What We Know so Far About Obstructive Sleep Apnea Management: A Review Article

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ABSTRACT
Obstructive sleep apnea is a common sleep disordered breathing condition. It is well recognized as a major risk factor for multiple medical conditions and poor quality of life. It has a great burden on health care resources and a substantial increase in health care use costs. Unfortunately, despite the prevalence, it is widely recognized that it remains under-diagnosed.

Effective treatment needs a comprehensive management plan approach that considers the patient as the centerpiece of management. Regular monitoring and a detailed follow up can have an impact on adherence to therapy. A constant and regular follow up can shed some light on patients who are not compliant with therapy and offer them with alternative therapeutic options that suits them better whenever feasible.

In this review, we aim to shed some light on where we are in terms of obstructive sleep apnea management strategies and options available to each individual patient.

Keywords
Obstructive sleep apnea; Continuous positive airway pressure; Upper airway.
INTRODUCTION

Obstructive sleep apnea (OSA) is a common sleep disordered breathing condition. It is defined as complete or partial cessation of airflow during sleep in the presence of breathing effort. It is the most common type of sleep breathing disorder. It is considered one of the risk factors for different medical disorders. In addition to that, it can lead to a suboptimal and poor quality of life. Furthermore, studies have shown that untreated OSA patients have a greater burden on health care resources when compared to patients without OSA, leading to substantial increases in health care utilization and costs\(^\text{[1,2]}\). Multiple studies conclude that treatment of OSA can reduce utilization of health care resources\(^\text{[3,4]}\). Unfortunately, we have to spend more resources in recognizing and diagnosing OSA as studies have estimated that OSA prevalence is still underestimated\(^\text{[5]}\).

Studies done on the prevalence of symptomatic OSA showed that around 2% to 4% of adults in the US are affected\(^\text{[6]}\). However, the significant increase in the rates of obesity and its association with the development of OSA would raise a big question mark about those estimates in the near future and would encourage a revision of these estimates accordingly. Using various published data on body mass index (BMI) and sleep cohorts, Peppard et al.\(^\text{[7]}\) proposed more realistic estimates of the prevalence of OSA. They estimate that around 13% of males and 6% of females have at least moderate OSA among adults. Moreover, mild OSA is estimated to be in approximately 14% of men and 5% of women\(^\text{[7]}\). A recent local study done by Wall et al.\(^\text{[8]}\) show an estimate of 12.8% in men and 5.1% in women for the overall prevalence of OSA in Saudi Arabia.

The clinical presentation of OSA ranges from no symptoms at all to multiple classical presentations that include loud snoring, excessive daytime sleepiness (EDS), recurrent awakening from sleep and gasping at night. Physical findings that have been encountered in patients with OSA include obesity, large neck size, deformities of the jaw bone and crowding of the posterior oropharynx.

Obstructive sleep apnea was found to be one of the independent risk factors for a variety of medical conditions. Among these are hypertension, ischemic heart disease, depression, congestive heart failure, asthma, chronic obstructive pulmonary disease, atrial fibrillation, type 2 diabetes, traffic and industrial related accidents, stroke and overall mortality\(^\text{[9-19]}\).

The consequences of OSA have a significant impact on healthcare and economy\(^\text{[20,21]}\). Effective treatment needs a comprehensive management plan approach that considers the patient as the centerpiece of management. Regular monitoring and a detailed, frequent follow up can have an impact on adherence to therapy. A constant and regular follow up can shed some light on patients who are not compliant with therapy and hence offer them with alternative therapeutic options that suits them better whenever feasible.

What Treatment Options are Out There?

What we have learned from OSA management is that one size does not fit all. However, continuous positive airway pressure (CPAP) remains the gold standard therapy.

Continuous Positive Airway Pressure Therapy

Continuous positive airway pressure works by applying positive pressure that splints the airway open. It acts as pneumatic pressure on the upper airways (UA). It applies positive pressure to prevent UA collapse during sleep. Prescribing a CPAP treatment usually preceded by an in laboratory polysomnogram (PSG) to determine the exact pressure required to eliminate the respiratory events in different sleeping positions. Another method that is gaining popularity recently is to use auto-titrating positive airway pressure (APAP) devices. It can measure inspiratory airflow and adjust the positive airway pressure automatically to maintain patient airways during sleep. Although the latter method has been used quite frequently, there is not enough data in the literature to support that it is superior to the standard in laboratory titration\(^\text{[22]}\). Despite the convenience of using APAP titration, patients with complex medical history such as chronic lung disease and heart failure are not good candidates for APAP titration and should have a standard in laboratory CPAP titration.

Several studies examined the impact of treatment with CPAP on OSA symptoms like EDS. Studies have shown a significant improvement of sleepiness during the day when measured subjectively, but with objective measurement of sleepiness the results were controversial. One of the large randomized placebo-controlled studies that included approximately 1000 subjects concluded that treatment of OSA with CPAP showed an improvement in both subjective and objective measures of EDS. These observations were largely seen in patients with severe disease\(^\text{[23]}\). Moreover, CPAP treatment was found to be associated with improvement in cognitive functions and neurobehavioral performance and overall quality of life as well\(^\text{[24]}\).

