Beyond CPAP in OSA

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Introduction

In the early days, the treatment of obstructive sleep apnea (OSA) was surgical therapy, by performing permanent tracheostomy, which could bypass the site of obstruction in the upper airway. Since its description in 1981 by Sullivan and colleagues, continuous positive airway pressure (CPAP) therapy, that could alleviate upper airway obstruction through air-pressure ‘splinting’ of collapsible upper airway segments, has become the treatment of choice for OSA. But, an alternative treatment may be required if CPAP is not feasible for medical or psychological reasons. Also, it has been shown that severely symptomatic patients with frequent apnea/hypoapnea readily improve with CPAP therapy, but in asymptomatic patients there is no measurable benefit and hence compliance with CPAP is much less in such patients. There are a multitude of other treatment options for OSA, which can be broadly classified into conservative, apparative, pharmacological and surgical methods.

Conservative

Conservative methods include weight reduction, optimizing sleeping hygiene, conditioning in respect to the avoidance of certain sleep positions and medicinal treatments. Obesity constitutes a major risk factor for OSA and several studies have shown that weight reduction significantly improves OSA in the short run, but the long-term success rate does not exceed 3%. Weight loss has been shown to be associated with reduction of upper airway collapsibility and a fall in resistance to airflow in awake patients. Although weight loss is important and can facilitate the treatment of OSA, it can rarely cure it without being associated to classical techniques, such as nasal CPAP.

The maintenance of a certain level of sleeping hygiene with sufficient and regular sleep hours, avoidance of alcohol and sedatives, reduction of nicotine and other noxious substances, observance of a regular sleep rhythm, etc. is part of the standard recommendations in the treatment of OSA. Obviously, no controlled long-term studies exist relating to these measures.

Oksenberg and co-workers reported that more than 50% of patients had posture-dependent OSA. In the case of positional OSA, apneas and hypopneas occur predominantly or solely only in the supine position. In the supine posture, the tongue tends to fall back due to gravitational forces unless these forces are counteracted by enhanced activity of the genioglossus muscle, which pulls the tongue forward. Patients may feel more comfortable sleeping in lateral position and a short-term therapy success of 75% has been documented in the case of mild and moderate positional OSA by using waistcoats that prevent a supine sleeping position. Less severely affected patients would be more likely to respond to positional therapy, providing for a useful treatment option in the milder group of OSA patients who frequently are less tolerant of CPAP.

Apparative

Apparative treatment options include respiratory treatment with continuous positive airway pressure with its various modifications, oral appliances, and electrostimulation. There are three types of oral devices: the tongue-retaining devices, the mandibular advancement devices (MAD), and the soft palate lifters, which may be combined with tongue extensors. In the recent years, mandibular advancement appliances...
have had the most success. They have been proven to be the most effective treatment while at the same time entailing the fewest side effects. For mild to moderate OSA, success rates of 50–70% have been reported. When fitted to the teeth these intra-oral devices reposition the mandible forward during sleep and increase the upper airway lumen by protrusion of the mandible and tongue, increase the upper airway muscle tone, and reduce the passive pharyngeal wall compliance. They are shown to improve nocturnal breathing disturbances, symptoms, quality of life, vigilance and blood pressure in OSA patients.

The oral appliances are easy to apply, handy, not dependent on electricity and are portable. Also, sleeping with an oral appliance is perceived as less socially disturbing than wearing a CPAP mask. These devices may be effective in controlling symptoms of OSA, nocturnal breathing disturbances, oxygenation and sleep disturbances, and even blood pressure. Although its efficacy in improving symptoms of OSA is reported to be as good as CPAP, it has been proposed that nocturnal electrical stimulation of the hypoglossal nerve by an implanted pacemaker may prevent sleep related upper airway collapse in such patients by activating submandibular muscles. Currently, electrostimulation as standard procedure is available only for the transcutaneous or transcutaneous–transmucous application. Initial data from small case series display a short-term subjective success in the treatment of simple snoring but not for OSA. However, this treatment is still experimental and there is insufficient evidence to support its clinical use.

Surgery

Surgery for obstructive sleep apnoea/hypopnoea syndrome aims to alleviate symptoms of daytime sleepiness, improve quality of life, and reduce the signs of sleep apnoea recorded by polysomnography. Surgery has two potential roles: first as an adjunct to nasal CPAP in individuals with nasal obstruction, and second, in patients who fail CPAP due to inability to use the therapy. Surgical procedures are performed both in the case of primary snoring and at all severity levels of OSA. The more severe the SDB, the more aggressive the surgical therapy required, if it is to be effective. In the case of higher level OSA, surgery is only secondarily indicated after an unsuccessful nasal CPAP therapy. For a primary surgical treatment, an apnoea/hypopnoea index (AHI) of approximately 30 is considered as threshold value.

Initially in the 1960s and 1970s tracheostomy was the only therapy available for OSA. Tracheostomy bypasses the site of obstruction in the upper airway and should provide
a complete cure, but it has serious disadvantages including technical problems involved in performing tracheostomy in obese patients, postoperative complications like infection and dehiscence, and cosmetic disfigurement.

Nasal surgery rarely affects the severity of OSA and is of use only in the minority of patients with primary snoring. But it may be used as an adjuvant therapy especially to facilitate nasal ventilation therapy with CPAP. The success rate of only nasal surgery for OSA is low, less than 20%. As nose is neither the site of obstruction during apneas nor the site of generation of snoring.

