How to Cite:
Mann, S., Soni, J. S., Jaryal, S., Modi, M., Aggarwal, N., & Chhina, B. K. (2022). Lifestyle modifications in the management of obstructive sleep apnea: Management of obstructive sleep apnea and the predictors of outcome. *International Journal of Health Sciences*, *6*(S2), 1507–1516. https://doi.org/10.53730/ijhs.v6nS2.5119

Lifestyle modifications in the management of obstructive sleep apnea: Management of obstructive sleep apnea and the predictors of outcome

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***Abstract*---**Obstructive sleep apnea (OSA) is an exhausting sleep disorder regulating an individual's routine life. It is the most common type of sleep-disordered breathing and is characterized by recurrent episodes of upper airway collapse during sleep. Besides, several

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
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Manuscript submitted: 27 Jan 2022, Manuscript revised: 18 Feb 2022, Accepted for publication: 09 March 2022

studies are performed to prove the efficacy of lifestyle strategies to resolute OSA in adults. Reducing weight, quitting alcohol and smoking, eating a nutritional diet, and exercising are the modifications to benefit people. This review aims to expand our knowledge of the association between alterations to comportment and better treatment outcomes for sleep apnea.

***Keywords*---**lifestyle, lifestyle modifications, obstructive sleep apnea, sleep disorder.

Introduction

Obstructive sleep apnea (OSA) is a disease identified by reduced oxygen saturation due to recurrent episodes of insufficient or complete airflow cessation in the upper airway during sleep. Obstructive sleep hypopnea occurs when breathing is diminished, even if it is not absent.The severity of OSA is typically assessed with the apnea-hypopnea Index (AHI), which is the proportion of apneas and hypopneas occurring every hour of sleep. Specific disease severity measures that signify the extent of average oxyhemoglobin desaturation and extent of sleep discontinuities (i.e., arousal frequency) are also used in the clinical and research fields.

The prevalence of obstructive sleep apnea is 2 to 9% in adults; the condition is under-recognized and often undiagnosed even in symptomatic patients. Obstructive sleep apnea is up to 4 times more common among men and 7 times more common among people who are obese (i.e. body mass index [BMI] > 30)[1].OSA and excess adiposity often accompany each other with the prevalence of OSA being high among obese individuals, and with the majority of patients presenting with OSA being overweight or obese[2]. Notably, OSA prevalence has risen over the last 2 decades, by 14% and 55%, depending on age and sex.

As per the Bernoulli Effect, airflow velocity peaks at the site of stricture in the airway. As the airway velocity surges, pressure on the lateral wall decreases, and the airway collapses as the transmural pressure is attained. Transmural pressure is the variation between intraluminal pressure and the pressure in the surrounding tissues[3].

Common symptoms of OSA include increased daytime sleepiness, blare snoring with periods of stillness followed by gasps, dry mouth, morning headaches, waking up repeatedly to urinate at night, impaired concentration and memory, stress, and depression[4]. Long-term cardiovascular sequelae of untreated OSA include poorly controlled hypertension, heart failure, and atrial fibrillation (even after catheter ablation) and other arrhythmias. OSA also increases the rate of non-alcoholic fatty liver likely due to intermittent nocturnal hypoxia and sleep disruption[4,5].

Diagnosis and Management

Diagnostic testing for OSA should be performed in conjunction with a comprehensive sleep evaluation and adequate follow-up. Polysomnography is the standard diagnostic test for the diagnosis of OSA in adult patients in whom there is a concern for OSA based on a comprehensive sleep evaluation. It is recommended that polysomnography, rather than home sleep apnea testing, be used for the diagnosis of OSA in patients with significant cardiorespiratory disease, potential respiratory muscle weakness due to neuromuscular condition, awake hypoventilation or suspicion of sleep related hypoventilation, chronic opioid medication use, history of stroke or severe insomnia[4].

Both apnea and hypoapnea must last a minimum of 10 seconds. Hypopneas are measured by oxygen desaturation of 3% or more or arousal from sleep. The apnea-hypopnea index is calculated by adding all apneas and hypopneas and then dividing by total sleep time. An apnea-hypopnea index of 15 or more events per hour, or five or more events per hour in the presence of symptoms or cardiovascular comorbidities, is diagnostic for OSA[6]. Multiple sleep latency test (MSLT) is an objective measure of daytime sleepiness. A time greater than 10 minutes is oftentimes defined as normal. OSA management typically involves behavioural modifications, continuous positive airway pressure (CPAP) therapy, mouth appliances, mandibular advancement devices, supplement therapies, and surgeries in severe cases of OSA[7, 8].

