Review Article

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Recent Trends in the Treatment of Adult Obstructive Sleep Apnea-A Comprehensive Review

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Introduction

Obstructive Sleep Apnoea (OSA) is one of the wide spectrums in Sleep related breathing disorder. In OSA, the patient has multiple episodes of breathing cessation or decrease in oxygen saturation during his hours of sleep. There is an increase in respiratory effort during these episodes which indicates that the cause is predominantly obstructive [1]. Cessation of breathing for at least 10 seconds is defined as apnea whereas hypopnea is decrease in airflow with resultant desaturation of >3% [2]. The episodes of apnea and hypopnea in OSA is quantified using Apnea-Hypopnea Index (AHI) which is the average number of apnea and hypopnea events per hour of sleep.

AHI >= 15; or >=5 with at least one of the following symptoms or clinical signs:

1. Excessive daytime sleepiness (EDS), non-restorative sleep, fatigue or insomnia.
2. Waking up with choking, breath holding or gasping.
3. Witnessed habitual snoring and/or breathing interruptions; and
4. Hypertension, mood disorder, cognitive dysfunction, coronary artery disease, stroke, congestive heart failure, atrial fibrillation or type 2 diabetes mellitus; gives a diagnosis of Obstructive Sleep Apnea Syndrome (OSAS). (2) OSA is a vast topic in terms of pathophysiology, diagnosis and treatment.

In this review article, we will only be covering the various modalities of treatment of Adult Obstructive Sleep Apnea. The aim of treatment of patients with Obstructive Sleep Apnea should be to alleviate symptoms, improve quality of life and to decrease the chances of developing co morbidities like hypertension, insulin resistance and cardiac conditions, which eventually decreases mortality [3]. The treatment should be guided on the basis of severity classification of OSA by polysomnography into mild, moderate or severe. In mild to moderate cases, symptoms determine treatment. Initially, non-medical measures should be adopted. These include:

Lifestyle Modification

Weight loss has a significant effect in reduction of AHI in patients with mild to moderate OSA. This involves calorie restriction, regular exercises and adoption of a healthy lifestyle [4]. Bariatric surgery significantly induces resolution and improvement but is not the first choice of treatment due to the associated complications, especially in people with comorbid conditions [5]. Additionally, patients are advised to adopt optimal dietary choices, exercise regularly, avoid consumption of caffeine, smoking and drinking as these are seen to have an effect in the quality of sleep of the patient [6]. Sleep posture: Sleeping in a supine position is seen to double the AHI than sleeping in a lateral position in patients with positional sleep apnea syndrome. Hence, patients are advised to avoid sleeping in a supine position and adopt maneuvers like 'tennis-ball position' to facilitate sleeping on the lateral position [7]. Nasal and oral appliances: Oral appliances

like mandibular advancement devices widen the upper airway during sleep. In a recent systematic review published in 2019 which analyzed 15 studies, mandibular advancement devices were known to reduce symptoms and improve the AHI in 92% of the included subjects [8]. Nasal appliances like nasal splint can improve symptoms in patients with nasal valve collapse. Recently, a social media trend went viral in which people were seen to adopt mouth taping at night and they reported significant decrease in snoring at night, but these methods are not validated and need more detailed research [9].

Continuous Positive Airway Pressure (CPAP)

CPAP is considered the gold standard treatment for OSA. As OSA involves pharyngeal musculature relaxation and collapse during sleep, CPAP provides a positive airway pressure which facilitates the oxygen delivery to the lungs. It is more likely to improve patients with moderate to severe OSA than those with mild symptoms. In 2015, a guideline was published by the American Academy of Sleep Medicine for positive airway pressure, which strongly recommends the use of positive airway pressure in OSA patients with excessive daytime sleepiness, reduced sleep related quality of life and in those with comorbid hypertension [2,10]. Furthermore, if the patient does not have any significant comorbidities, positive airway pressure therapy can be initiated using either APAP (auto-adjusting positive airway pressure) at home or in-laboratory PAP titration. APAP has the benefits of automatically adjusting pressure requirements over time like in cases of alcohol consumption, changes in body position or changes in weight. In lab titration includes both full night and split night titration. Initially, APAP or CPAP is to be used instead of BPAP (bilevel positive airway pressure). BPAP may be used in patients with higher therapeutic pressure requirements or in patients with failed CPAP or APAP [10].

The main issue in the use of positive airway modalities in patients with OSA is compliance. In order to mitigate this adverse effect, education about PAP therapy and information on what to expect should be given before initiation of therapy. Behavioral changes that need to be adapted before and during PAP therapy along with troubleshooting interventions that focus on PAP related problems need to be addressed, especially in the early phase of treatment. Telemonitoring guided interventions which include remote monitoring of PAP parameters and settings during initiation of treatment and follow up should be carried out for better compliance [10]. For other issues of CPAP therapy like dryness, air leak and discomfort around nose and mouth area; measures like humidified PAP and appropriate selection of masks can be adopted respectively. Some patients develop central sleep apnea when they are treated for Obstructive Sleep Apnea with a CPAP device. This is termed as the Complex Sleep Apnea Syndrome [1]. These patients require a new type of CPAP device known as adaptive servo-ventilator [11].

Medical Management

Various drugs like modafinil and armodafinil have been used to treat residual sleepiness despite continuous positive airway pressure in obstructive sleep apnea (res-OSA). These drugs are seen to promote wakefulness. In a systematic review published in 2016, these drugs were seen to improve subjective and objective daytime sleepiness in res-OSA [12]. However, in 2011, the European Medicines Agency removed the indication of res-OSA based on an unfavorable risk-benefit profile. Other drugs that have been seen to reduce OSA severity by reducing excessive daytime sleepiness are amphetamine and pitolisant [13]. In addition, atomoxetine, which is a norepinephrine reuptake inhibitor and oxybutynin, which is an antimuscarinic agent were seen to improve genioglossus muscle activity and improve airway patency during sleep when used in combination [14].