Surgeries proposed for treatment of OSA include Bypass upper airway Tracheotomy; Soft tissue ablation-Retropalatal Uvulopalatopharyngoplasty (UPPP), laser-assisted uvulopalatoplasty (LAUP), Retrolingual Laser midline glossectomy/lingualplasty (LMG), radiofrequency tongue base ablation (RFTA), tongue base reduction with hyoepiglottoplasty (TBRHE), Retropalatal and Uvulopalatopharyngolossoplasty (UPPGP); Skeletal modification Retropalatal Transpalatal advancement pharyngoplasty (TPAP), Retrolingual Mandibular advancement (MA), genioglossal advancement (GA), hyoid myotomy and suspension of hyoid from mandible, hyoid myotomy and attachment of hyoid to thyroid cartilage, Retropalatal and Maxillomandibular advancement (MMA).

UPPP is the most commonly performed surgery for OSA. It was introduced in 1981 by Fujita as a procedure which avoided the necessity of neck opening by amputating the uvula, excising the tonsils, and tightening the pharyngeal mucosa, thereby widening the pharyngeal cross section. However, it was soon realized that a large percent of subjects with OSA had their site of narrowing or obstruction at the level of the base of the tongue at a distance from the site of the UPPP and the procedure could cause only 50% reduction in AHI. In a large meta-analysis, the success rate of UPPP for OSA has been estimated at about 40.7%. Tongue base procedures including suspension or resection have been performed for management of OSA. But, these procedures have been performed in small patient groups and the results require further confirmation.

Tracheotomy and maxillo-facial surgery are aggressive procedures and are not recommended routinely.

OSA is increasingly considered as a disorder of the entire upper airway. In an attempt to achieve the maximum degree of improvement in each individual patient while minimizing the extensiveness of surgical intervention, protocols have been established by which surgery is staged in planned sequential phases. The Stanford step-by-step approach for surgery in OSA is considered in patients not successfully treated with CPAP. The first stage comprises limited mandibular osteotomy (with or without UPPP, genioglossus advancement, hyoid myotomy, and hyoemtyroidopexy). Maxillo-mandibular advancement osteotomy, stage II surgery, is considered if stage I is not successful, or in the first place if cranio-facial dysmorphia is present.

One of the main reasons for OSA in children is tonsillar hypertrophy and children with severe OSA show reduced neurocognitive performance, which is reversible after combined adenotonsillectomy. An isolated adenoidectomy does not seem to be as effective as an isolated tonsillectomy nor as a combined adenotonsillectomy. The cure rate of adenotonsillectomy as an isolated procedure in children is approximately 85–95%. As substantial hypertrophy of the palatine tonsils is rare in adults, adenotonsillectomy does not have any significant role in adults with OSA but in selected patients including those with adeno-tonsillar hypertrophy, and cranio-facial malformations various surgical techniques that enlarge the upper airway may be a treatment option for OSA.

In morbidly obese patients suffering from OSA bariatric surgery should be considered as a treatment that reduces obesity and at the same time improves OSA. Gastric surgery may allow marked loss in weight, which may be associated with significant improvements in parameters of sleep-disordered breathing, sleep architecture and quality of sleep, and severity of obesity-related diseases such as diabetes and hypertension. Marked reductions in AHI and improvement in oxygen saturation has been reported after gastric surgery in obese patients.

There are a few trials assessing different surgical techniques with inactive and active control treatments. The studies assembled do not provide evidence to support the use of surgery as primary treatment of sleep apnoea/hypopnoea syndrome, as overall significant benefit has not been demonstrated.

**Pharmacological Therapy**

Though, drug therapy has been proposed as an alternative to CPAP in some patients with mild to moderate sleep apnoea and could be of value in patients intolerant of CPAP, unfortunately there are currently no drugs that allow effective pharmacological therapy of OSA. These include an increase in tone in the upper airway dilator muscles, an increase in ventilatory drive, a reduction in the proportion
of REM sleep, an increase in cholinergic tone during sleep, a reduction in airway resistance and a reduction in surface tension in the upper airway. Many agents have been used so far, including alkaloids and analeptics, which also stimulate the pharynx musculature via the respiratory center, tricyclic antidepressants, which reduce the portion of REM sleep, antihypertensives, methylxanthines, oxygen, progesterone analogs, and others.\(^5\) In compliant OSA patients with residual hypersomnolence despite exclusion of other causes and effective CPAP treatment, modafinil, a drug prescribed to treat hypersomnolence in narcoleptics, has been used as an adjunct to improve alertness.\(^6\) No reports exist of patients with polysomnographic data who have received therapy for more than 18 months. Even for theophylline, a methylxanthine frequently used in Germany, there are no long-term results.\(^7\) Presently, there is insufficient evidence to recommend the use of drug therapy in the treatment of OSA. Small studies have reported positive effects of certain agents based on short-term outcome. Individual patients had more complete responses to particular drugs and it is likely that better matching of drugs to patients according to the dominant mechanism of their OSA will lead to better results but this also needs further study.\(^8\)

**Conclusion**

CPAP therapy is the most successful treatment modality available for management of OSA but its efficacy is compromised because a large proportion of patients cannot tolerate or are non-adherent to its regular use. Life style changes, weight reduction and sleeping in lateral position may improve symptoms in mild OSA and should be a part of the standard recommendations in the treatment of OSA. Removable oral appliances are attractive and acceptable treatment option for patients with OSA not able or not willing to tolerate the standard CPAP therapy. Although newer surgical procedures are also available to treat OSA and experimental approaches to treatment, such as electrical stimulation of pharyngeal dilator muscles are under development, positive airway pressure applied through the nares. Lancet 1981; 1: 862–5.


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