Multiple randomized controlled trials evaluated blood pressure responses to CPAP therapy. These trials showed a significant blood pressure reduction. Randomized controlled trials have also evaluated the impact of OSA management on markers of cardiovascular disorders such as endothelial dysfunction, inflammatory markers, insulin sensitivity, and cardiac ejection fraction. The overall findings were consistent with favorable effects of CPAP on surrogates for cardiovascular risk markers.

The total duration of time spent using CPAP during the night is a question that has raised a significant debate over the last few decades. Individual variations were
noticed when trials attempted to determine the optimum CPAP use time. Some patients showed subjective and objective improvements when they use CPAP more than seven hours per night, but others failed to achieve such an improvement despite long hours of CPAP at night. The current acceptable duration is four hour per night, and patients are always instructed that the more hours used the better the outcome[24].

Unfortunately, despite the significant effect of CPAP therapy and its effectiveness, sleep medicine providers are facing the challenges of patient’s compliance to therapy. Attempts have been done to examine causes of suboptimal compliance and measures were taken to improve usage on multiple levels of medical care with no great results. Even the sophisticated technological aspects of those machines have been altered and updated at different levels to meet the sophisticated technological aspects of those machines are looking for as health care providers[25]. Other measures such as educational support as well as psychological support in terms of cognitive behavioral therapy could have an impact on tolerance and acceptance of treatment with CPAP[26].

Mandibular Advancement Devices

Oral appliances also known as mandibular advancement devices are another option to consider for OSA therapy. It can be even utilized as a first option for patients with mild to moderate OSA or as an alternative option to CPAP. Although oral appliances use was as effective as CPAP in reducing sleepiness and improving cognitive performance, CPAP was superior in reducing Apnea Hypopnea Index (AHI) and the degree of oxygen desaturation[27,28]. Any patient who elects to use oral appliances needs to be evaluated with a follow-up PSG to evaluate the efficacy of the oral appliance objectively. Despite the overall subjective improvements in OSA symptoms, a significant number of those patients have a persistent elevated AHI. In a cohort of patients with OSA using oral appliances, only 65% had an AHI of 10/hour or less on follow-up PSG[29]. Different methods were assessed to find better predictors for response to oral appliances. Finding the best fit could improve comfort and subsequently improve adherence as well, which can have a significant impact on the utilization of this therapeutic option.

Some of the improvements that were introduced to the oral appliances new devices is its ability to be adjusted remotely similar to CPAP machines and can be titrated in the sleep lab similar to CPAP. This new tweak in the technology can play a role in identifying the individuals who will benefit from this modality and can accurately assess the degree of advancement required to achieve a better control of the AHI[29]. Finally, pretreatment assessment to have a better selection of patients that would likely benefit from this therapy can be achieved by direct visualization during a nasopharyngoscopy to assess the degree of mandibular advancement[30].

Nasal Expiratory Positive Pressure

Another alternative treatment method for OSA is nasal expiratory positive pressure (nEPAP). It works by decreasing airflow through the nose through a one-way valve which subsequently creates a positive pressure at the end of expiration, this is the time when the airways are more vulnerable to obstruction. Clinical efficacy trials demonstrated significant decreases in the AHI, although tolerability and adherence has not been assessed properly yet[31,32].

Positional Therapy

Some patients with OSA have a positional component of their OSA. Those patients can benefit from positional therapy. The goal from this approach is to avoid sleeping in a supine position which can subsequently decrease the apnea episodes and total AHI. These devices can be worn around the chest or abdomen and it works by alerting the patient via a sensor or vibration to encourage them to roll away from their supine position. Positional treatment is reserved for patients with a positional component and mild sleep apnea. Unfortunately, we do not have long term trials on their efficacy and compliance[33,34].

Surgical Options

Surgical options for OSA management has been used for decades. Multiple options are available based on individual’s anatomy. These options include nasal surgeries like tonsillectomy, septoplasty, uvulopalatopharyngoplasty (UPPP), in patients with enlarged tonsils, and tongue advancement procedures. In addition to that, advancement of the mandible can be done in selected patients as well. They are considered as an alternative option for patients with OSA in whom other methods were either intolerable or cannot be used. Visual assessment of the UA can be utilized as a predictor in patients who would benefit from this surgery. It involves evaluation of the palate position and tonsils size[35]. All can be used to predict outcome of surgical procedures such as UPPP and tonsillectomy. The most favorable outcome is achieved when the patient has a low BMI and the surgery can correct the upper airway anatomy to have less UA obstruction[36].

Direct visualization with nasopharyngoscopy can directly assess UA anatomy in addition to dynamic behavior of the UA during a Müller’s maneuver. Unfortunately, precise localization of the site of airway collapse during a Müller’s maneuver has a low predictive value of post UPPP response[36,37].

Despite the significant advancements in surgical procedures, unfortunately its results in treating OSA patients are not great. Uvulopalatopharyngoplasty can have an impact in reducing snoring and in selected patients it can make the CPAP use more comfortable because it can increase the UA patency. However, UPPP followed by
genioglossal muscle surgery can have a better success\[38\]. New surgical techniques and novel procedures can hopefully alter the response to such treatment modalities.

