Obstructive Sleep Apnea and Heart Disease

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Abstract

Obstructive sleep apnea (OSA) is characterized by recurrent episodes of complete and partial obstruction of the upper airways, leading to intermittent hypoxemia, autonomic fluctuations, and sleep fragmentation. Approximately 34% and 17% of middle-aged men and women, respectively, meet the diagnostic criteria for OSA. Sleep disorders are common and underdiagnosed among middle-aged and older adults, and prevalence varies by race/ethnicity, gender, and degree of obesity. The prevalence of OSA reaches 40-80% in patients with arterial hypertension, heart failure, coronary heart disease, pulmonary hypertension, atrial fibrillation and stroke. Despite its high prevalence in patients with heart disease and the vulnerability of cardiac patients to OSA-related stress and adverse cardiovascular outcomes, OSA is often unrecognized and untreated in cardiovascular practice. We recommend screening for OSA in patients with resistant/poorly controlled hypertension, pulmonary hypertension, and recurrent atrial fibrillation after cardioversion or ablation. In patients with New York Heart Association class II–IV heart failure and suspected sleep apnea or excessive daytime sleepiness, a formal sleep assessment is appropriate. In patients with tachybradia or ventricular tachycardia syndrome, or in survivors of sudden cardiac death who are suspected of having sleep apnea after a comprehensive sleep assessment, evaluation of sleep apnea should be considered. After a stroke, there is a clinical balance regarding screening and treatment. Patients with angina pectoris, myocardial infarction, arrhythmias, or related shocks from implanted cardioverter-defibrillators may especially often have comorbid sleep apnea.

All patients with OSA should be considered for treatment, including behavior modification and weight loss as indicated. Continuous positive airway pressure should be offered to patients with severe OSA, while oral devices may be considered for patients with mild to moderate OSA or those who cannot tolerate continuous positive airway pressure. Follow-up sleep testing should be performed to evaluate the effectiveness of treatment. **(TCM-GMJ March 2023; 8 (1):P3-P6)**

Keywords: Obstructive sleep apnea; Heart disease; Apnea.

Introduction

The pathophysiology of OSA is complex and multifactorial with many unrecognized and poorly understood aspects. In general, OSA results from an interaction between poor upper airway anatomy and sleep-related changes in airway function (1). Normal physiological phenomena associated with sleep affect the mechanics of breathing. These include, but are not limited to, reduced pharyngeal diameter, decreased muscle activity, increased upper airway resistance, impaired respiratory load compensation, and a slight (5 mmHg) increase in arterial carbon dioxide. Other physiological endophenotypic factors include variations in arousal threshold, loop amplification (indicative of ventilatory instability), and critical airway closure pressure. Morphological abnormalities are the most common contributing factors to upper airway obstruction. Examples include retrognathia, enlargement of the tonsils, and enlargement of the soft tissues of the neck. Notably, jugular vein swelling in patients with decompensated HF may exacerbate OSAS in these patients by increasing pressure on their hypopharynx, especially in the supine position.

Clinical manifestation

OSA has been associated with a number of cardiovascular complications, including hypertension, AF and other arrhythmias, HF, coronary heart disease, stroke, PH, metabolic syndrome, diabetes, and cardiovascular mortality. Notably, OSA is a condition with the potential for negative feedback whereby it worsens the condition, which in turn can worse OSA (eg, OSA→hypertension→worsening OSA).

Heart failure

OSA is common and associated with poor outcomes in patients with HF (2, 4, 11). Patients with HF are also at increased risk of central sleep apnea (CAS). The overall prevalence of sleep disturbances in patients with symptomatic HF ranges from 40% to 60%, with OSA

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accounting for approximately one-third of cases (2, 3). Most studies in patients with HF reported approximately equal proportions of OSA and CSA. However, in a meta-analysis of 2570 patients with heart failure with reduced ejection fraction and moderate to severe sleep apnea, CSA was the dominant phenotype in >70% of cases (3).

Sleep apnea is independently associated with an increased risk of adverse outcomes, including progression of HF-related symptoms, hospitalization, and mortality. Patients without HF diagnosed with OSA have an increased subsequent risk of HF (4). Pressure drops and exacerbation of systemic hypertension.

