ECRONICON OPEN ACCESS

EC PULMONOLOGY AND RESPIRATORY MEDICINE

Perspective

Understanding Obstructive Sleep Apnea in Adults

Zeena Nackerdien*

Lederberg Laboratory, Rockefeller University, USA

***Corresponding Author:** Zeena Nackerdien, Lederberg Laboratory, Rockefeller University, New York, USA.

Received: February 16, 2018; **Published:** April 18, 2018

Abstract

Obstructive sleep apnea (OSA) - with its hallmark of upper airway anatomical impairment - is a common, but underdiagnosed medical condition. Current approaches have failed to reverse the reported rise in OSA cases in the USA. It is therefore important to fully understand the triggers and consequences of this form of sleep-disordered breathing that may vary from person to person. Resolution of the signs and symptoms of OSA and improvement of sleep quality remain the major goals of disease management, especially in persons with cardiovascular and other comorbidities. Polysomnography is the gold standard for diagnosis and positive airway pressure is the mainstay of treatment for patients with moderate to severe OSA. Rising healthcare costs have accelerated the search for novel strategies to enhance patient adherence to non-pharmacologic and pharmacologic treatments. Continued health education may help patients to promptly access treatment, upon recognition of symptoms, to prevent negative consequences such as increased traffic accidents and exacerbation of other chronic conditions.

Keywords: *Obstructive Sleep Apnea; Sleep-Disordered Breathing; Upper Airway; Positive Airway Pressure; Hypopnea; Telemedicine*

Abbreviations

AHI: Apnea Hypopnea Index; BMI: Body Mass Index; CSA: Central Sleep Apnea; EPAP: Expiratory Positive Air Pressure; OSA: Obstructive Sleep Apnea; PACE: Pharmacotherapy of Apnea by Cannabimimetic Enhancement; PAP: Positive Airway Pressure; Pcrit: Pharyngeal Critical Closing Pressure; SDB: Sleep-Disordered Breathing; Tele-OSA: Impact of Interactive Web-Based Education and Interactive Voice Response (Automated Follow-up) Programs on CPAP Adherence for the Treatment of Obstructive Sleep Apnea

Introduction

Healthy adults at rest take 12 to 20 breaths per minute. When these individuals are awake, the neuromuscular control of breathing is a multifaceted, autonomous process, rarely subject to stoppages. However, "under-breathing" or cessation of breathing may become more frequent during sleep. A switch to the biologically vital process of sleep places breathing under metabolic control, leaving sleepers with low carbon dioxide reserves or higher upper airway collapsibility more prone to apneas (a cessation of airflow for ≥ 10 seconds) [1,2]. Sleep-disordered breathing (SDB) typically induces hypoxemia and hypercapnia (magnitude of conditions are affected by pulmonary condition and reserve) [3] - episodes that are known to negatively impact heart rate, cardiac contractility, and peripheral vascular resistance [4], among other factors. Moreover, almost two-thirds of all stroke patients have SDBs. SDBs contribute to not getting enough sleep - a state affecting one-third of US adults [5]. Ongoing bouts of sleep deprivation are linked to several diseases (diabetes, heart disease, obesity, and depression), work-related mistakes, and motor vehicle crashes [5].

The range of disorders known as SDBs can mostly be classified as sleep-related hypoventilation, central sleep apnea (CSA), and obstructive sleep apnea (OSA) [6]. The least common form of apnea (~20% of all apnea cases) [7], in which a patient breathes shallowly or not at all, is known as CSA (interested readers are referred to a Mayo Clinic overview for further reading) [8]. When the brain fails to transmit signals to breathing muscles for a variety of extrinsic or intrinsic reasons, CSA can occur, either alone or in combination with the most common SDB i.e. OSA [8]. A person with a partial/complete collapse of the upper airway caused by relaxation of the muscles controlling the soft palate and tongue can experience symptoms characteristic of OSA [2].

OSA is also characterized by daytime symptoms (e.g. fatigue, sleepiness, or poor concentration), breathing interruptions (e.g. obstructive apneas, overly shallow breathing or hypopneas, respiratory-effort-related arousals), and signs of disturbances during sleep (e.g. snoring, restlessness, or resuscitative snorts) [9]. When a sleeper's OSA is defined in broad terms (apnea-hypopnea [AHI] index > 5 events per hour), the prevalence rates in North America range from up to ~30% in males to up to ~15% in females. When a more stringent OSA definition is applied e.g., AHI ≥ 15 events per hour of sleep, prevalence rates range from ~15% in males and ~5% in females. Obesity appears to be a contributing factor to the rising OSA rates in the USA. Craniofacial anatomy, age, medical conditions (e.g. pregnancy, hypothyroidism, congestive heart failure, polycystic ovary syndrome), menopause, hereditary predisposition, alcohol, smoking, and ethnicity are further independent risk factors for OSA [9,10].

