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Analysis of Comparative Studies on Obstructive Sleep Apnea and Different Modes of Management

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ABSTRACT

Obstructive Sleep Apnea (OSA) is a common disorder with episodes of recurrent and intermittent cessation of breathing due to collapse of upper airway during sleep. This phenomenon happens because of abnormality in the neurological coordination in sleep leading to upper airways musculature instability. OSA Syndrome presents mostly in obese individual with snoring, recurrent intermittent hypoxia, sleep fragmentation leading to excessive daytime somnolence. It is associated with increased cardiovascular morbidity and mortality. Different treatment options are now available for effective management. However, even after four decades, Continuous positive airway pressure (CPAP) is still considered the gold standard treatment. Regular usage of CPAP is effective in improving the quality of life and reducing the clinical sequelae of obstructive sleep apnea.

Keywords: Continuous positive airway pressure, obstructive sleep apnea, oral appliance, positional therapy, uvulopalatopharyngoplasty.

INTRODUCTION

Sleep is a normal yet a complex restorative biological process. Normally, most adults require 7-8 hours of sleep each night. A number of important body functions remain active in sleep that keeps the person normal and healthy. Lack of adequate quality or quantity of sleep affects the physical and mental health besides daily functioning. Inadequacy of normal sleep can give rise to multiple morbidities and accelerate mortality.

Sleep disorders are conditions that disturbs normal sleep pattern. There are more than 80 different sleep disorders. Most of the sleep disorders can be classified either as disorders of initiation of sleep (DIS) or disorders of maintenance of sleep (DMS). Sleep Disorders can present as either Hypersomnias (excessive sleep) or Hyposomnias (reduced sleep). Major types include - Insomnia, sleep apnea, restless leg syndrome (RLS), hypersomnia, circadian rhythm disorder, parasomnias. Sleep apnea is a breathing disorder where the person stops breathing for more than 10 seconds during sleep, repetitively and intermittently. Sleep apneas are majorly of two types: Obstructive and Central.

Obstructive sleep apnea (OSA) is a common chronic sleep disorder affecting 2-4% of adult population mostly among middle aged men and relatively lesser in women. The condition is characterized by repetitive episodes of complete or partial collapse of the upper airway (mainly the oropharyngeal tract) during sleep, with a consequent cessation or reduction of the air flow in breathing (1,2). Typically, obstructive sleep apnea causes recurrent episodes of progressively worsening asphyxia leading to hypoxemia that increasingly stimulates breathing efforts against the collapsed airway, until the person gets neurological arousals or is awakened.

The diagnosis is made by using the technique of Polysomnography (PSG). PSG is nocturnal monitoring of Neurological parameters in sleep besides respiratory and cardiac parameters aimed to correlate sleep in relation to detecting obstructive events in breathing and following changes in blood

oxygen saturation (SaO2) (3). Apnea / Hypopnea index (AHI) is the index used to define the severity of OSA which is calculated as number of obstructive events per hour of sleep during PSG (3).

Causes of Obstructive sleep apnea (OSA) are multifactorial. They are complex interplay between anatomic, neuromuscular and underlying genetic predispositions (2,4). Common risk factors include snoring, male gender, middle age, menopause in women, obesity, craniofacial and oropharyngeal features such as large neck circumference, micrognathia, enlarged adenoids, low lying soft palate, nasal obstruction, enlarged tonsils (2,4). There are recurrent episodes of apneas, recurrent intermittent hypoxia and sleep fragmentation, giving rise to metabolic alterations resulting in Homeostatic imbalances (5). As the disorder progresses in duration it leads to impaired performance at work and major-work related and road accidents (2,6) with remarkable adverse effects on quality of life (7).

If left untreated, OSA is one of main determinants for cardiovascular morbidity and mortality (8). These may vary from drug resistant systemic hypertension, ischemic heart disease, cardiac arrhythmias and stroke (5). Important metabolic impairment can lead to Insulin resistance, type II diabetes, altered serum lipid profiles (9) and increased mortality (8,10,11).

Management

The management of OSA is a multidisciplinary approach and should be individualized at best. Positive airway pressure (PAP) is the most effective and commonly used treatment since the beginning of 1980s and remains the cornerstone of treatment.

Positive Airway Pressure (PAP) Treatment

PAP is a concept to splint open the upper airway during sleep using continuous counterbalancing air pressure all through the sleep. Continuous PAP (CPAP) devices functions by delivering an air pressure which acts as a pneumatic splint to maintain upper airway patency by equalizing the upper airway collapsing closure pressure above the critical value. PAP therapy is indicated when AHI value is greater than 15 per hour (12). PAP therapy is life-long treatment in most of cases and can be given using conveniently designed home PAP ventilators popularly called CPAP or Bi-level PAP devises with nasal or Oro-nasal masks acting as human-machine interface.

Continuous positive airway pressure

Continuous PAP (CPAP) is administered most commonly using a nasal mask (nCPAP) as the machine - human interface. PAP is still considered gold standard treatment for OSA and nCPAP is first - choice treatment recommended worldwide (12,13). Symptoms of excessive sleepiness and nocturnal symptoms are reversed after a short regular usage of CPAP (13,14). It also helps patients after usage for 3-6 months by improving memory, attention and executive function (15,16) though thorough neurocognitive improvements remain controversial (17). There is significant improvement in simulated driving performance within 2-7 days (18) and a meta-analysis showed significant risk reduction following the treatment (19). Some studies have evidence of CPAP treatment having positive impact on cardiovascular outcomes (5,10). A large meta-analysis on 32 studies shown PAP treatment is associated with reduction in diurnal and nocturnal systolic and diastolic blood pressure (20). Another meta-analysis supports CPAP in reduction of drug resistant hypertension (21). One more study supports CPAP treatment to protect against new cardiovascular accidents (22). CPAP rapidly improves insulin sensitivity (23,24). Combining CPAP with weight loss is the best approach in improving glucose metabolism in obese patients (25). Serum lipid profile betterment by CPAP therapy has been confirmed by another extensive meta-analysis study (26). CPAP usage also reduced serum levels of inflammatory

markers such as C-reactive proteins (CRP), Tumor necrosis factor (TNF) and interleukin 6 (27).