Some patients, such as obese and heart failure patients with reduced ejection fraction, may have a mixed pattern of CSA and OSA. In these patients, carefully conducted and interpreted sleep studies are needed to make an accurate diagnosis and determine the predominant pathophysiology. Making the correct diagnosis is particularly important in HF patients with reduced ejection fraction, given the safety concerns associated with positive pressure therapy in these patients. Although adequate treatment of CSA in patients with HF remains unclear, new therapeutic approaches such as diaphragmatic stimulation and oxygen therapy are promising and are rapidly evolving. Results from two ongoing studies: ADVENT-HF (Effect of Adaptive Servoventilation [ASV] on Survival and Hospitalization in Heart Failure) and LOFT-HF (Effect of Low-Flow Nocturnal Oxygen Therapy on Hospitalization and Mortality in Patients with Heart Failure). and central sleep apnea) is likely to report the benefits of adaptive servo ventilation and nocturnal oxygen therapy, respectively, for the treatment of HF and CSA. In the context of HF, the safety and efficacy of positive airway pressure (PAP) therapy differ between CSA-predominant and OSA patients. CPAP is only partially effective in 50% of patients with HF associated with residual central apnea. Literature on the effect of CPAP therapy on HF outcomes in patients with isolated or predominant OSA is limited. Although several small studies have reported benefits associated with CPAP, including improved left ventricular function, reduced sympathetic tone and myocardial oxygen consumption, and lower rates of hospitalization and HF mortality, a meta-analysis of patients with OSAS found that CPAPhad no significant effect. either left ventricular ejection fraction or hospitalization rates (5). The 2017American Heart Association/American College of Cardiology guidelines identified CPAP as a possible reasonable treatment strategy (class IIb) to improve sleep quality and daytime sleepiness in patients with cardiovascular disease and SOA.(6, 18, 22).

Hypertension

OSA is common in hypertensive patients, of which 30% to 50% will have concomitant OSA.(7, 8). This is especially true in patients with resistant hypertension, among whom up to 80% may have OSA.(8). A risk factor for hypertension and resistant hypertension, The effect of continuous positive airway pressure (CPAP) on blood pressure (BP) reduction in hypertensive patients with OSA has been disappointing and inconsistent, with a meta-analysis showing a BP reduction between 2 and 3 mmHg. p.(9, 11,17).

Compliance with the CPAP regimen is associated with a more pronounced decrease in nocturnal BP. Even in patients with OSA and resistant hypertension, 3-month treatment with CPAP (compared with no CPAP) resulted in a decrease in 24-hour systolic, mean, and diastolic BP by ≈3 mm Hg. Art. with a significant correlation between hours of CPAP use and BP reduction. (10, 12).

Notably, both OSAS and hypertension are common conditions with multifactorial causes and often coexist, although hypertension may not necessarily be due to OSA. Non-CPAP therapy may also be of value in patients with hypertension and OSA. In a meta-analysis of treatment with oral appliances (eg, soft palate lifts, tongue restraints, mandibular thrusters), BP reduction was similar to that seen in the meta-analysis of CPAP trials (2–3 mmHg). (11). Uvulopalatopharyngoplasty may be beneficial in selected patients with significant BP reductions of 4–9 mmHg. 6 and 24 months after surgery in a small randomized controlled trial.(12, 21). Spironolactone in a small randomized controlled trial in patients with resistant hypertension.(13, 15, 18). In a randomized validation study of 60 patients with resistant hypertension and moderate to severe OSA, renal denervation significantly reduced office and ambulatory BP at 3 and 6 months post-procedure, with modest reduction in OSAS severity. (14, 15, 19).

Atrial Fibrillation

OSA is an independent risk factor for the development of AF in patients without other heart disease.(15, 19). OSA and AF share common risk factors, including obesity, age, male sex, hypertension, and HF, and are independently associated with similar adverse outcomes, but it has not been conclusively proven that OSA causes AF.

There are several possible substrate and trigger mechanisms for AF in patients with OSA. Acute episodes of apnea lead to hypoxia and hypercapnia, changes in intrathoracic pressure, increased sympathetic tone, and autonomic dysregulation. Chronic relapses and abrupt negative changes in intrathoracic pressure can lead to structural and functional atrial remodeling and cause atrial fibrosis with connexin suppression and electrophysiological changes. in improving arrhythmia-free survival. (16, 17, 24).