The US Preventive Services Task Force has recommended against screening asymptomatic adults for OSA, because of insufficient current evidence to assess the balance of benefits and harms of screening this population [11]; however, even symptomatic OSA is underdiagnosed, with corresponding detrimental effects to individual health and the economy. For instance, mild to moderate OSA can be associated with poor neurocognitive performances and negative medical outcomes. Severe OSA is known to be linked to increased all-cause and cardiovascular deaths [9]. Moreover, undiagnosed moderate to severe sleep apnea may lead to ~$3.4 billion in additional medical costs in the USA [2].

Diagnosis

Older men and women are more likely to complain about OSA, with every increment of a decade enhancing the odds of an AHI elevation by at least ~15%. Prevalence rates may also be higher in blacks, Hispanics, and Asian populations [12]. Persons with known risk factors and symptoms, usually identified by a bed partner, are referred to a sleep specialist and/or an ear, nose, and throat doctor following physical tests, which may include checking blood pressure, oral abnormalities, assessments of comorbidities, and measurements of the neck and waist circumferences [13]. Neck circumferences of > 17 inches in men and > 16 inches in women, or a body mass index (BMI) ≥ 30 kg/m2 are among the factors suggestive of the presence of OSA [14]. It is worth noting that OSA is highly prevalent in obese and overweight populations, as established by evidence from the literature. Conversely, lifestyle-related or surgically-induced weight loss has been associated with reductions in the degree of OSA [10].

After each apneic episode, a patient hyperventilates, carbon dioxide is reduced to the apneic threshold, expiratory time is prolonged, and the upper airway may collapse again. Pharyngeal muscles may also become damaged due to inflammation, contributing to reduced responsiveness to the negative upper airway pressure that is a feature of OSA [10]. Portable sleep monitoring may play a diagnostic role to evaluate a probability of sleep apnea in the absence of any significant comorbidity; however, polysomnography (sleep study) remains the gold standard for a diagnosis of OSA and evaluation of sleep apnea severity [14]. Full or split-night studies provide detailed information about a patient's sleep health by using an electroencephalogram, an electromyogram, an electrooculogram, an electrocardiogram, a snore microphone, and a video recording [10]. While initial clinical evaluations can identify comorbid conditions such as hypothyroidism or laryngospasm related to gastroesophageal reflux disease, additional tests (e.g. sleep diaries) may also be useful in ruling out or identifying other sleep-related disorders. Examples include hypersomnia due to drug use, periodic limb movement disorder, inadequate sleep due to behavioral factors, narcolepsy, CSA, and Cheyne-Stokes respiration (gradual increase followed by declines in breathing effort and airflow, usually associated with congestive heart failure or a stroke) [8]. Asthma and chronic obstructive pulmonary disorder (overlap syndrome) are two respiratory diseases that could co-exist with OSA, potentially multiplying the negative impact of the latter condition on sleep quality and health outcomes [15,16].

Patients with AHI indices > 30 respiratory events per hour of sleep and an oxyhemoglobin saturation below 90 percent for more than 20 percent of the total sleep time are classified as having severe OSA. Systematic hypertension and/or sleep fragmentation can occur in patients who have between 15 and 30 respiratory events per hour of sleep i.e., individuals with moderate OSA. Patients with mild OSA have AHI indices between 5 and 15 respiratory events per hour of sleep, are frequently asymptomatic, and daytime sleepiness often will not impact activities of daily life [17].

Treatment

Normalizing the underlying pathology associated with OSA by mechanical, surgical, or behavioral means is a cardinal treatment goal. Although weight loss and exercise do not eliminate OSA entirely, increased energy expenditure has net positive benefits in terms of overall health and metabolic parameters. Counseling on sleep position (non-supine), alcohol avoidance, and concomitant medications that may exacerbate OSA typically forms part of patient education; however, positive airway pressure (PAP) therapy is the treatment mainstay for patients with OSA [18]. Continuous PAP (CPAP) provides steady, gentle pressure in the airway to keep it open. Evidence from the literature remain equivocal regarding the cardiovascular and glycemic control benefits of CPAP; however, in keeping with findings from randomized clinical trials, there is a growing consensus that patients with moderate to severe OSA should be offered this form of therapy to improve health, quality of life, and productivity of work [19].

