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Review Article

Role of CBCT in sleep apnea – A review

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ABSTRACT

Sleep apnoea is a common condition in the elderly population with potentially significant consequences, including comorbidity and cognitive decline. There is now a wealth of information indicating that untreated sleep apnea is associated with an increased risk of fatal and nonfatal cardiovascular event, a higher propensity of sudden death during sleep and a greater risk for stroke and all-cause mortality. Consequently, OSA represents a significant evolving public health challenge in both the developed and developing world. Currently many cases of obstructive sleep apnoea syndrome are unrecognized which leads to unnecessary morbidity and even mortality. By posing a few additional questions during the routine clinical interview, patients in need for further diagnostic testing can be easily identified. The best methods of diagnosis are costly and increased sophistication of screening devices and interpreting physicians are required to reduce the need for full polysomnography. CBCT, with its 3D presentation of the airway and its surrounding structures, offers the increased visualization of both untreated obstruction tendencies and potentially of changes in the airway by treatment modality.

1. Introduction

Sleep apnoea may be described as a potentially life threatening disorder in which periods of cessation of breathing occur in the presence of inspiratory effort i.e; the chest wall is active, but no air reaches the lungs.[1] Sleep apnea can be associated with lack of energy, fatigue during daytime, memory impairment and may lead to number of diseases, including hypertension, stroke and coronary heart disease. The prevalence of sleep apnoea worldwide in the adult population is about 2% in women and 4% in men, based on minimal diagnostic criteria (AHI ≥5 and excessive daytime sleepiness). Increased prevalence of sleep apnoea is seen in older aged group of 65 years and above. Subjective reports from epidemiological study in the US conducted including large population have found that the prevalence of reported apnoeas in women and men was 4% and 13% respectively. While the prevalence of reported snoring was 19% for women and 33% for men.[2] Sleep apnea is further classified into 3 types: Obstructive sleep apnea (OSA), Central sleep apnea (CSA), and Mixed apnea (MSA).[3]

1.1. Obstructive sleep apnea

Obstructive SA (OSA) is characterized by a cessation of airflow caused by occlusion of the oropharyngeal tract.[4] OSA typically occurs in males in an age range between 30 and 60 years with prevalence rate of 1-5% of adult men.[5] The underlying disturbance in OSA is transient airway occlusion, usually at the level of the oropharynx. The airway collapse in OSA depends on the inability of the airway dilator and abductor muscles to maintain airway patency during inspiration, i.e. when subatmospheric pressure is generated inside the respiratory system.[4] OSA is characterized by moderate obesity, snoring

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history, excessive sleepiness in daytime, noctural choking or gasping.[3]

1.1.1. Central sleep apnea

Central sleep apnea is a disorder characterized by repetitive cessation or decrease of both airflow and ventilatory effort during sleep.[6] In contrast to OSA, the apneic events in CSA are associated with a decreased or absent ventilatory effort. CSA depends on a defective central drive to the ventilatory muscles. The resulting apnea has pathophysiologic consequences that are similar to those of OSA.[4] It is however quite common in patients with cardiac failure, in patients with few neurological disorders and in those on high dose opiates.[7] The International Classification of Sleep Disorders (ICSD-3) classified CSB into 5 different types i.e; Central sleep apnea with Cheyne-Stokes breathing (CSB), Central sleep apnea due a medical disorder without CSB, Central sleep apnea due to high altitude periodic breathing, Central sleep apnea due to a medication or substance and Primary central sleep apnea.[8]

1.2. Mixed apnea

Mixed apnea represents a combination of the two types of apnea i.e; obstructive sleep apnea and central sleep apnea. It is characterized by a cessation of airflow caused by occlusion of the oropharyngeal tract (OSA) and by a transient abolition of the neural drive to respiratory muscles (CSA). An event with initial absence of respiratory effort followed by a respiratory effort.[4,9]

2. Assessment of Sleep Apnea

The pathophysiologic mechanisms predisposing to SA are complex and overlapping. Thus, neither history nor physical examination is sufficiently accurate to exclude the diagnosis of SA. Various clinical prediction rules can assist in identifying patients with a high pretest probability for SA.[10] Because of the high prevalence of OSA and patients often not reporting sleep problems to clinicians, the review of systems should include asking about history of snoring, pause in breathing during night, and excessive fatigue or sleepiness during the day. Many Questionnaires available for preoperative screening of which the first and foremost include thorough history taking.[11]

2.1. History

Sleep clinic visits include an extensive history consisting of a thorough description of the sleep problem. If there is a bed partner, the partner will be queried about the frequency and loudness of snoring, witnessed apneas, and so forth.[11]

2.2. Physical examination

Assessment and physical examination (PE) should consist of a full review of body systems with a focus on the head, ears, nose, neck and throat portions as well as neurocognition.[12] Physical assessment of patients with OSA generally includes a height/weight algorithm called body mass index, as well as neck, waist and hip circumference as indicators of body habitus, dietary intake particularly saturated fats and sedentary lifestyle both contribute to overweight, obesity and distribution of body fat, which play roles in OSA severity.[9] By having the patient open their mouth the health care provider (HCP) can observe tongue placement and visualize the tongue's position with respect to the hard palate, soft palate, uvula base, uvula, and tonsils, along with the relaxed tongue. This staging lends to the start of a combination of assessments in the multisystem testing method.[12] Maxillofacial abnormalities such as retrognathia, nasal septal deviation, macroglossia, enlarged tonsils, large uvula, turbinate hypertrophy; predispose one for OSA. Narrowing of airway can be clinically quantified by using Mallampati score.[13]

