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Review Article

Obstructive Sleep Apnoea in Children and Adults

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Abstract

Obstructive sleep apnoea is a disorder leading to repetitive collapse of pharyngeal airway while sleeping. This causes desaturation of oxygen, low oxygen levels in blood and disturbed sleep. The symptoms include snoring, apnoeas, choking sensation, and sleepiness. The pathogenesis of sleep apnoea could be anatomical issue with upper airway, central respiratory control system issues, muscular factors with improper neuromuscular control of the dilator muscles of upper airway. Continuous positive airway pressure, bi-level positive airway pressure, auto-titration airway pressure can be used for management of sleep apnoea. Other treatments include dental devices, surgery, and weight loss.

Keywords: Obstructive sleep apnoea, pathogenesis, airway, snoring.

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INTRODUCTION

Obstructive Sleep Apnoea is a common disorder occurring due to repetitive collapse of pharyngeal airway while sleeping [1]. The collapse of pharyngeal airway may be complete (apnoea) or partial (hypopnea). The instabilities in gaseous exchange result in oxygen desaturation, hypercapnia, and sleep fragmentation, which all contribute to obstructive sleep apnoea such as cardiovascular-effects, metabolic, and neurological effects. Various treatment options exist for sleep apnoea but such options are not well tolerated and relieve the instabilities partially. Thus, improvement of patients compliance with the current treatment and development of new treatments or their combination is required. There is a relation of obesity with sleep apnoea. With the rise in obesity, the number of cases with sleep apnoea have increased. The prevalence of sleep apnoea have been proposed to be as high as 11 percentage in children and even higher in adults [2-4]. Obstructive Sleep Apnoea is a global health crisis; in Asian countries, Brazil, United States, UK have similar prevalence [5, 6]. The occurrence of obstructive sleep apnoea has been reported to be present if there are more than five apnoea or hypopnea events per hour of sleep.

Diagnosis and Definitions of obstructive sleep apnoea

Patients with obstructive sleep apnoea report snoring, cessation of breathing, choking sensation, increased sleepiness [1]. Other symptoms such as difficulty in sleeping, restlessness, feeling fatigued, and morning headache are also present [7]. Positive indicators for obstructive sleep apnoea are a positive family history of sleep apnoea, obesity, increased neck circumference, and reduced size of oropharyngeal airway [8]. The ideal test for obstructive sleep apnoea is a polysomnography recorded overnight in a testing center with measurement of apnoea-hypopnoea index [9]. This index is the number of apnoea and hypopnea episodes per hour while asleep. This test monitors both sleep and respiration. To identify the state of sleep, or wakefulness, electroencephalogram, electrooculogram, chin electromyogram are also recorded [9]. Radiological measurements include the airway dimensions in anteroposterior, transverse, and length on a cone beam computed tomography [10]. Caution has to be exercised when using two dimensional radiographs and assessing airway as the rotational errors can lead to distortion of measurements [11]. Cone beam computed tomography is a valuable tool for assessment as it is immune to such distortions with rotational error [11]. Minimal cross-sectional area indicates the area of airway which has the least space in the airway passage. It has been reported that minimal cross-sectional area of patients with obstructive sleep apnoea is lower than normal patients [12]. The airway volume and minimal cross-sectional area of airway can be measured with the help of cone beam computed tomography and it can be undertaken with dynamic thresholding and static thresholding [13]. The respiratory measurements

include respiratory effort measurement such as respiratory inductance plethysmography bands on the thorax and abdomen, air-flow monitor with nasal air pressure, thermal-air sensors, and arterial oxygen saturation [14, 15]. Artificial intelligence has been able to identify radiographic findings [16]. With advanced technologies, it may be able to identify the polysomnography report and detect sleep apnoea in patients. The electromyography of the anterior tibia muscle is done to measure the limb movements that can alter the stage of sleep [17]. The phase of respiration and body position is evaluated as obstructive sleep apnoea is position specific for some patients.

