studies have shown that apnea causes arterial hypertension, which is reversible with treatment.[7] OSA patients have significantly more hypertension, ischemic heart disease, and cerebrovascular disease than individuals without OSA.[2,3-6,8,9] However, OSA patients have a high incidence of other coexisting cardiovascular risk factors such as obesity, hyperlipidemia, increased age, smoking history, and excessive alcohol intake, which potentially confounds the identification of an independent association of OSA with cardiovascular disease.[10]

Among other consequences of sleep apnea, excessive daytime sleepiness (EDS), cognitive impairment,[11,12] impaired ability to operate a motor vehicle,[13] and an increased automobile accident rate[13,14] have been recently documented. The patients' relative risk to have an accident lies between 2.3 and 7.3 times that of nonapneic individuals.

A series of recent studies agreed that patients with OSA have a reduced quality of life.[15] There is a clear association between headache and sleep disturbances, especially headaches occurring during the night or early morning. Patients with headache also report more daytime symptoms like fatigue, tiredness, or sleepiness. These symptoms contribute to their reduced quality of life. Identifying respiratory- related sleep disorders in chronic headache patients is worthwhile, as improvement of the headache may follow treatment of sleep disorders in this group.[16]

Pathophysiology

Negative airway pressure is generated by the activity of the diaphragm and intercostal muscles during inhalation. To a large extent, the patency of the upper airway is dependent on the action of oropharyngeal muscles. These dilator and abductor muscles are normally activated in a rhythmic mode in coordination with each inspiration. When the negative pressure exceeds the force produced by these muscles, the pharynx will collapse, occluding the airway.[17]

Frequently, sleep apnea patients have constricted upper airways that increase the pharyngeal resistance during inspiration. This, in turn, necessitates an increase in pharyngeal dilator muscle contraction to maintain airway patency. Such an increase has been shown in OSA patients during wakefulness,[18] but was also shown to decrease in contraction during sleep, thus contributing to the development of obstructive apnea.[19] Interestingly, when compared with normals, OSA patients show greater pharyngeal dilator muscle contraction during sleep, suggesting that an imbalance between negative airway pressure and dilator muscle contraction is responsible for the obstruction, rather than a primary deficiency in muscle contraction. A sustained increase in dilator muscle contraction in OSA could predispose these muscles to fatigue,[20] possibly aggravating the tendency to pharyngeal occlusion.

The role of negative intrapharyngeal pressure as a stimulus to dilator muscle contraction is reinforced by studies of the impact of nasal continuous positive air pressure (CPAP) on pharyngeal muscle function.Nasal CPAP results in a marked decrease in both tonic and phasic contraction of the genioglossus muscle.

Other procedures such as uvulopalato-pharyngoplasty (UPPP) and mandibular advancement (either surgical or with a mandibular advancement oral appliance) are based on the principle of pharyngeal enlargement to reduce the degree of negative intrapharyngeal pressure during inspiration.[21]

Diagnosis

During the past 2 decades, the mounting evidence of the significance of sleep disorders to health, and thus the clinical relevance of sleep, spurred growth in the field of sleep medicine aimed at diagnosis and treatment of sleep disorders. The historically research-based laboratory studies are still considered the primary standard for the diagnosis of sleep apnea.[22] The laboratory recording technique is called polysomnography (PSG), and was proposed by Holland and colleaguesin 1974 to describe the recording, analysis, and interpretation of multiple, simultaneous physiologic parameters. As a tool, PSG has been essential in the diagnosis for sleep-disordered patients and in the enhancement of our understanding of both normal sleep and its disorders.

Polysomnography is a complex procedure that should be performed by a trained technologist. Using electrodes and other sensors, a routine clinical polysomnogram includes the monitoring of brain electrical activity (elec- troencephalogram, EEG), electro-oculography, electromyography, effort to breath (generally from both thoracic and abdominal sensors), nasal and oral airflow, oxygen saturation (oximetry), electrocardiography, and body position. Other more specialized studies may include additional measures, such as endoesophageal pressure.[23]

The major polysomnographic measurement used to determine if a patient is clinically diagnosed with sleep-disordered breathing has beenthe frequency of the respiratory events per hour of sleep. This measure provides the major index of severity of the disorder and generally is a combination of the number of apneas and hypopneas per hour of sleep. The apnea-hypopnea index (AHI), or more recently the respiratory disturbance index (RDI), has been shown to be a reproducible measure within a patient as well as a predictor of associated cardiovascular disease.[24] The severity of the accompanying oxygen desaturation and sleep fragmentation during polysomnography are combined with the clinical symptoms to assess the immediate consequences to the individual from the sleep-disordered breathing.[24]

It is now accepted that a diagnosis of clinically significant OSA should be accompanied by compatible signs and symptoms, and not based simply on an arbitrary AHI/RDI threshold. The syndrome should be defined when an index of abnormal obstructed breathing events, or arousals caused by them, exceeds a threshold in a patient with clinical features or symptoms related to the abnormal respiratory pattern during sleep. A recent suggestion by Kryger[22] stated that patients with daytime sleepiness who have more than 5 abnormal respiratory events per hour of sleep should be treated, or at the very least receive a clinical trial of nasal CPAP, is in agreement with the previously published consensus statement in 1999.

