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Review Article

Obstructive Sleep Apnea: A Review Article

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Abstract

Obstructive sleep apnea is characterized by repetitive episodes of complete or partial collapse of the upper airway during sleep. Prevalence of obstructive sleep apnea is favored in men more than woman with a ratio of 2-4:1. Risk factors include nasal obstruction, obesity, gender, craniofacial anatomy, and smoking. Reoccurring symptoms, such as daytime sleepiness and irregular snoring have lead scientists and doctors to further find appropriate means of diagnosis. Polysomnography is proved to be the golden-standard method for diagnosing obstructive sleep apnea. Other diagnostic tools include taking a home apnea test. Positive airway pressure and oral appliances are the two most common non-invasive devices used to treat obstructive sleep apnea. Surgical procedures, like uvulopalatopharyngoplasty and maxillomandibular advancement are the most effective surgeries, especially in severe cases. Obstructive sleep apnea also arises complications and side effects that do not only affect the patient's physical health but also impact their social and mental well-being; however, there are means to prevent it and lead a healthy lifestyle. In this review, the abovementioned aspects of obstructive sleep apnea are focused on and supported in detail.

Keywords: Complications, diagnosis, obstructive sleep apnea, prevalence, prevention, risk factors, symptoms, treatment.

INTRODUCTION

The term 'obstructive sleep apnea' (OSA) was only introduced during the late twentieth century. However, symptoms of this disorder were recognized over 2,000 years ago. During that time, the symptoms of OSA were associated with the term "Pickwickian syndrome" [1]. Studies, back then, revolved mainly about obesity being the only factor in developing this condition. The 1960s was a period of significant discoveries as further research was conducted, proving that obesity was not the only cause. Several factors were mentioned to have association with OSA [2].

Definition of Obstructive Sleep Apnea

OSA is defined as the condition of repetitive episodes of complete or partial collapse of the upper airway during sleep that is followed by transient awakening, which results in restriction of the upper airway permeability (complete cessation or reduction of air flow leading to arousal and hypoxia) [2].

Prevalence of Obstructive Sleep Apnea

OSA is considered as the second most common respiratory disorders following asthma, which leads scientists to perform many studies of OSA prevalence in various countries [3]. For instance, in a study conducted in Pennsylvania, prevalence of OSA was found to be 17% in men and 5% in women, while the overall prevalence in United State, based on The Wisconsin Cohort Study, is estimated at 9% in women and 24% in men [4]. Across the globe, Europe's prevalence of OSA is 26% in men and 28% in women, such as in Spain [2]. In addition, some Asian epidemiological studies have estimated the prevalence of OSA in Hong Kong as 8.8% in men and 3.7% in women, and some epidemiological researches from other Asian countries, including Korea and India, have shown similar findings [2]. According to a recent epidemiological study in Saudi Arabia, it has been deduced that the prevalence of OSA is estimated at 8.8%, affecting 12.8% of men and 5.1% of women [5].

In summary, 7%–26% in men and 3%–28% in women constitute the prevalence of OSA worldwide, and such disproportion in the percentages through these epidemiological studies may be attributed to a lot of geographical differences including the diversity of the population, age, and ethnic origin [2].

Risk Factors of Obstructive Sleep Apnea

OSA can affect anyone. However, there are several factors that increase one's risk of developing this sleeping disorder.

Obesity

OSA is quite prevalent in obese and overweight population. In fact, those with excess weight are four times more prone to having OSA than people with normal weight [2, 3]. The upper airway may be obstructed during one's breathing due to fat accumulation [2].

Nasal Obstruction

Nasal passages are naturally the path in which air flows to our bodies. Any obstruction in these passages result in a limited airflow that is most recognized during sleep, producing apneas and symptoms associated with OSA [2].

Gender

With a 2-4:1 ratio, men lead women when it comes to the chances of developing OSA [2]. The reason males are more prone can be attributed to a variety of factors. Men have longer airways, which increase the chances of collapsing, whereas women have shorter airways that are more stable. Also, adipose tissue accumulation in men is centered on the upper body part, while women usually develop lower body fat [3].

Craniofacial Anatomy

Craniofacial characteristics are directly linked with the development of OSA (2). Enlarged tongue, soft palate, and inferiorly positioned hyoid bone cause narrowing of the upper airway, increasing its chances to collapse [3].