Pathophysiology of obstructive sleep apnoea

Obstructive sleep apnoea can occur due to anatomical problems of upper airway in which craniofacial structural arrangement and increase in body fat percentage lead to reduced size of the pharyngeal airway. This has been shown to increase the changes of airway-collapse [18]. When awake, the airway is acted upon by multiple upper airway muscle which dilate it and hold it patent. When asleep, the muscle activity is reduced and this can contribute to airway-collapse [19, 20]. This is the not the only factor responsible for obstructive sleep apnoea. Several other contributory factors are responsible for collapse of upper airway [21].

An important factor is the central system of respiratory-control. When the central system measurements of the respiratory output increase and decreases, the upper airway muscles responsible for dilation also are signaled accordingly. When there is a low central respiratory drive, there is allow activity of upper airway muscle for dilation and therefore there is a high chance of airway collapse [22, 23]. This respiratory control loop or high loop gain is a contributory factor in many patients [24, 25].

Management

The management of obstructive sleep apnoea is performed with nasal continuous positive airway pressure. It is the treatment of choice for patients with obstructive sleep apnoea [26]. It can be used in adult patients to prevent collapse of pharyngeal airway [27]. Continuous positive airway pressure results in maintenance of a positive pharyngeal transmural pressure and it allows the intraluminal pressure to exceed that of the surrounding pressure [28]. Continuous positive airway pressure can help the patients with obstructive sleep apnoea in decreasing the symptoms and also protection of cardiovascular health [26, 29, 30]. Various other options can be used for patients who are not comfortable with continuous positive airway pressure. Bi-level positive airway pressure and auto-titration pressure is utilized as an alternative and has been found to be more comfortable for some patients. Orthodontic appliances can be used to posture the mandible in advanced anterior position. Some appliances can also posture the tongue forward. These appliances increase the pharyngeal airway patency by way of pulling the mandible and tongue forward [31]. Maxillary expansion can lead to decrease in resistance of nasal airway in children. In adults, bone anchored maxillary expansion with skeletal anchorage or mini implants leads to increase in the airway volume [32]. Mini implants are placed in the palatal region in bone anchored maxillary expansion which have shown to be have high success percentage [33, 34]. Bone anchored maxillary expansion appliance can be opened two times a day for opening the mid palatal suture [35]. If the suture does not open, then osteoperforations can be done on the palate [36]. Osteoperforation lead to an increase in the osteoclasts number and bone resorption and therefore, help in achieving the desired result in such cases [37]. When the mid palatal suture is open, it may lead to the appearance of diastema between the incisors [38]. In addition to mid palatal suture, it also increases the width of circummaxillary sutures and this helps in moving the maxilla forward in Class III patients [39]. Maxillary protraction in class III patients also have a positive effect on the airway [40-42]. Bone anchored maxillary expansion does not lead to extrusion of molars so it has minimal effects on overbite [43].

Surgical options can be done on soft palate such as somnoplasty, laser-assisted uvulopalatopharyngoplasty. Such treatment options have shown small effects in improving the symptoms in a select few patients [44-46]. More aggressive surgeries such as maxilla and mandible advancement have shown definite improvements in apnoea-hypopnoea index. But because it is a major surgery, many patients tend to avoid it. Experimental surgical procedures such as stimulation of hypoglossal nerve have been done but the effectiveness of the procedure is still not very clear [47-49]. Therefore, more studies are required for identifying the best methods for management of obstructive sleep apnoea.

CONCLUSION

Sleep Apnoea can be likely targeted in the future by addressing the cause of the disease. Obstructive sleep apnoea occurs due to different reason in the patients. Diagnosis and proper management of sleep apnoea can prevent a lot of consequences due to this disorder. Upper airway anatomy and muscular factors can contribute to development of sleep apnoea. Both non-surgical and surgical options are available for treatment with sleep apnoea. Surgical options can be minor surgery of the soft palate or major surgery of maxilla and mandible. Further research investigating the mechanisms of the disease and treatment strategies would be helpful to patients with this disorder.

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