Significance of Early Detection and Treatment of Sleep Apnea Syndrome

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Sleep disordered breathing (SDB) is an umbrella term for several chronic conditions in which partial or complete cessation of breathing occurs many times throughout the: one SDB condition in particular, obstructive sleep apnea syndrome (OSAS), has been globally recognized as a growing public health issue. OSAS is a chronic disease involving repetitive pauses in breathing during sleep that can cause numerous health issues if left untreated such as increased risk for hypertension, coronary heart disease, type–2 diabetes, stroke and depression. Daytime sleepiness, which can occur secondary to OSAS, impacts one’s ability to operate a motor vehicle properly and is likened to driving under the influence of alcohol. Early screening has the potential to identify OSAS and initiate subsequent treatment, which can improve breathing during sleep and decrease daytime sleepiness. The significance of early detection cannot be overlooked, as the far–reaching effects of OSAS have large public health implications.

Key words: sleep apnea, cardiovascular disease, screening, prevention

Introduction

OSAS is a chronic disease characterized by repetitive obstruction of the upper airway often resulting in arousal from sleep and oxygen desaturation1. Largely overlooked in the past, OSAS has recently been globally recognized to be almost as highly prevalent as asthma2. When evaluating the severity of OSAS, the apnea hypopnea index (AHI) is utilized and is identified by apnea and hypopnea episodes per hour of sleep; with an apnea and hypopnea defined as complete stoppage of air flow or the number of low breaths (drop in air flow). The severity of OSAS is defined by AHI as previously mentioned but combined with clinical symptoms such as drowsiness, hypertension, and cardiovascular complications3. Through population–based cohort studies carried out in the United States, Australia, Asia, and Europe, the high prevalence and wide spectrum of severity of OSAS have become well documented. Studies have shown that 1 in 5 adults have at least a mild form of OSAS (AHI > 5) and 1 in 15 has moderate or severe OSAS (AHI > 15). However, most patients with treatable OSAS remain undiagnosed4. Just as OSAS is identified as a chronic disease, treatment should be approached in the same manner, requiring long–term, multidisciplinary management5. There are medical, behavioral, and surgical options that exist for treatment of OSAS; however treatment options are dependent on symptoms and the severity of OSAS but generally focus on weight loss, smoking cessation, and limiting alcohol intake to improve life quality. General global consensus agrees that continuous positive airway pressure (CPAP) is the preferred treatment for mild, moderate, and severe OSAS5,6. However, other various forms of treatment exist through the

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use of external devices and surgical procedures. Oral appliances (OA) such as a prosthetic mandibular advancement (PMA) or a tongue-retaining device (TRD) are used to treat OSAS; surgical treatment includes tonsillectomy, and tracheostomy.\(^7\)-\(^10\).

Measurement of OSAS

A prospective cohort study that has been conducted across Japan since 1963, the Circulatory Risk in Communities Study (CIRCS), examines risk factors for cardiovascular diseases in various communities around the nation. Recent CIRCS studies, utilizing nocturnal intermittent hypoxia (NIH), a surrogate marker for OSAS in the general population, estimated NIH by the hourly occurrences of oxygen desaturation > 3% (3% oxygen desaturation index [3% ODI]) measured during sleep using a pulse-oximeter (PULSOX-3Si, Minolta Co., Osaka, Japan) during a night’s sleep in the participant’s home.\(^11\)-\(^12\).

ODI is the number of times per hour of sleep that the blood's oxygen level drops by a certain degree from baseline and is typically measured as part of OSAS testing. With OSAS, breathing becomes disrupted during sleep and the oxygen levels of the blood repeatedly falls. Those drops are associated with collapses of the upper airway, events called apneas or hypopnea, with the latter representing a partial collapse of the airway. All of which negatively impact quality of sleep.\(^13\)

The previously mentioned CIRCS study utilized a population-based sample from 2000 to 2002, was conducted that also examines annual cardiovascular risk.\(^11\) The study also used a pulse-oximeter to measure oxygen desaturation and in turn the severity of SDB among the study population. In this study, a significant positive association between alcohol consumption and the severity of SDB among middle-aged Japanese men, independent of age, BMI, and smoking status was found. In short, Tanigawa et al., found an association with SDB even among men with a moderate ethanol intake (0.5 to <1.0 g/d per kg). This finding is significant as it gives reason for the spike in the apnea-hypopnea index following ethanol prior to sleep at a dose of 0.5 g/kg, potentially representing drinkers modifying or underreporting their alcohol consumption at a particular time and in turn its impact on SDB.\(^11\)

is suggested that the strong effect that excess weight has on SDB may be potentially masked between alcohol intake and SDB among men with higher BMI.\(^11\)

Another measurement mentioned earlier, AHI, differs from ODI in its inclusion of events that may cause arousals or awakenings from sleep without affecting oxygen levels. ODI also does not reflect the absolute minimum blood oxygen level measured; where if oxygen levels are low enough and sustained for more than five minutes, hypoxemia may be diagnosed.