Numerous small and mostly retrospective observational studies have evaluated the ability of CPAP to reduce the burden of AF after ablation or cardioversion.(17, 23). Despite methodological problems and small sample sizes, these studies strongly support the notion that CPAP reduces the burden of AF. This is independent of the method of rhythm control, including antiarrhythmic drug therapy, DC cardioversion, or catheter ablation. In a cohort of 10,132 patients with AF and OSA, patients treated with CPAP were less likely to develop permanent AF than those without CPAP.(18, 22, 26).

Future treatment strategies for AF should take into account any comorbid sleep breathing disorders. Prospective

clinical trials are needed to confirm the effect of OSAS on the severity and outcomes of AF, clarify the benefits of treating OSA, and evaluate the need and cost-effectiveness of routine screening for OSA.

Other Arrhythmias

In addition to AF, OSA is associated with a spectrum of cardiac arrhythmias and sudden cardiac death. Long pauses and bradycardia are typical for patients with OSA. In one report, polysomnographic studies showed that 58% of patients with implanted pacemakers for sick sinus syndrome had not previously been diagnosed with sleep apnea.(19, 20, 25). Overall, patients with OSAS experienced a reduction in cardiac arrhythmias when treated with CPAP.(20, 22, 27).

An increased risk of sudden cardiac death has been reported in patients with severe OSA. In a 15-year longitudinal follow-up study of 10,071 adults, OSA predicted sudden cardiac death, with age >60 years, mean nighttime oxygen saturation <78%, and AHI >20 (21, 27) being the best predictors.

Coronary Artery Disease

OSA itself increases the risk of coronary events. Repetitive hypoxemia and reoxygenation caused by OSA can lead to oxidative stress and systemic inflammation, which contribute to the development of coronary atherosclerosis and acute myocardial infarction (MI). OSA has also been associated with coronary artery calcification, plaque instability, and plaque fragility, and was associated with a 2-fold increased risk of CV events or death. (22, 25). Mooe et al. (23, 27). showed that the severity of hypoxemia is a major factor in determining ST-segment depression occurs during sleep, and in patients with OSA, the onset of MI is more likely to occur at night. Patients with ST-segment elevation MI who also have OSA have a lower 18-month event-free survival.(24, 7, 8). OSA may be associated with an increased risk of serious adverse cardiovascular events after percutaneous coronary intervention. Whether CPAP reduces the risk of MI remains controversial.

Metabolic Syndrome and Type 2 Diabetes

OSA has been associated with a greater likelihood of the metabolic syndrome and type 2 diabetes, independently of adiposity level. (25, 27). Central adiposity is linked to the development of both OSA and the metabolic syndrome, with both sharing similar pathophysiological features (eg, systemic inflammation, endothelial dysfunction). (26, 15). In addition, intermittent hypoxia of adipose tissue, sympathetic activation, induction of adipocytokines, and oxidative stress may promote the development of metabolic risk factors. (26, 13). Although CPAP has been shown to lower BP and markers of sympathetic activation, it has not been demonstrated to affect lipid levels, glycemic control, or rates of metabolic syndrome or diabetes.

Treatment

CPAP: (Eligibility - OSA: The Centers for Medicare & Medicaid Services cover CPAP on the basis of an AHI or REI ≥15 events per hour or AHI (or REI) ≥5 with documented symptoms of excessive daytime sleepiness, impaired cognition, mood disorders or insomnia, or documented comorbidities (ie, hypertension, ischemic heart disease, or history of stroke). Clinical trials have shown improvement in BP, improvement in subjective sleepiness or dozing propensity (ESS), and improvement in quality of life). Effectiveness - Clinical trials have shown improvement in BP, improvement in subjective sleepiness or dozing propensity (ESS), and improvement in quality of life. APAP; BPAP (Eligibility - Patients intolerant of CPAP pressure or who require additional ventilatory support); ASV (Eligibility - Treatment-emergent CSA in OSA in the absence of systolic HF (LVEF <45%)); Lifestyle intervention/medical weight loss (Eligibility - Patients with snoring or documented OSA) Effectiveness- 10% weight loss reduces AHI by 26% Lifestyle interventions (diet, exercise, and the combination) improve OSA by similar degrees Antiobesity pharmacological therapy modestly improves OSA symptoms and severity Daytime exercise routines can prevent rostral redistribution of fluid, resulting in modest improvements in AHI; Oral appliances: Alternative to CPAP for mild to moderate OSA or in patients who do not tolerate CPAP. (Effectiveness - Adherence overall greater than for CPAP Comparable improvement in sleepiness Improves 24-h ambulatory BP measures and markers of inflammation). Upper airway surgery. Neurostimulation. Bariatric surgery.