Recently, a novel approach to examine the UA called drug-induced sleep endoscopy has been gaining more attention in which the UA is assessed during awake sedation with Propofol. The relevance of its finding in caring for patients going for UA surgery has not been well established ye\[38,40\].

Dental surgical procedures like mandibular advancement surgery is another option for treating OSA in selected patients. Preoperative selection of patients to maximize the potential benefit after surgery is important and has to be done by an expert in the field of maxillofacial surgery. Selection of patients requires an extensive preoperative work up including UA imaging to enhance the success rates of the surgery\[41,42\]. These procedures showed a non-inferior impact in terms of snoring, quality of life and EDS but it was not as good as CPAP in reducing AHI and the degree of oxygen desaturation\[43-45\].

**Weight Reduction Surgeries**

Obesity is a major risk factor for OSA. It is also associated with the severity of OSA. Weight loss can be of great benefit in improving OSA and in some patients it can completely cure their disease. Bariatric surgery and other weight reduction approaches are considered as a therapeutic option for obese patients with OSA. However, despite the success in reducing or eliminating respiratory events during sleep, sleep apnea can still persist in some cases and another modality needs to be added even after weight loss. Patients who underwent a weight reduction surgery need to have another PSG done after they achieve a significant weight loss to objectively document a resolution of their OSA\[46,47\].

**Hypoglossal Nerve Stimulation**

A novel modality recently introduced as a management option for OSA is electrical stimulation of the hypoglossal nerve. It was hypothesized that loss of innervation to dilator muscles in the UA is a key factor in the pathophysiology of OSA. Stimulating the hypoglossal nerve during sleep would lead to genioglossal muscle activation and subsequently dilating the UA during sleep which in turn can decrease the incidence of obstruction. In patients with moderate to severe OSA with a BMI of less than 40 kg/m² the electrical stimulation showed a significant reduction in AHI that exceeded 50%\[46-48\]. Although experience with this technique still at best remains limited, hypoglossal nerve electrical stimulation may be a useful alternative therapy for selected patients who cannot or refuse to use CPAP therapy.

Given the lack of adherence to CPAP despite being the most successful treatment method for OSA, new treatment modalities need to be developed taking into account the different individual phenotypes of OSA patients. The literature has shown differences between individuals in the pathophysiology of OSA. For instance, a defect in the ventilatory centers during sleepiness can lead to a greater ventilatory response to an apnea which can subsequently lead to worsening of preexisting apnea. On the other hand, some patients have a very low arousal threshold which can play a role in the disturbance of the ventilation controls and centers during sleep. In other patients, suboptimal and poor activation of the genioglossus dilator muscles during UA obstruction is a predominant pathophysiologic feature. Anatomical factors, which can result in collapse of the UA are as well found to be a major contributory factor for the development of OSA\[49\].

From the observations that OSA patients have different phenotypes, further details and research would help in personalizing the treatment options we offer for patients. Although the mechanical options available including CPAP, surgical treatment and oral appliances are the most effective treatment options, we still have a wide gap in their acceptance and adherence and further personalization may be required to close the gap in adherence and to achieve optimal outcomes. Moreover, patients with ventilation centers instability may respond better to novel therapeutic options to control their ventilation during sleep.

Novel approaches such as hypoglossal nerve stimulation, that stimulate the dilator muscles activity during sleep and subsequently overcome the collapsing forces is promising in a subset of patients. Overall the management approach to patients with OSA is changing from one size fit all to a more personalized approach. Accepting the fact that patients have different phenotypes would facilitate the development of new novel therapies in the near future\[51,52\].

**CONCLUSION**

The last few decades showed a significant advancement in treatment options for patients with OSA. Unfortunately, despite the improvement in technology used in CPAP therapy, adherence is still having a significant impact on its utilization. There was a recent shift in the management of OSA to be tailored to each individual separately given the different phenotypes of patients. We are still in need for a novel therapeutic approach that is comfortable and effective and has a less invasive approach. Further research in this field is of paramount importance and more resources and efforts need to be directed to that goal.

**Conflict of Interest**

The author has no conflict of interest.

**Disclosure**

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**Ethical Approval**

Obtained.
REFERENCES

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ما مدى ما توصل إليه العلم في مجال علاج اокоاع النفس الإلزادي اللاريادي أثناء النوم

فاسس فلاح الحميلى
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المستخلص.

بعد مرض اوكاع النفس الإلزادي اللاريادي أثناء النوم، أحد أكثر أمراض اضطرابات النوم شيوعاً، فالأشخاص المعينون قد يكونوا أكثر عرضة للإصابة بأمراض القلب والشرايين وغيرها من الأمراض الأخرى إذا لم يتم التصدي لهذا المرض بطرق العلاج المتعددة وبحسب حالة المريض، وقد حدث تطور كبير ونوعي في علاج هذا المرض خلال العقود المنصرمة، ولاحظ في الأفق طرق علاج جديدة في هذه الورقة البحثية سوف نطرح طرق العلاج المتوقعة، ونسبة نجاح كل منها وأسباب اختيارها.