Different modalities of positive airway pressure ventilation

Considering trouble in breathing while exhaling against high CPAP pressure Bi-level PAP (BPAP) ventilation providing two different levels of pressure is considered to treat OSA in place of CPAP. BPAP therapy is better in patients with severe obesity with impaired awake blood gas values with high Carbon-dioxide (28), in patients with severe OSA requiring high treatment pressures (29).

Autotitrating CPAP (Auto-CPAP) is more sophisticated device than the traditional CPAP, with advantage of delivering a floating pressure automatically adjusting according to changes in airflow resistance in order to maintain upper airway patency according to the preset computerized algorithms (13) depending on patient's position, degree of nasal congestion or sleep stages improving breathing synchrony and patient's comfort. Compliance with Auto-CPAP is marginally higher than with fixed CPAP (30).

Other treatment options for OSA besides PAP Therapy:

Positional therapy

Supine position in sleep enhances the effect of gravity on tongue and soft palate accentuating upper airways collapse and even gives rise to postural OSA (32), which accounts for nearly 30% of the patients with OSA (33). Retrospective studies indicate patients with positional OSA have milder AHI (33,34). Training Patients to sleep on their sides or even sleeping prone helps in reducing OSA. Wearing Tennis Balls stitched on the back in night attire is used to help in sleeping on sides.

Oral appliances

They are considered as alternative to CPAP in mild to moderate OSA and for patients with intolerance to CPAP (35). Mandibular advancement splints (MAS) are the most commonly used oral appliances. These are attached to both the upper and lower dental arches. This way these devices advance and retain the mandible to a forward position, making the upper airway widened and improving genioglossus function (36). Side effects like maxillo-mandibular arthralgia, teeth pain and occlusal changes can be their limitations (37,38). Better outcomes and a better compliance have been obtained with individually customized devices (39). MAS reduces daytime somnolence, improves neurocognitive impairment and quality of life (38,40). Treatment with MAS has a favorable effect on blood pressure control as well as significant reduction in both nocturnal and diurnal blood pressure values (41,42) though long-term effects with oral devices on cardiovascular health and other health outcomes are still uncertain (42). Although MAS is viable alternative in mild to moderate OSA, data on compliance are controversial and still scarce (43). Treatment success is achieved in young, female patients without obesity, in non-positional and milder OSA (44). Noticeable changes are found when one single night titration is used predicting the efficacy of MAS (45). They are also very useful as multimodality treatment option in complex cases as dual therapy with CPAP / BPAP. Although promising, there is still insufficient evidence to recommend the use of oral appliance in most case of OSA (46).

Surgical treatment

The aim of surgery is to remove the cause of upper airway obstruction and to widen the airway after detecting where the obstruction occurs. The most common sites are adenoids, tonsils, nose & oropharyngeal tract (4).

Minimal invasive techniques (under local anesthesia as an outpatient procedure) along with more invasive procedures can be attempted. Currently surgeries are performed at the level of nose, oropharynx tract, tongue and craniofacial structures.

Tonsillectomy and adenoidectomy are most commonly used surgical procedures to treat in children and are highly effective (47). Patients with OSA have excessive tissue in the oropharyngeal tract. Conventional Uvulopalatopharyngoplasty (UPPP) or Laser assisted (LAPP) are can be attempted in selected patients however; the results have been mostly disappointing. Most common long term complications of UPPP include velopharyngeal insufficiency, dry throat and swallowing difficulty (48). The radio frequency ablation (RFA) of the palate is less invasive alternative to UPPP but results in submucosal scarring of the soft palate making it more stiff (49). It though, does improve snoring. A small number of studies have shown partial resection of the tongue can improve AHI but only accounting for 36.6% success (50).

Maxillomandibular advancement (MMA) with osteotomy of maxilla and mandible induces anterior displacement of the soft palate and tongue with widening of the pharyngeal space (46). After MMA a mean reduction in AHI of 87% has been reported and proven to be most effective surgical approach after tracheotomy (46,51). However, such surgeries need specialized training and expertise.

Weight Control and bariatric surgery

In patients with severe obesity (BMI > 40) bariatric surgery including gastric bypass and bandage can be used when conservative treatments failed (52). A meta-analysis concluded both bariatric surgery and non-surgical weight loss have significant beneficial effects on OSA. Bariatric surgery helps both in reduction in BMI and AHI more than with non-surgical alternatives (53).

Educational and behavioral intervention

Patients with OSA should be discouraged and instructed about the risk factors such as smoking, drinking alcohol, using sedatives and hypnotics. Priority about obesity reduction which plays an important role in this disorder, and to maintain optimal weight needs to be explained by the physician. Intensive life style interventions such as significant weight loss with regular sleep habits, following strict sleep hygiene principles help in reduction in sleep apnea severity are effective in the management of OSA. Supportive behavioral intervention can increase compliance in patients with moderate to severe OSA (54).

CONCLUSION

The etiology of OSA is multifactorial, consisting of a complex interplay between anatomic and neuromuscular factors, causing upper airway collapsibility in sleep. Different treatment options are now available for effective management of OSA. CPAP is highly effective in controlling symptoms, improving quality of life and reducing clinical consequences of sleep apnea. CPAP is considered the first line of treatment. A multidisciplinary approach and implementation of educational programs will significantly improve the management of the disorder.

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