Symptoms and impact

The pathophysiology of OSAS is multifactorial and varies considerably between individuals. Important risk factors include obesity, male sex, and aging as the prevalence of OSAS is two to three times greater in males than in females and in older individuals (>65 years) when compared with middle-aged individuals (30-64 years)\(^3\). Various effects of OSAS on pathophysiology and cardiovascular disease include vasoconstriction, hypertension, tachycardia, insulin resistance, obesity, myocardial infarction, nocturnal angina, and cerebrovascular disorders (Figure-1).\(^4\)-\(^15\).

For instance, SDB increases the risk of type-2 diabetes.\(^12\)-\(^16\). Approximately 10% of the onset of type-2 diabetes can be attributed to SDB. Both SDB and type-2 diabetes are frequently associated with obesity and metabolic syndrome and it is therefore not uncommon to find individuals affected by one or the other.\(^17\). Cross-sectional estimates from population and clinic studies suggest that up to 40% of patients with OSAS have diabetes, likewise, in patients known to have diabetes, the prevalence of OSAS may be up to 23% and the prevalence of some form of SDB may be as high as 58%\(^17\)-\(^18\).

Additionally, many studies bring forth evidence for the support of a causal relationship between OSAS and hypertension. Early studies have shown that hypertension was found in about 50% of OSAS patients, while about 30% of hypertensive patients also have OSAS.\(^14\)-\(^16\). In other research, systolic and diastolic blood pressures were significantly higher in patients with OSAS than in patients without OSAS.\(^20\)-\(^22\).
Sleep apnea and driving

In addition to the rising prevalence of OSAS, several studies have found that OSAS is associated with a significantly increased risk of motor vehicle accidents, about 2.5 to 3 times more at risk for accidents than those without OSAS or on OSAS treatment. OSAS causes sleep quality to drop and consequently results in increased daytime sleepiness and reduced vigilance. OSAS represents the highest risk factor for sleepiness and accidents among sleep disorders. The cognitive impairments brought upon by OSAS result in delayed response times, which are essential for immediate decision making while driving. Daytime sleepiness leading to drowsy driving is often likened to drunk driving. Studies have shown that losing just a few hours of sleep each night can impair one’s ability to drive in the same way as drinking too much alcohol.

In the United States, the U.S. National Highway Traffic Safety Administration (NHTSA) conducts annual research on driver behavior and traffic safety. In 2015, over 72,000 police-reported crashes involved drowsy drivers, which led to 41,000 injuries and more than 800 deaths. However, it should be noted that there is a broad consensus across traffic safety, sleep science, and public health communities that this is a severe underestimate of the impact of drowsy driving. A sleep disorder such as OSAS, that is not treated is likely to prevent people from getting quality sleep. Good quality sleep helps to prevent daytime sleepiness, fatigue, and poor cognitive functioning. More than 12 million people in the U.S. have OSAS and studies have shown that it creates a large increase in the rate of crashes caused by drowsy driving.

In Japan, a commercial truck driver struck and
killed a man who was crossing an intersection in Aichi prefecture; the driver ignored the red stop light and subsequently struck the man. The driver was brought to court in 2008 and was identified by the court to have had OSAS during the incident and was therefore unable to be indicted. The court ruled the reason for missing the signal could not be determined as intentional as the possibility exists that persons with severe OSAS could fall asleep without knowing. It is therefore not possible to deny the possibility of the driver experiencing a micro-sleep episode when he failed recognize the red stop signal in time.

The overall quality of life is negatively impacted by OSAS, with hallmark symptoms including snoring (loud and severe), excessive daytime sleepiness, chronic fatigue, and concentration difficulties. Driving with OSAS puts all those on the road at risk. A common theme from a 2004 Japanese Ministry of Health, Labor and Welfare commissioned research investigation highlighted the influence OSAS on drivers; some drivers mentioned that they did not notice themselves dozing off at the wheel till they woke up after hitting the car in front of them. The other driver noted that frequent nodding off while driving has been deemed the cause for at least five rear-end accidents in the last 10 years\(^\text{30}\).

**Conclusion**

With the growing recognition of OSAS around the world and its direct impact on driving, the significance of early screening cannot be understated. Advances in screening and treatment have immense implications for the prevention and or at the very least potential to decrease traffic accidents due to daytime sleepiness caused by OSAS. Poor sleep quality and poor cognitive performance due to OSAS results in the same driving capability as a drunk driver and is a major public health issue that can be realistically approached with early detection by screening. Early screening and treatment can curb the impact of OSAS on mental and physical health as well as induced drowsy driving caused by excessive daytime sleepiness.

**References**