2.2.1. Screening tools

There are standardized questionnaires that could be used in primary care visits for screening patients with possible SA.[14] There are various screening tools to identify the patients who are at risk such as Berlin questionnaire, STOP-BANG questionnaire, Epworth Sleepiness Scale and Preoperative questionnaire. Although the accuracy of many of them is limited. Of all the Epworth Sleepiness Scale (ESS) is most commonly used for OSA screening - subjective measure of sleepiness. STOP-BANG is an easily administrable tool which has high sensitivity comparative to others.[13,15]

2.3. Diagnostic rests

The sleep tests are classified based on the number of channels that being monitored during the test. Type 1 test is the in-lab attended sleep study or polysomnography (PSG), which is the one of the gold standard test for diagnosing OSA.[15] Polysomnography (PSG) incorporated several methods to assess cardiopulmonary, neurophysiologic and other physiological parameters over the duration of several hours, particularly during an entire night (overnight PSG) simultaneously as well as continuously.[16] It provides information and knowledge on the physiological changes occurring in different organ systems with relation to wakefulness and sleep stages. It allows qualitative and quantitative documentation of abnormalities with respect to sleep as well as wakefulness, sleep– wake transition and also physiological function of other organ systems which are influenced by sleep.[17]

Out-of-center sleep testing (OCST) or Home Sleep Apnea Test (HSAT) is used as an alternative, when PSG is not feasible.[17] Traditional PSG has always been the standard diagnostic procedure in the field of sleep medicine. As PSG possess the consequent economic burden and limited access, which led to development of less costly procedures with wider access.[18] Hence, Home sleep apnea testing (HSAT) is used as an alternative to PSG in the diagnosis of OSA. When used in accordance with the most recent clinical guidelines, HSAT can be part of the assessment and treatment of OSA.

3. Cone Beam Computed Tomography in Airway Imaging

As OSA may be ascertained through loud snoring, excessive sleepiness during daytime, fatigue and arousal from sleep due to oxygen desaturation.[19] However, due to the insufficient awareness of the above condition, almost 80% of individuals with OSA suffer from the disease unnecessarily despite of the modern investigations, medical facilities and dental treatments that are available on hand.[20] Early diagnosis of OSA is usually strenuous, as insufficient results and data have been published for the numerous tools that have been proposed, hence disqualifying them as evidence-based screening tools. Many questionnaires have been developed to help diagnose OSA as early and straightforwardly as possible.[20] With the increased incidence of this condition, there may be many patients with undiagnosed OSA who report to dental clinics for routine dental checkup. Dentists should have a high index of clinical suspicion and an appropriate high understanding of this condition to perform the in home basic screening to recognise patients suspected of having OSA during routine dental procedure.[21] Any technology that would enhance clinicians ability to visualize where in the airway obstruction occurs would help identify those subsets of patients who may or may not benefit from a choice of treatment modalities.[22] However, approximately 25-50% of patients with OSA will either refuse the offer of PAP therapy, or will not tolerate it.

The best way to non invasively assess the airway changes is by using imaging modalities. Airway volume has been measured with various imaging techniques, including computed tomography (CT), cone-beam computed tomography (CBCT), cephalometry, fluoroscopy, nasopharyngoscopy, and magnetic resonance imaging (MRI).[23] Many of the previous studies had limitations in evaluating the upper airway volume based on patients' lateral cephalograms.[24] With the advent of newer 3D imaging such as CBCT we have overcome the limitations. Cone-beam computed tomography (CBCT) is an 3D imaging modality commonly used in the dentistry to capture accurate 3-dimensional images.[22] As enlarged soft tissues around the airway are also a important predisposing factor for OSA, With the increasing use of CBCT in dental clinics in recent years, dentists could use CBCT as a screening modality by assessing the upper pharyngeal airway to rule out the maxillofacial anatomy predisposing to obstructive sleep apnea.[22]

The parameters such as A-P distance and the width of the minimum surface area of the oropharynx are more commonly used to evaluate the upper airway. A recent systematic review revealed that the most common measurements of the airway used to evaluate OSA subjects with CBCT included total volume and minimum cross-sectional area, followed by area and lateral and anterior-posterior linear measurements.[25] Other methods of assessing upper airway includes measuring the total length of upper way, total airway volume of oropharyngeal region, the average airway volume of the oropharyngeal region, and the smallest width and anteroposterior (AP) measurements.[22]

4. Conclusion

Although PSG is the most commonly used technique for the identification of the degree of airway obstruction, the use of 3D modality such as CBCT is fast becoming an integral part. CBCT is useful in 3D volumetric assessment of the retropalatal and retroglossal area and thus, is an important aid in the diagnosing of conditions affecting the airway resulting in debilitating conditions like OSA. CBCT is a less time-consuming, cheaper and more convenient alternative for the patient when compared to PSG and can serve as a useful adjuvant tool in the diagnosis of OSA. Increasing levels of expertise in CBCT and the availability of reliable questionnaires have enabled routine screening of dental patients for OSA, so as to potentially diagnose patients and can be referred to a sleep specialist, medical clinic for further evaluation, investigation and proper treatment, if needed, as well as receiving any necessary dental interventions.

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6. Conflict of Interest

None.

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