The formulation of clear-cut guidelines for the assessment, management, and follow-up of OSA patients is essential. In the near future, the assessment of these patients will likely involve clinicians outside major sleep centers. The high prevalence of OSA, and the increasing availability of new simplified limited diagnostic systems, suggest this likelihood. An expert consensus is required to establish the ideal combination of variables to be recorded by the new limited diagnostic systems; the oxygen saturation is still the only consistent variable common to such devices. The efficacy of home-based sleep studies has been recently reviewed. While offering improved sleep quality and cost savings, the risk of technically unsatisfactory results is still high due to the lack of technician supervision. The benefits and limitations of these approaches need further evaluation.

Positive Airway Pressure Therapy

The first reported use of nasal continuous airway pressure (nCPAP or CPAP) for OSA in adults was by Sullivan and colleagues[25] in 1981. Their device consisted of intranasal tubes attached to a blower unit. In 1983, the nasal mask delivery system, similar to contemporary systems, was introduced. Fundamentally, the application of a therapeutic level of CPAP results in immediate relief in the upper airway obstruction.

This benefit has been attributed to the CPAP functioning as a "pneumatic splint" for the upper airway. Additional physiologic benefits of CPAP application have been shown to include improvement in the function of pharyngeal dilator muscles,[26] ventilator drive,[27] and upper airway morphology.[28] CPAP rarely results in serious side effects. However, about 25% of patients may develop nasal congestion with chronic use.[29]

The benefit of CPAP in treating the sleepiness associated with OSA has been well established. The patient's perceived quality of life showed a significant increase after treatment. Interestingly, the spouses of OSA patients also gained from CPAP therapy, as it eliminated the impairment of their own sleep due to the snoring and sleep disruption caused by bed partners. Furthermore, data from a large uncontrolled study suggested a strong benefit from CPAP in reducing the frequency of driving accidents.

The introduction of automatically adjusting CPAP devices (auto-CPAP) over the past several years represents a significant advancement in CPAP technology since its inception in 1981. The device continuously adjusts the applied airway pressure to an "optimum" level throughout the night and appears to improve compliance. Upper airway resistance is influenced by many dynamic factors that may change, such as body position, sleep stages, sleep deprivation, body weight, and fluctuations of nasal congestion. Some of these factors may change within a single night. Alcohol intake can also depress the tone and contractility of the pharyngeal muscles, resulting in higher pressure requirements to maintain pharyngeal patency.[30] Therefore, a single pressure level, as with standard CPAP, could result in a situation in which the pressure is excessive for parts of the night, but may be insufficient at other times, particularly after alcohol consumption.

After having been shown to improve compliance in comparison to standard CPAP,[31] auto- CPAP is expected to become more popular in the future as it facilitates the initiation and follow-up of the treatment, especially the process of optimal initial pressure titration, and the elimination of repeated titrations over prolonged years of therapy.

Oral Appliances

Oral appliances used for OSA generally fall into one of two classes, viz. mandibular advancement splints (MAS) and tongue retaining devices (TRD). MAS induce protrusion of the mandible by anchoring a removable device to part of or the entire upper and lower dental arches, while TRD use a suction cavity to protrude the tongue out of the mouth. MAS are far more widely used in clinical practice compared to TRD. There are many designs available, but they generally fall into either one-piece (monobloc) or two-piece (duobloc) configurations. Beyond this, they can differ substantially in size, type of material, degree of customization to the patient's dentition, coupling mechanism, amount of occlusal coverage, titratability of mandibular advancement, degree of mandibular mobility permitted (vertical and lateral), and allowance for oral respiration.

Two-piece splints consist of an upper and a lower removable plate with some type of intermaxillary coupling. There are several modes of coupling between the upper and the lower plates, such as elastic or plastic connectors, metal pin and tube connectors, hook connectors, acrylic extensions or magnets. There has been a steady shift toward the predominant use of two-piece appliances in clinical practice because of the advantages they often confer, including titratability over time and permission of movement (vertical and/or lateral). Although prefabricated appliances are commercially available, it is considered that the best retention, comfort, and side-effect profile is achieved with custom-made oral appliances.

Summary

Obstructive sleep apnea is a disorder that has significant medical and psychosocial consequences. As discussed in this review, this is a common, underdiagnosed disorder that affects adults. Although recognized for centuries, its importance for individuals and society has only recently been appreciated. Because individuals with narrow airways and/or craniofacial anomalies may have increased risk for obstructive sleep apnea, dentistry can play a pivotal role in the identification and possible treatment of patients with this syndrome.

References

For a complete list of references are available on request, please mail us editor@healtalkht.com