Other types of machines that healthcare providers could suggest may change pressure during the night based on the sleeper's breathing patterns (adjustable PAP) or provide more pressure upon inhalation and less pressure upon exhalation (bilevel PAP). Patients with mild to moderate OSA may prefer oral appliances as an alternative to PAP. Comparative studies have shown that CPAP reduced objective sleep parameters e.g. AHI, to a greater extent than oral appliances (mandibular advancement splints and tongue retaining devices); however, patients have strong subjective preferences for oral appliances. Both treatments caused similar blood pressure reductions in hypertensive patients [20].

Surgery may be an alternative option in cases where PAP or oral appliances are ineffective in the treatment of OSA. Surgically correctable lesions of the upper airway include tonsillar hypertrophy, adenoid hypertrophy, or craniofacial abnormalities [18]. Drugs to improve the respiratory drive generally do not form part of the primary treatment, although a cannabinoid, dronabinol, has recently shown efficacy in the treatment of OSA. Initial findings from a randomized, placebo-controlled, Phase 2 Pharmacotherapy of Apnea by Cannabimimetic Enhancement (PACE; NCT01755091) trial of persons with moderate or severe OSA, showed that dronabinol was associated with a lower AHI and improved self-reported patient outcomes such as treatment satisfaction [21]. Based on personalized treatment considerations, healthcare providers may also suggest adjunctive wake-promoting agents (e.g. modafinil and its R-enantiomer, armodafinil, in patients who complain of residual daytime sleepiness, in spite of undergoing conventional treatment [22].

Future approaches

OSA is classically viewed as mainly arising from the excessive relaxation of throat muscles and structural abnormalities, exacerbated by obesity which may further narrow the upper airway; however, about half of all people with OSA are not obese and only 25% of individuals report daytime sleepiness [19,23,24]. The fact is that there are multiple contributors and presentations of OSA. Each anatomic and non-anatomic contributor represents a potential therapeutic target. Premature awakening to mild airway narrowing (low respiratory arousal threshold), unstable control of breathing, and impaired pharyngeal dilator muscle function are among the non-anatomical contributors to OSA; however, as upper airway anatomical and neuromuscular impairments are integral to the pathophysiology of the condition, it makes sense that new approaches are being investigated to measure this composite endpoint, also known as the pharyngeal critical closing pressure (Pcrit). Simply quantifying peak flow during routine polysomnography has recently been correlated with an active Pcrit. One or more current investigational measures, once validated, may be viable non-invasive alternatives to drug-induced endoscopy to select appropriate candidates for surgery [24].

Understanding the neural control of airway muscles will also be important in assessing the purported therapeutic/preventive benefits of investigational or unconventional regimens e.g. lower risk of OSA associated with playing a double reed wind musical instrument [25]. In addition, an expiratory positive air pressure (EPAP) device has shown promise in improving AHI, subjective sleepiness, and subjective sleep quality in select patients when compared to a sham device [26,27].

Periodic follow-up assessments, with further sleep studies for persistent or recurrent symptoms, should form part of any current, tailored, treatment plan. Automated telemedicine treatment strategies may help appropriate patients achieve targeted goals of CPAP usage. For instance, use of CPAP telemonitoring with automated feedback messaging improved 90-day adherence by patients with suspected OSA enrolled in the Tele-OSA randomized trial (NCT02279901), compared with patients who received telemedicine-based education alone or usual care [28].

Conclusions

OSA is a prevalent, treatable, underdiagnosed condition; ~75% of severe cases are undiagnosed [10], Successful treatment of OSA may modify the course of other chronic health conditions e.g., diabetes and cardiovascular disease, and improve overall health-related quality of life.

Acknowledgments

None.

Conflicts of Interest

The author has no conflicts of interest to declare.