Smoking

Smoking increases the amount of inflammation and fluid retention in the upper airway, and it also results in daytime sleepiness [2, 3]. Higher risk of snoring and OSA is found in smokers than non-smokers or former smokers [2].

Signs and Symptoms of Obstructive Sleep Apnea

Nocturnal Symptoms

One of the most common nocturnal symptoms of OSA is loud and chronic snoring, which is caused by critical narrowing of the upper airway during sleep, leading to airflow limitation and turbulence [3]. However, not everyone who snores has sleep apnea. Snoring is also very common in the adult general population, affecting 25%-30% of all women and 40%-45% of all men on a regular basis. Snoring of people with OSA becomes increasingly intense and irregular over time often in relation to increased body weight, smoking, nasal obstruction, or intake of muscle-relaxant drugs [2, 3]. Observed apneas (respiratory pauses that interrupt snoring) high blood pressure, abrupt gasping, choking sensations, night-time sweating, nycturia, and insomnia are additional nocturnal symptoms related to OSA [3].

Daytime Symptoms

Daytime sleepiness, usually beginning during quiet activities, is the main daytime symptom of OSA, which is due to the fragmentation of sleep. Fatigue, concentration difficulties, memory loss, mood swings, and decreased libido are also recognized symptoms, all of which result from daytime sleepiness. Other daytime symptoms may include morning headaches and waking up with a dry mouth or a sore throat [3].

Diagnosis of Obstructive Sleep Apnea

Diagnostic Tools

The procedures followed in diagnosing a patient with OSA are few but precise. These methods include a polysomnography test and a home sleep apnea test [6]. Both of which are sleep studies, the most effective and accurate diagnostic tools [7].

Polysomnography for Diagnosis

A polysomnography is a test that records various body movements and functions while the patient is asleep in a hospital or sleep center [6]. This testing method is deemed as the gold standard examination to diagnose OSA [4, 8]. The most important data from the polysomnography is the apnea-hypopnea index (AHI). It represents the severity of OSA by relating the values of apneas and hypopneas. It is equal to the sum of hypopneas and apneas multiplied by sixty and divided by total sleep time in minutes. A result less than 5 corresponds to no or minimal OSA. A result equal to or greater than 5 but less than 15 is mild. An AHI greater than or equal to 15 but less than 30 is moderate. Finally, an outcome greater than or equal to 30 correlates to severe OSA.

Other Diagnostic Tools

A home apnea test is also a sleep test. Unlike the polysomnography, however, a home apnea test is taken at home and can only test for OSA [7]. A Mallampati score is also a simple physical exam that is predictive of OSA. The back of the throat's structure is observed and compared to the different scores. Higher scores directly correlate to higher chances of OSA. Patients with scores 3 and 4 are most prone to having obstructed airways when asleep [8]. If they suffer from snoring and restless sleeping, they should have a polysomnography done.

Treatment of Obstructive Sleep Apnea

OSA's treatments are considered as life-long treatments. These therapies are divided into non-invasive and invasive treatments. The non-invasive treatments such as continuous positive airway pressure (CPAP), which is considered the first therapy for mild

to severe patients, do not require anesthesia. Invasive treatments, on the other hand, require surgical intervention such as Uvulopalatopharyngoplasty (UPPP) [9]. Surgeries are not the primary treatments for OSA. However, they are recommended for patients who reject or are unable to tolerate noninvasive medical treatments, such as CPAP and for patients who have mild OSA and specific anatomical abnormalities that can be corrected [9, 10].

Continuous Positive Airway Pressure Treatment (CPAP)

The first line treatment for mild-severe OSA patients is CPAP. It had been discovered in 1983 by Dr. Sullivan. CPAP has constantly been demonstrating that it reduces the nocturnal obstructive events from the first night of the treatment [11]. "CPAP introduces a column of air that serves as a pneumatic splint for the upper airway preventing the airway from collapsing that is the physiological definition of the syndrome" (12). CPAP devices consist of three parts: a blower, a tube that transports the pressure to the mask, and a mask which is applied to the patients' face [13]. Due to the mechanism of CPAP, it has been proven that it eliminates snoring while sleeping. Therefore, CPAP is considered to improve quality of life by reducing OSA symptoms, such as daytime sleepiness, nocturnal wakening, and gasping during sleep [13]. Despite the CPAP effectiveness, poor adherence and some side effects are the only limitations of this treatment [12]. One of the reasons beyond CPAP poor adherence is the annoyance of breathing through a mask that applies pressure. Another reason is the patients' intolerance to sleep with a mechanical device attached to them [11]. In addition, patients have many causes to quit CPAP treatment due to the innovation of the new alternative therapies for OSA. Bi-level positive airway pressure, for example, treats OSA patients by lower mean airway pressure than CPAP [13].