Surgical Treatment Options

According to the level of obstruction causing sleep apnea, various surgical modalities can be adopted. These are summarized in the Table 1.

Table 1.

Level of obstruction	Surgeries that can be performed
Nose	Rhinoplasty including nasal valve surgery
Nasal cavity	Turbinoplasty, septoplasty, polypectomy
Nasopharynx	Adenoidectomy
Soft Palate	Uvulopalatopharyngoplasty, laser assisted uvulopalatoplasty, cautery-assisted palatal stiffening operation, pillar implants, injection snoreplasty
Hard Palate	Rapid maxillary expansion, transpalatal pharyngoplasty
Oropharynx	Tonsillectomy, tongue suspension, radiofrequency ablation of the tongue, midline glossectomy, lingual tonsillectomy, transoral robotic glossectomy
Hypopharynx	Genial tubercle advancement, hyoid suspension
Epiglottis	Epiglottopexy, epiglottoplasty
Larynx	Supraglottoplasty, arytenoidopexy
Craniofacial	Maxillomandibular advancement
Neck	Tracheostomy

Among these, some commonly performed surgical procedures are discussed below:

Nasal Surgeries

If the level of obstruction is seen to be the nose or nasal cavity as per clinical or endoscopic assessment, nasal surgeries can be considered to correct the cause. Septoplasty, turbinate reduction, nasal valve repair can be done to correct structural abnormalities which will help in improving nasal patency.

Uvulopalatopharyngoplasty (UPPP)

Uvulopalatopharyngoplasty was initially described by Fujita et al in 1981 which involves surgical excision of uvula and tonsils, and lateral pharyngoplasty (trimming and reorientation of the posterior and anterior tonsillar pillars) [15]. It acts by widening the airway but is associated with complications like postoperative pain, nasal reflux, pharyngeal stenosis, dysphonia, and velopharyngeal insufficiency [16].

Other Palatoplasty Procedures

Although UPPP has been shown to improve outcomes in patients with OSA, the failure rates range from 30 to 90% [17]. For this reason, surgeons have sought new techniques for modification of palatoplasty procedures to increase the effectiveness. One of these modifications is anterior palatoplasty which involves excision of a horizontal rectangular strip of mucosa and submucosa of approximately 4*1 cm from the soft palate at 1 cm above the attachment of the uvula to the upper palatal pillar. This stripped area is then sutured with Vicryl sutures, which pulls the soft palate anteriorly and superiorly [18]. This technique prevented the possible narrowing of the lateral distance between the tonsillar pillars, and it required no muscle reconstruction. In 2017, a systematic review was published which showed anterior palatoplasty to be a moderately effective surgical procedure for the treatment of OSA [19]. For patients with previous tonsillectomy, a new modification was developed, termed Z-palatoplasty. This procedure helped by widening the anteroposterior and lateral oropharyngeal air spaces at the level of the palate [20]. Lateral pharyngoplasty procedure involves bilateral tonsillectomy and microdissection of the superior pharyngeal constrictor muscle within the tonsillar fossa, sectioning of this muscle, and suturing of the created laterally based flap of that muscle to the same side palatoglossus muscle. In addition to this, a palatopharyngeal Z-plasty is performed to prevent retropalatal collapse [21].

Palatal Implants

This is an office-based procedure which involves insertion of polyethylene terephthalate in the soft palate. Implants work by stiffening the palate which in turn decreases palatal flutter. The inflammatory reaction in response to the implant leads to the formation of fibrous capsule which further increases the structural support and prevents collapse of the airway. The complications of this procedure include extrusion, prolonged pain, perforation or necrosis of the nasal floor, palatal mucosal necrosis, and altered sensation of the palate [22]. A similar procedure is palatal cautery which also causes scarring and subsequent stiffening. Injection snoreplasty procedure uses sodium tetradecyl sulphate in the formulation of 1% or 3% and around 2 ml of the solution is injected into the soft palate. (snoreplasty) [23]. The mechanism of action is similar to that of palatal implants and palatal cautery. If used in well selected patients, these modalities can become a relevant part of the treatment.

Genioglossus Advancement

Genioglossus advancement and hyoid suspension is done in patients in whom the level of obstruction is the hypopharynx. When the genial tubercle is advanced, it places the tongue under tension, thus preventing airway collapse [24].

Hypoglossal Nerve Stimulator

Hypoglossal nerve supplies genioglossus which acts in tongue protrusion. Hypoglossal nerve stimulation involves implantation of a neurostimulator device which provides either continuous or intermittent electrical stimulation (according to the device used) which in turn, protrudes the tongue and increases the airway patency [25].

New Advances

In recent days, smartphone technologies have been developed offering diagnosis and management for patients with OSA. Wearable sleep trackers linked to the smartphone provide additional home-based options for monitoring and follow up. However, these technologies require a learning curve and review of reliability, quality and validity. A systematic review conducted in 2022 evaluated 10 smartphone apps. However, at present, they were not seen to be as accurate as the available traditional options. Nevertheless, with improving technology, these definitely have a great future ahead [26].

Conclusion

In the last decade, increasing attention has been given to developing newer treatment modalities for OSA and recording their outcome. The newer devices have seemed to be more effective in comparison to the traditional treatment modalities. However, patient selection should be carefully carried out for maximum effectiveness. Furthermore, large RCTs and systematic reviews are needed to gain a new path for treatment of OSA in the upcoming years.

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