Conventional Therapy

Continuous Positive Airway Pressure Devices

As formulated by the American Academy of Sleep Medicine, the subsequent guidelines for PAP therapy have been suggested to treat patients with sleep-disordered breathing (SDB).OSA is typically categorized as mild, moderate, or severe based on the AHI (i.e., the number of breathing disturbances per hour of sleep).Today, the respiratory disturbance index is frequently used, as it incorporates other events called respiratory effort-related arousals[9]. The search for a global predictive index to provide a more informative assessment of treatment effectiveness and morbidity/mortality risk as compared with the AHI remains an open research issue. PAP devices are used to reduce the AHI values and are considered primary devices to manage OSA. These devices are commonly used for treating moderate-to-severe OSA. PAP machines include a mask that is fitted over the nose and mouth or sometimes beneath the nose. It provides pressurized air that flows regularly or is suspended during sleep. An increase in air pressure avoids airway collapse and enables continuous breathing during sleep without fragmentation. CPAP machines need the airway pressure to be constantly between inhalation and exhalation. Such pressure is generally accomplished by a servo-regulated air compressor regulating the airway pressure as close to the desired pressure despite the patient's inspiration and exhalation[10]. However, adherence to CPAP is only between 17 and 54% [11], thus leaving a large group of patients without adequate treatment. Many patients therefore seek alternative treatments, such as oral appliances and surgery.

Mandibular Advancement Appliances

The main objective of MAD is to advance or move the jaw with respect to the maxilla, in order to keep the airway open or released to a sufficient degree, in such a manner that its fortuitous or unconscious closure is prevented. It is, therefore, an effective device to treat Sleep Apnoea-Hypopnoea Syndrome and chronic snoring. MAD is considered an alternative, which can be the initial choice of treatment in simple snorers, mild OSA patients, mild-moderate OSA with low BMI, and patients suffering from the increased resistance of the upper airway syndrome and secondly preferred in patients who are intolerant to PAP devices, patients at elevated surgical risk.

Minimally Invasive Surgeries

Surgical therapies for the treatment of OSA aim to improve airway patency by addressing selected sites of obstruction. Common surgeries include nasal surgery, redundant tissue surgery of the oropharynx, surgeries of the tongue, craniofacial surgery, tracheostomy, and bariatric surgery for weight loss[12]. Nasal surgery- Nasal ventilation has only minimal impact on the severity of sleep disordered breathing in adults[13]. Accordingly, improvement of nasal breathing by any means whatever has failed to show a significant impact on adult OSA. This is also true of nasal surgery[14].

Multi-level surgery- In most cases of moderate to severe OSA the entire upper airway is obstructed. Based on that concept multi-level surgery addresses the palate as well as the hypopharynx, combining procedures at both levels during one single operation if nasal ventilation is rejected or abandoned in spite of intensive care for the patient[15]. As with any other treatment modalities for OSA, surgical therapies have variable efficacy, but are a very important tool on OSA management in selected patients and have been shown effectiveness in decreasing the morbidity and mortality associated with the disease[16].

Behavioral Interventions

Weight Loss

Several conditions associated with OSA, such as high BP, insulin resistance, systemic inflammation, visceral fat deposition, and dyslipidemia, are also present in other conditions closely related to OSA, such as obesity and reduced sleep duration. Weight loss has been accompanied by improvement in characteristics related not only to obesity but to OSA as well, suggesting that weight loss might be a cornerstone of the treatment of both conditions[17]. Obesity contributes to the airway's anatomical narrowing, and research has found that a 10% weight gain can be equal to a six-fold rise in OSA risk[18].

A panel of sleep and pulmonary physicians, weight management experts, and behavioral scientists developed seven therapy-related questions, reviewed the relevant literature, and used the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) approach to summarize the outcomes and shortcomings of the literature. On the basis of this analysis, evidence-based

recommendations were made for the management of overweight/obesity in adults with OSA. For patients with OSA who are overweight or obese (i.e., BMI ≥25 kg/m^2) it was suggested they participate in a comprehensive lifestyle intervention program that includes that includes a reduced-calorie diet, exercise, and behavioural counselling rather than no program. For patients with OSA with a BMI greater than or equal to 27 kg/m^2, whose weight has not improved despite participating in a comprehensive weight-loss lifestyle program, and who have no contraindications including no active cardiovascular disease were recommended for an evaluation for antiobesity pharmacotherapy[19].