Bibliography

1. Xie A. "Effect of sleep on breathing - Why recurrent apneas are only seen during sleep". *Journal of Thoracic Disease* 4.2 (2012): 194-197.
2. Sleep Apnea Facts and Figures.
3. Chin K. "Overcoming sleep disordered breathing and ensuring sufficient good sleep time for a healthy life expectancy". *Proceedings of the Japan Academy. Series B, Physical and Biological Sciences* 93.8 (2017): 609-629.
4. Beuchée A., *et al*. "Influence of Hypoxia and Hypercapnia on Sleep State-Dependent Heart Rate Variability Behavior in Newborn Lambs". *Sleep* 35.11 (2012): 1541-1549.
5. Watson NF., *et al*. "Recommended Amount of Sleep for a Healthy Adult: A Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society". *Journal of Clinical Sleep Medicine* 11.6 (2015): 591-592.
6. Kapur VK., *et al*. "Clinical Practice Guideline for Diagnostic Testing for Adult Obstructive Sleep Apnea: An American Academy of Sleep Medicine Clinical Practice Guideline". *Journal of Clinical Sleep Medicine* 13.3 (2017): 479-504.
7. American Sleep Apnea Association. Central Sleep Apnea.
8. Mayo Clinic. Central Sleep Apnea.
9. Strohl KP., *et al*. "Overview of obstructive sleep apnea in adults". In: UpToDate: Wolters Kluwer (2017).
10. Gharibeh T *et al*. "Obstructive sleep apnea syndrome: natural history, diagnosis, and emerging treatment options". *Nature and Science of Sleep* 2 (2010): 233-255.
11. US Preventive Services Task Force. Final Recommendation Statement. Obstructive Sleep Apnea in Adults: Screening.
12. Epocrates: An Athenahealth company. Obstructive sleep apnea in adults: Diagnostic Approach.
13. Obstructive Sleep Apnea: Diagnosis & Treatment.
14. Epstein LJ., *et al*. "Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea in adults". *Journal of Clinical Sleep Medicine* 5.3 (2009): 263-276.
15. Malhotra A., *et al*. "Research Priorities in Pathophysiology for Sleep-disordered Breathing in Patients with Chronic Obstructive Pulmonary Disease. An Official American Thoracic Society Research Statement". *American Journal of Respiratory and Critical Care Medicine* 197.3 (2018): 289-299.

16. Sundbom F *et al*. "Effects of Coexisting Asthma and Obstructive Sleep Apnea on Sleep Architecture, Oxygen Saturation, and Systemic Inflammation in Women". *Journal of Clinical Sleep Medicine* 14.2 (2018): 253-259.

17. Kline LR. "Clinical presentation and diagnosis of obstructive sleep apnea in adults". In: UpToDate: Wolters Kluwer (2017).

18. Kryger MH *et al*. "Management of obstructive sleep apnea in adults". In: UpToDate: Wolters Kluwer (2017).

19. Laratta CR., *et al*. "Diagnosis and treatment of obstructive sleep apnea in adults". *Canadian Medical Association Journal* 189.48 (2017): E1481-E1488.

20. Cistuli PA. "Oral appliances in the treatment of obstructive sleep apnea in adults". In: UpToDate: Wolters Kluwer (2017).

21. Carley DW., *et al*. "Pharmacotherapy of Apnea by Cannabimimetic Enhancement, the PACE Clinical Trial: Effects of Dronabinol in Obstructive Sleep Apnea". *Sleep* 41.1 (2018).

22. Kuan YC., *et al*. "Effects of Modafinil and Armodafinil in Patients With Obstructive Sleep Apnea: A Meta-analysis of Randomized Controlled Trials". *Clinical Therapeutics* 38.4 (2016): 874-888.

23. Gray EL., *et al*. "Obstructive Sleep Apnea without Obesity Is Common and Difficult to Treat: Evidence for a Distinct Pathophysiological Phenotype". *Journal of Clinical Sleep Medicine* 13.1 (2017): 81-88.

24. Osman AM., *et al*. "Obstructive sleep apnea: current perspectives". *Nature and Science of Sleep* 10 (2018): 21-34.

25. Ward CP., *et al*. "Risk of obstructive sleep apnea lower in double reed wind musicians". *Journal of Clinical Sleep* Medicine 8.3 (2012): 251-255.

26. Rosenthal L., *et al*. "A multicenter, prospective study of a novel nasal EPAP device in the treatment of obstructive sleep apnea: efficacy and 30-day adherence". *Journal of Clinical Sleep Medicine* 5.6 (2009): 532-537.

27. Kryger MH., *et al*. "Long-term use of a nasal expiratory positive airway pressure: EPAP device as a treatment for obstructive sleep apnea: OSA". *Journal of Clinical Sleep Medicine* 7.5 (2011): 449-453b.

28. Hwang D., *et al*. "Effect of Telemedicine Education and Telemonitoring on Continuous Positive Airway Pressure Adherence. The Tele-OSA Randomized Trial". *American Journal of Respiratory and Critical Care Medicine* 197.1 (2018): 117-126.

Volume 7 Issue 5 May 2018