Conclusion

Although OSA increases the risk of all-cause and cardiovascular mortality, this condition is often underrecognized and undertreated in cardiovascular practice. A strong association is present between OSA and numerous cardiovascular conditions. We recommend screening for OSA in patients with resistant/poorly controlled hypertension, PH, and recurrent AF after either cardioversion or ablation. In patients with New York Heart Association class II to IV HF and suspicion of sleep-disordered breathing or excessive daytime sleepiness, a formal sleep assessment is reasonable and needed to distinguish OSA from CSA. In patients with tachy-brady syndrome, those with ventricular tachycardia, or survivors of sudden cardiac death in whom sleep apnea is suspected after a comprehensive sleep assessment, evaluation for sleep apnea should be considered. After stroke, clinical equipoise exists with respect to screening and treatment. Therefore, clinical trial enrollment should be offered when possible. Patients with nocturnally occurring angina, MI, arrhythmias, or appropriate shocks from implanted cardioverter-defibrillators may be especially likely to have comorbid sleep apnea. All patients with OSA should be considered for treatment, including behavioral modifications and weight loss as indicated.

CPAP should be offered to patients with severe OSA, whereas oral appliances can be considered for patients with mild to moderate OSA or for CPAP-intolerant patients. Follow-up sleep testing should be performed to assess the effectiveness of treatment.

References

1. Michel V, Pilatz A, Hedger MP, Meinhardt A. Epididymitis: revelations at the convergence of clinical and basic sciences. Asian Journal of Andrology. 2015; 17: 756-63.
2. Pilatz A, Hossain H, Kaiser R, et al.: Acute epididymitis revisited: impact of molecular diagnostics on etiology and contemporary guide line recommendations. European Urology 2015; 68: 428-35.
3. Luzzi GA, O'Brien TS. Acute epididymitis. BJU Int. 2001; 87 (8): 747-55.
4. Vatutin NT, Kalinkina NV, Demidova AL. Endothelins and the results of multicenter research. Ukrainian journal of Cardiology. 2006; 1: 101-5.
5. Klimova YM, Kordon TI, Groma VG. The dynamics of endothelin-1 level and the development of postoperative complications in the patients, having been operated on colorectal cancer. Oncology. 2011; 13 (1): 247-50.
6. Abrahamovim OO, Faynik AF, Nechaj OV. The mechanisms of development of endothelial dysfunctions and its role in the pathogenesis of coronary heart disease. Ukrainian journal of Cardiology. 2007;. 1: 81-7.
7. Lytvynets YeA, Vintoniv OR, Kostenko LV. Color Doppler as method of detection of vascular erectile dysfunction. Galician doctors magazine. 2013; 1: 34-6.
8. Draun M, Sommer F, Lehmacher W. Erectile dysfunction. Are interdisciplinary diagnosis and therapy necessary? Dtsch.Med.Wochenschr. 2004; 38 (3): 227-31.
9. Gozmakov OA. The system of endothelin peptide: the mechanisms of endovascular pathology. Cardiology. 2000; 1 (32): 9.
10. Klimova OM, Kryvorotko IV, Kordon TI. The diagnostic significance of indexes of immunoreactivity for prognosis impossibility of anastomoses in patients suffering from colorectal cancer. Kharkiv surgical school. 2011; **1** (46): 15-20.
11. Filayeva JA, Tenchurina TG. The homeostatic peculiarities of angiogenic factors during wound healing with hypertrophic scar after mammoplastic. The modern problems of science. 2007; 2: 73-7.
12. Pivovar SN. The dynamics of endothelin-1 level and functional state parameters of heart in patients with complicated course of myocardial infarction. Ukrainian medical journal. 2000; 4: 140-3.
13. Carncek P, Stewart DJ. Immunoreactive endothelin in human plasma: marced elevation in patients in cardivasculary shok . Biochem Biophys Res Commun. 1989; 161: 562-7.
14. Berezhna NM. The role of immunity system cells in the microenvironment of the tumor. Oncology. 2009; 11(39): 6-17.
15. Eltze E, Wild PJ, Wülfing C [*et al.*] Expression of the endothelin axis in noninvasive and superficially invasive bladder cancer: relation to clinicopathologic and molecular prognostic parameters. Eur. Urol. 2009; 56 (5): 837-45.