Investigations were made to correlate the association between the efficacy of weight loss and improvement in OSA. According to the study, weight loss reduced the upper airway soft tissues' volumes in people with obesity and OSA. The AHI scores improved with weight loss by depletions in the tongue fat. Hence, the researchers consider new treatments that reduce tongue fat for patients with OSA[20].

A randomized controlled parallel-group 1-year follow-up study carried out to determine whether a very low calorie diet (VLCD) with supervised lifestyle counselling could be an effective treatment for adults with mild OSA. Seventy-two consecutive overweight patients (body mass index, 28–40) with mild OSA were recruited. The intervention group (n = 35) completed the VLCD program with supervised lifestyle modification, and the control group (n = 37) received routine lifestyle counselling. The apnea–hypopnea index (AHI) was the main objectively measured outcome variable. Change in symptoms and the 15D-Quality of Life tool were used as subjective measurements. The lifestyle intervention was found to effectively reduce body weight (−10.7 ± 6.5 kg; body mass index, −3.5 ± 2.1 [mean ± SD]). There was a statistically significant difference in the mean change in AHI between the study groups (P = 0.017). The adjusted odds ratio for having mild OSA was markedly lowered (odds ratio, 0.24 [95% confidence interval, 0.08–0.72]; P = 0.011) in the intervention group. All common symptoms related to OSA, and some features of 15D-Quality of Life improved after the lifestyle intervention[21].

Dietary and Exercise

Various dietary approaches with different caloric content and macronutrient composition have been recommended to treat obesity in adults. As a general principle, the optimal diet to treat obesity should be safe, efficacious, healthy and nutritionally adequate, culturally acceptable and economically affordable, and should ensure long-term compliance and maintenance of weight loss. Setting realistic goals for weight loss and pursuing a balanced dietary plan tailored to individual needs, preferences, and medical conditions, are the key principles to facilitate weight loss in obese patients and most importantly reduce their overall cardiometabolic risk and other obesity-related comorbidities. Successful diets involve gradual and stable changes. An even more optimal goal is weight loss maintenance and weight loss prevention through holistic education, motivation, and behaviour changes to obtain long-lasting weight loss and other health benefits[22].

In a recent meta-analysis of five studies, Iftikhar et al. found significant reductions in the AHI and daytime sleepiness, as well as increases in sleep efficiency and peak oxygen consumption (VO_{2peak}), in adult patients with OSA. The authors found that OSA patients undergoing regular exercise had a 32% reduction in the AHI (a reduction of 6.27 events/h) and a 28% reduction in daytime sleepiness, as well as a 5.8% increase in sleep efficiency. Another important point is that even if exercise has no significant impact on OSA severity, indirect benefits of exercise include decreased blood pressure, improved metabolic profile, and reduced overall cardiovascular risk. More recently, Aiello et al. Performed a meta-analysis of nine studies and confirmed the findings of Iftikhar et al., having found a reduction in the AHI and in daytime sleepiness after exercise as the sole treatment for OSA[23].

Myofunctional therapy is a non-invasive therapy to reinforce the oropharyngeal muscles and the tongue, thereby regulating the resting tongue position. The treatment includes a list of mouth and face exercises to strengthen the musculature. Exercises should be repeated for 45 minutes each day, and the entire set should be done at least four times each day for optimal outcomes. For optimal results, exercises should be performed consistently for at least two years[24]. Several studies are performed to assess orofacial myofunctional therapy (OMT)'s efficacy as a treatment modality for OSA. Following the review of 11 studies, it was emphasized that OMT reduces snoring and severity of OSA and improves life quality. Also, patients show increased adherence to CPAP therapy when OMT is used as an adjunct therapy[25].

Recent studies have focused on exercise programs for patients with OSA because they constitute a low-cost, easy-to-use treatment modality and have been shown to be effective in mitigating several harmful consequences of OSA, including cardiovascular disorders, glucose intolerance, and fatigue [26, 27]. Recently, Kredlow et al. performed a meta-analysis of the effects of acute and regular exercise on sleep quality and found that exercise can improve subjective perception and objective parameters of sleep (including total sleep time, sleep efficiency, and duration of slow-wave sleep).

