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Peer Reviewer of *World Journal of Clinical Cases*, Madhukar Mittal, FACE, MBBS, MD, Professor, Endocrinology and Metabolism, All India Institute of Medical Sciences Jodhpur, Jodhpur 342005, India. mittalspace@gmail.com

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EDITORIAL

Recent advances in managing obstructive sleep apnea

Deb Sanjay Nag, Abhishek Chatterjee, Roushan Patel, Biswajit Sen, Bappa Ditya Pal, Gunjan Wadhwa

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Deb Sanjay Nag, Abhishek Chatterjee, Roushan Patel, Bappa Ditya Pal, Gunjan Wadhwa, Department of Anaesthesiology, Tata Main Hospital, Jamshedpur 831001, Jharkhand, India

Abhishek Chatterjee, Roushan Patel, Department of Anaesthesiology, Manipal Tata Medical College, Jamshedpur 831017, India

Biswajit Sen, Department of Anesthesiology, Tata Main Hospital, Jamshedpur 831001, India

Corresponding author: Deb Sanjay Nag, MD, Doctor, Department of Anaesthesiology, Tata Main Hospital, C Road West, Northern Town, Bistupur, Jamshedpur 831001, Jharkhand, India. ds.nag@tatasteel.com

Abstract

Obstructive sleep apnea (OSA) is a rapidly increasing global concern. If it remains untreated, it can lead to cardiovascular, metabolic, and psychiatric complications and may result in premature death. The efficient and effective management of OSA can have a beneficial effect and help reduce the financial burden on the health sector. There has been constant development in OSA management, and numerous options are available. The mainstay of therapy is still the conventional measures and behavioral modifications. However, in cases of failure of these modalities, surgical therapy is the only option. Numerous studies have shown that proper management of OSA has beneficial effects with good long-term outcomes.

Key Words: Sleep apnea; Obstructive; Continuous positive airway pressure; Concepts; Pharmacological

Core Tip: Obstructive sleep apnea (OSA) is a common sleep disorder that is responsible for not only its symptoms but is also a causative disorder for many chronic and morbid diseases like hypertension, diabetes, and metabolic disorders. While patients with OSA have various treatment options with varied success, conservative modalities, airway pressure devices, pharmacologic modalities, and surgical options must be customized based on individual patient needs.

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INTRODUCTION

The term "Apnea" is a Greek word that means "without breath." Obstructive sleep apnea was described for the first time in 1837 by Charles Dickens[1], who described it as "Pickwickian syndrome." However, in 1956, Sydney Burwell described the signs and symptoms of this condition in detail and distinguished this condition from other diseases[2]. Apnea is a discontinuance of airflow during sleep, which has to last for at least 10 seconds with oxygen desaturation of more than 3% with or without associated arousal[3]. Intermittent complete or partial upper airway obstruction OSA is defined as the occurrence of at least five hypo-apneas or apneas in an hour, which decreases oxygen saturation and sleep fragmentation [3].

OSA presents a global burden and affects almost 10% of the population[4], with 14% prevalence among males and 5% in females[4]. The prevalence of OSA is 47%-67% after menopause, and an increase in body weight is not the only factor responsible for this[5].

Several authors have found a strong correlation between OSA and the development of hypertension, stroke, coronary artery disease, congestive heart failure, diabetes mellitus, and metabolic syndrome[6,7]. OSA is also associated with daytime somnolence[8], depression[9], cognitive decline[10] and may also lead to motor vehicle accidents[11]. Therefore, OSA should be diagnosed early and managed efficiently and adequately to avoid significant economic costs to the healthcare system.

MANAGEMENT OF OSA

The management of OSA can be sub-stratified into conservative measures, including weight loss, exercise, positional therapy, and alcohol avoidance.

Weight loss

Body mass index has been considered an important predictor of OSA, and studies[11] have shown that a reduction of 10% in body weight can reduce the apnea and hypopnoea index by 26%. Reduction in body weight also decreases the collapsibility of the airway and results in near-complete resolution of apnea[12]. However, the effect of bariatric surgery on the management of OSA is controversial. Some studies[13,14] have shown beneficial effects, whereas some studies[15] have failed to observe any favorable effects. A systematic review and meta-analysis of 136 studies of 22094 patients showed that effective weight loss resulted in "complete resolution or improvement" in OSA[13].