Oral Appliances

Oral appliances (OA) have become commonly used as a useful alternative treatment for OSA disease. It has been proven that OA is the first line therapy for patients with OSA with varying severity, mainly those with milder OSA, who fail treatments attempts or are unable to tolerate CPAP, according to the American Academy of Sleep Medicine [11, 14-16]. OA are two dental splints attached to the both the upper and lower dental arches. It is used to keep the lower jaw and the tongue in an anterior position in order to expand the upper airway volume in its lateral dimension of the velopharyngeal region. As a result, the number of nocturnal apnea and hypoxia events during sleep will be decreased [11, 14-16]. OSA patients who use OA as an alternative treatment have experienced improvements in the symptoms and quality of life. OA, in contrast to CPAP, is more tolerated; therefore, the long-term efficacy of the treatment is fairly high. One of the factors that has enhanced the effectiveness of OA is the ability to be titrated in order to meet the patients' specific needs [12, 15, 16]. At the initial using of OA treatment, the patients might suffer from certain side effects. Side effects can be classified as mild and transient that includes excessive salivation, mouth dryness, headache, and gum irritation. These effects are temporary and last around two months. Long-term persistence effects, on the other hand, are arthralgia, teeth pain, and movement of the upper and lower teeth into more anterior position [11,14-16]. Bite changes are also one of the most common side effects that appear after 1-2 years of adherence to OA, and they may lead to discontinuation the treatment [14, 15]. In a comparison of OA to CPAP, research shows that both OA and CPAP improve the OSA symptoms, but the effectiveness of CPAP is much greater [15]. Therefore, CPAP remains the superior and gold standard therapy in treating OSA patients. Moreover, OA is usually used in combination with other treatments such as positional therapy (PT) when it does not show any improvement in itself [15, 16].

Positional Therapy

Because of the anatomical and physiological mechanism of the human body, OSA patients' position during sleep plays a key role in the severity of snoring and obstructive events. Apnea and hypopnea events take place increasingly when patients sleep in a supine position due to the effect of gravity on the pharyngeal cavity [12]. PT, a device that prevents patients from lying on their back, is considered as an alternative treatment for milder OSA patients [12] PT has many forms, such as the tennis ball technique. This technique consists of a small ball that is attached on the posterior part of the patients to obstruct sleeping on a supine position. Supine alarms and different positional pillows also improve the OSA symptoms respectfully [12]. Although PT is effective and well tolerated in mild OSA cases, it remains an inferior treatment when compared to CPAP [12, 14].

Nasal Surgeries

Nasal surgeries do not improve OSA. However, they improve nasal breathing and patients' tolerance and compliance to CPAP. Septoplasty, turbinectomy, and polypectomy are the most common nasal surgeries that are performed to establish an unobstructed nose and airway stability. These procedures involve the reducing of turbinate's size and the straightening of the septum [13, 17, 18].

Uvulopalatopharyngoplasty

UPPP is the most common procedure to treat OSA in adults. It involves the removal of the obstructing excess tissues in the uvula, soft palate, pharynx, and tonsils if present to widen the airway. Risks associated with this procedure may include pain, bleeding, altered food taste, swelling, infection, and dysphagia. It also decreases patients' compliance with

CPAP and may alleviate snoring as an advantage [17-19].

Maxillomandibular Advancement

Currently, maxillomandibular advancement or jaw surgery is the most effective surgery for OSA. This procedure includes the advancing of the maxilla and mandible forward up to 10-12mm as well as the forward stretching of the tongue away from the throat which as a result enlarges the entire upper airway and reduces the pharyngeal obstruction. The risks of the procedures include bleeding, facial numbness, and infection [5, 7, 17].

Genioglossus Advancement

Genioglossus advancement is a surgical procedure that involves cutting a rectangular segment in the genial tubercle, the lower jaw bone, where the genioglossus muscle is attached. Then, this rectangular segment from the lower jaw bone is repositioned forward with the muscle attached to it. The advancement of these structures stabilizes the tongue base and the associated pharyngeal dilators, which result in limiting the backward fall of the tongue during sleep. The risks with the procedure may include infection, hematoma, damages to the genioglossus muscle, and paranesthesia of the lower teeth [17, 18].