Positional Therapy

Many positional therapy (PT) strategies are available for treating positional obstructive sleep apnea (OSA). PT is primarily supplied to selected patients as a secondary treatment option when other therapies have failed. In a study, patients suspected of having OSA were referred to the University Sleep ApneaCenter (USAC) Groningen, University Medical Center Groningen (UMCG), Groningen, the Netherlands. Forty-six used PT as primary treatment option, while 43 chose a different treatment: CPAP n = 19, oral appliance n = 5, ear nose and throat surgery n = 6, other/no therapy n = 13. Seven patients used PT as secondary treatment option after another treatment had failed. In total 53 patients used PT. PT effectively reduced the time spent in supine sleeping position from median (IQR) 155.3 (97.8–193.7) minutes at baseline to 33.5 (0.5–66.9) minutes, $p < 0.001$. At baseline all patients spent at least 30 minutes in both the supine and non-supine position. PT for the short-term was successful in 27 (commercial waistband n = 14; and self-made construction n = 13) of 40 patients (68%): these

27 patients showed a reduction in AHI of ≥ 50% from the baseline value. In conclusion, this study shows that on the short-term PT (both self-made construction and commercial band), is an easy and effective method in most patients with positional OSA[28]. However, as long-term compliance is low, close follow-up of patients with regard to their compliance is necessary, especially in patients with moderate-to-severe OSA, as these patients are more prone to stop using PT.

New technology to assess sleep apnea

With the advent of technology, new smart devices are increasingly used by people on a day-to-day basis. These devices, such as smartphones with external sensors and smartwatches with inbuilt sensors, facilitate the detection of the patients' sleep behaviour. Traditional visual scoring or sleep-analyzing software is required to assess the smart devices' signal data. Wireless data communication enables uploading data to a cloud database and connected to the individual-health repository[29]. Recently, studies have been aimed at questioning the efficacy of fitness-tracking systems.

Alcohol consumption and smoking

Alcohol consumption is associated with a range of important health consequences, and a history of alcohol consumption is common among people with OSA. It is plausible that alcohol increases the risk of OSA because alcohol consumption reduces genioglossal muscle tone, predisposing patients to upper airway collapse and generally increasing upper airway resistance. High alcohol intakes also contribute to dietary energy intake, and hence in some cases a high body mass index, which is itself a risk factor for OSA

According to the Centers for Disease Control and Prevention, heavy drinking is consuming 15 drinks or more per week for men, and heavy drinking is consuming eight glasses or more per week for women[30]. Heavy drinkers appear to be at expanded risk for OSA, distinctly when they snore, though even moderate amounts of alcohol significantly increase the frequency and severity of apneas among persons with OSA, especially in the first few hours of sleep when blood alcohol levels are the highest.Sleep-disordered breathing may be an additional contributor to sleep complaints and sleep disruption in heavy drinkers. Even after a single drink normal sleepers can develop snoring and even obstructive sleep apnea (OSA) resulting in oxygen desaturations. Furthermore, the combination of OSA and alcohol increases a person’s risk of heart attack, stroke and sudden death.

To clarify and quantify the association between alcohol consumption and the risk of OSA a systematic review and meta-analysis of comparative epidemiological studies including data on alcohol consumption affects and OSA in adults was carried out. Among the 21 studies included in the pooled analysis of relative risks a sensitivity analysis showed that relative to people who did not consume any alcohol, those who consumed alcohol had 25% higher risk in OSA[30-32]. Effects of alcohol on sleep: Irrespective of the dosages, alcohol reduces sleep onset latency with an integrated first-half sleep and elevated sleep fragmentation in the second

half of the sleep cycle. There are dose-related effects on REM sleep in the first half of sleep, with low and moderate doses showing no profound impact on REM sleep in the first half of the night. On the other hand, at high doses, REM sleep reduction in the first part of sleep is considerable. Total night REM sleep percentage is lower in most studies at moderate and high amounts, with no clear trend apparent at low doses[31].

Smoking and OSA are widely prevalent and are associated with significant morbidity and mortality. It has been hypothesized that each of these conditions adversely affects the other, leading to increased comorbidity while altering the efficacy of existing therapies. Cigarette smoking may increase the severity of OSA through alterations in sleep architecture, upper airway neuromuscular function, arousal mechanisms, and upper airway inflammation. The higher number of nicotine binding sites observed in smokers is a result of chronic hypoxia. This surge in the number of nicotine binding sites further sustains the vicious cycle of smoking and expands smoking frequency. Conversely, some evidence links untreated OSA with smoking addiction[33].

Conclusion

Treatment for OSA depends on addressing the underlying cause of the disease. As several lifestyle changes have been applied to the successful control of weight loss and metabolic diseases, a comprehensive behavioural intervention addressing OSA therapy, including smoking cessation and alcohol intake, may improve the quality of life for the patients suffering from OSA. Prevention is pivotal to prevent harm and reclaim the quality of life when it comes to sleep and weight. With an appropriate treatment plan, sleep apnea carries a remarkable prognosis. Therefore, it is crucial to see a physician for an accurate diagnosis and begin to control weight.

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