Exercise

Physical exercise is recommended in patients suffering from OSA because it significantly decreases the cardiovascular complications associated with OSA. Authors of the AHEAD (Action for Health in Diabetes) study[15] observed the beneficial effects of lifestyle interventions, including exercise, on OSA. A 10-year follow-up of 134 adults with polysomnography showed that weight loss through intensive lifestyle intervention improved OSA severity[16].

Positional sleep therapy

The mainstay of positional sleep therapy is to encourage patients with OSA to sleep on their side rather than sleeping in the supine position. To keep the patients off their backs at night, various devices and garments are used in positional sleep therapy. Vibratory sleep devices raise a vibratory alarm when placed around the neck at night, and the patient rolls over to a supine position. The vibration stops when the patient rolls out of the supine position. A Cochrane Database Systematic Review, which included 8 studies and 323 patients, showed that positional sleep therapy was significantly less effective as compared to continuous positive airway pressure (CPAP) in reducing apnea-hypopnea index (AHI)[17]. However, it was tolerated longer than CPAP at night[17].

Alcohol avoidance

A meta-analysis[18] has shown that not only do people consuming alcohol have a 25% higher prevalence of obstructive sleep apnea, but they also have a longer duration of apnea and a lower nadir of oxygen saturation[19]. The authors have concluded that these effects were due to the selective adverse effect on airway dilator muscles with depression of genioglossus muscle activity or on the hypoglossal nerve[20,21]. A systematic review and meta-analysis of 21 studies from 1985 to 2015 concluded that the "risk of OSA to be increased by 25%" in those who consumed alcohol or consumed it in higher amounts as compared to those who did not consume it in lower amounts[18].

AIRWAY PRESSURE TREATMENTS

CPAP

This is the most common mode of administration of positive airway pressure in the management of OSA. In this mode, a positive pressure is maintained throughout the respiratory cycle. CPAP machines deliver a continuous flow of pressurized air to help keep the upper airway patent; thus, they help reduce AHI significantly[21]. In a meta-analysis[21], CPAP has been considered as the first line of treatment for moderate-to-severe OSA and for mild obstructive sleep apnea with cardiovascular disease or excessive daytime somnolence. CPAP should be used for at least 4 hours on 70% of nights recommended for use during the entire sleep period[21]. The common adverse effects of using CPAP in OSA patients are nasal irritation, dry mouth, and infection of the sinuses[21]. The m but is-analyses commissioned by the American Academy of Sleep Medicine evaluated 184 studies and concluded that positive airway pressures resulted in significant clinical improvement in disease severity and "sleep-related quality of life in adults"[21].

Nasal expiratory airway pressure

Devices have been used as an alternative to CPAP devices in mild to moderate OSA[22]. In contrast to CPAP, these devices only generate resistance to expiratory airflow while providing minimal inspiratory resistance[22]. In a randomized trial involving a "cohort of 34 analyzable subjects" where these devices were compared to placebo treatment, the median AHI of the subjects reduced from 15.7 events per hour to 4.1 events per hour[23]. Discomfort during exhalation, nasal irritation, and dry mouth are the common adverse effects of using these nasal devices[22].

Intraoral negative pressure therapy

The United States Food and Drug Administration (FDA) has recently approved this therapy for sleep apnea of any variety[23]. These devices apply negative pressure through an intraoral device held in place by a flange between teeth and lips. Studies[23] have shown that compared to retroglossal airway collapse, these devices are more effective when OSA is due to retropalatal collapse[23]. In a study that enrolled 19 patients, 15 were responders, and 4 were non-responders to therapy with a negative pressure with an intraoral interface[24].

Mid-frequency anti-snoring devices

This device is usually worn in the lower jaw (submandibular area) when a patient lies supine and sleeps. The device delivers a mid-frequency electrical stimulus when the patient starts snoring. In a recently concluded study[25] on 50 patients, the mid-frequency anti-snoring device successfully decreased the duration of snoring, AHI episodes, and SpO2 < 90% in moderate-to-severe OSA patients.

Pharmacological agents

Studies[22] have shown that protriptyline and fluoxetine reduced the number of apnea and hypopnea events by reducing rapid eye movement sleep. Carbonic anhydrase inhibitors like topiramate, acetazolamideor zonisamide, also reduce the adverse impact on AHI[22]. In a "prospective crossover unblinded trial" on 12 patients, 6 had good responses to either fluoxetine or protriptyline, and fluoxetine was better tolerated than protriptyline[26].