Prevention of Obstructive Sleep Apnea

Some lifestyle habits can act as major contributors in reducing and preventing OSA severity. These habits include weight loss, physical exercises, and cutting down smoking and alcohol especially before sleep time. These lifestyle modifications have shown their efficacy by reducing the AHI and increasing oxygen consumption [6, 10, 20].

Complications of Obstructive Sleep Apnea Health

A growing number of studies indicate that the OSA-resulting intermittent episodes of hypoxia, the condition when the body is at low oxygen levels, induce metabolic mechanisms such as sympathetic activation, systemic inflammation, impaired glucose and lipid metabolisms, and endothelial dysfunction [21]. Left untreated, these mechanisms lead to higher risks and susceptibility for metabolic disease, hypertension, cardiac disease, coronary heart disease, stroke, morbidity, and mortality [21-24].

Quality of Life

Untreated OSA can also negatively affect patients' quality of life [25]. For instance, undetected OSA is a chief factor to deteriorating quality of life and health-related quality of life in men below the ages of 69 [23, 26]. This is explained by the insomnia which co-occurs with OSA in men more than women, affecting quality of life and causing fatigue [27]. The mere diagnosis of OSA has been shown to positively impact the general well-being of patients [28], and treatment alleviates problems with sleepiness, socializing, and signs of depression [29].

Psychological Well-being

Recent studies imply that the OSA-resulting dysfunction of underlying biological, metabolic, and neurological mechanisms can be exhibited in OSA patients as psychiatric disorders, lower cognitive abilities, and impaired neurocognitive skills [22, 30, 31]. One psychological side effect of OSA is depression as depression has shown a greater predominance between OSA patients in both community and sleep disorder clinic cases, and an established connection between risk of depression and OSA severity has been made [25, 32]. Lastly, over 50% of the partners who share beds with OSA patients have reported anxiety symptoms, and 18% have reported depressive symptoms before starting treatment [33].

Socially and Economically

Sleep disordered breathing (SDB) results in social and economic detriments for the patients and their partners [34]. Studies previously conducted revealed that OSA increases medical treatment costs for working-age adults [35]. Patients of untreated OSA may be required to pay twice as much for medical expenses due to the cardiovascular diseases accompanying OSA [36]. Furthermore, a study made on OSA patients in a sleep clinic showed that patients with excessive daytime sleepiness due to OSA displayed suffering from limitation in time management, work quality, and interpersonal relationships [35]. OSA also adversely affects patients' functionality, decreases productivity, and ails healthcare systems and communities [23].

Personal Life

In various studies, untreated OSA has been shown to adversely affect patients' sleep, temperament, personal satisfaction, and interpersonal relationships [33, 35]. For instance, spouses of OSA patients reported difficulty sleeping in the same bed with the patient which lead to relationship troubles [33]. Furthermore, when a patient of OSA shares a bed with their partner, it creates a burden on the partner to keep under observation the patient's breathing [33]. Lastly, Insomnia symptoms are three times more probable to be reported by partners of patients with OSA [33].

Academic Performance and Work Efficiency

SDB has been reported to hinder children from obtaining goals by impairing their cognitive abilities [37]. Moreover, SDB affects not only the successful achievement of educational objectives, but also the development of skills which encourage independence [37]. Nonetheless, various studies propose that SDB therapy leads to notable enhancements in cognition in children if opportune intervention is carried out [37]. Teng and Won have stated in their OSA research that "the consequences of OSA pose a danger to public safety not only for workers but for those whom they

serve" [38]. To support the previous statement, a study shows that 20% of firefighters who tested positive for a sleep disorder recounted falling asleep while driving once per month at minimum [39]. Thus, OSA patients are at an increased danger for workplace accidents [24].

CONCLUSION

Over the last decades, studies conducted on OSA have noted its prevalence and revealed its various risk factors, associated symptoms, successful diagnostic means, and effective therapy options. Due to OSA's multiple negative complications, more clinical studies and trials on OSA are recommended in order to better understand the nature of its effects. Furthermore, it is of complete importance to raise awareness of this disorder among community members and increase its recognition in health sectors to help in the early diagnosis and intervention for OSA.

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