Surgical

Surgical options to OSA patients should be offered only when conservative measures and airway devices have failed to provide any benefits to these patients[20]. The surgical procedures offered to these patients are:

Uvulopalatopharyngoplasty

This procedure has been the mainstay of surgical treatment since 1980 when Fujita *et al*[27] described it for the first time. A meta-analysis of 15 observational studies showed that the AHI could be reduced by 33%[28]. However, the same meta-analysis[28] showed that laser-assisted uvulopalatopharyngoplasty could reduce the incidence of AHI by only 17%. Adverse effects of this surgery include postoperative hemorrhage, difficulty in swallowing or nasal regurgitation, voice changes, disturbance of taste, and even death in 0.2% of the operated cases[28].

Tongue reduction surgery

Midline glossectomy with removing elliptical tongue tissue from the dorsal surface has been proposed as an adjunct to uvulopalatopharyngoplasty[22]. Radiofrequency ablation and reduction of tongue size were associated with a decrease in AHI by 34%[27]. In a study on 45 patients of moderate-to-severe OSA AHI reduction of > 50% was achieved in 75% of patients undergoing transoral robotic surgery (TORS) and 62.1% in patients undergoing tongue base coblation resection [29]. Patients undergoing TORS have less incidence of postoperative hemorrhage foreign body sensation of dysfunction in taste perceptio[29].

Hypoglossal nerve stimulation

The FDA approved hypoglossal nerve stimulation[22] in 2014; since then, it has been gaining popularity. The hypoglossal nerve stimulator device has an implantable pulse generator, a lead for stimulation, and a lead for sensing respiration. The pulse generator senses and, if needed, then enhances the neural stimulation of the hypoglossal nerve to the genioglossus and geniohyoid muscles. Thus it results in protrusion of the tongue forward. In the first such report of a 5-year follow-up surgical intervention for OSA using "upper airway stimulation *via* a unilateral hypoglossal nerve implant" on 97 patients

Table 1 Treatment modalities of obstructive sleep apnea

Broad modalities	Specific modalities	Evidence
Conservative measures	Weight reduction	Moderate
	Exercise	Moderate
	Positional sleep therapy	Moderate
	Alcohol avoidance	Moderate
Airway pressure treatments	Continuous positive airway pressure	High (Gold standard)
	Nasal expiratory airway pressure devices	Moderate
	Intraoral negative pressure therapy	Moderate-low
Pharmacological therapy	Antidepressants, carbonic anhydrase inhibitors	Very low
Surgical procedures	Uvulopalatopharyngoplasty	Moderate-low
	Tongue size reduction	Moderate-low
	Hypoglossal nerve stimulation	Moderate-low
	Maxillomandibular advancement	Moderate-low

who completed the protocol, significant improvement in quality of life and Epworth Sleepiness Scale was observed in 15%-67% and 33%-78% respectively), with significant AHI improvements being observed on 75% of 71 participants who volunteered for polysomnography[30].

Maxillomandibular advancement

A composite procedure consisting of Lefort 1 osteotomy and bilateral sagittal split of mandibular rami increases airway volume by creating a larger space[22]. A Case series involving 214 such cases has shown that this surgery resulted in an 87% decrease in AHI[28].

CONCLUSION

OSA, although a commonly encountered problem, can be managed efficiently. Various existing and evolving treatment modalities (Table 1: Treatment modalities of obstructive sleep apnea) include conservative measures, airway pressure treatments, pharmacological therapy, and surgical procedures. The Grading of Recommendations Assessment, Development, and Evaluation approach has been used to provide the quality of currently available evidence for each therapeutic modality[31]. All have demonstrated varied degrees of success, and further search will guide us toward patient-specific treatment modalities. However, CPAP remains the gold standard of treatment as of date. It is also highly cost-effective, especially after 1-2 years of continuous therapy, given its impact on quality of life, incidence of cardiovascular diseases, and motor vehicle accidents[32,33].

FOOTNOTES

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Country of origin: India

ORCID number: Deb Sanjay Nag 0000-0003-2200-9324.

Corresponding Author's Membership in Professional Societies: Indian Society of Anaesthesiology, No. S2863.

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