International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Diagnostic Methods of Obstructive Sleep Apnoea - A Review

Dr. Rythm Kharbanda

MDS Orthodontics

Abstract: ***Obstructive sleep apnoea (OSA) is a disorder of repetitive pharyngeal collapse during sleep. It is essential to determine and diagnose the specific features of the affected patients and thereafter provide them appropriate treatment for the same. This review article explains the various diagnostic procedures that can be administered in order to diagnose the patients with obstructive sleep apnoea.***

Keywords: obstructive sleep apnoea, polysomnogram

1. Introduction

Obstructive sleep apnea (OSA) is a disorder of repetitive pharyngeal collapse during sleep. Pharyngeal collapse could be complete (causing apnoea) or partial (causing hypopnoea). Disturbances in gas exchange lead to oxygen desaturation, hypercapnia, and sleep fragmentation, which contribute to the consequences of obstructive sleep apnoea. e. g cardiovascular, metabolic, and neurocognitive effects.1

Hypopnoea is characterized by a decreased airflow in the airways by over 50% (compared to the 2-minperiod of stable respiratory rhythm) lasting over 10 s or leading to a blood saturation decrease by more than 4% [19]. OSA is diagnosed in 4% of men and 2% of women, in whom the disease develops later, usually after menopause. The disease occurs more frequently in men than in women due to anatomic differences.2Upper airway anatomic factors are thought to play a critical role in the pathogenesis of airway closure in OSA. Individual patients with sleep apnea may have occlusion at different points along the upper airway, with the retropalatal region and retroglossal regions being implicated most frequently.3 Sleep apnea severity is typically assessed with the apnea–hypopnea index (AHI), which is the number of apneas and hypopneas per hour of sleep.4

Prevalence-The risk of OSA (AHI≥10) for adults over 65 years is 6.6 times the risks facing those between 20 and 44 years. The prevalence of OSA (AHI≥10) in males aged to 44, 45 to 64 and 65 and above years rose from 3.2% to 11.3% and 18.1% respectively. Amongst women, the increase in prevalence of OSA (AHI≥15) rose from0.6% to2.0% and 7.0% for ages 20 to 44, 45 to 64 and 65 and above respectively. For both genders the prevalence of OSA plateaued around 60 years of age, after a steady increase from younger ages.5

Etiology and Diagnosis

The etiology of OSA is multi-factorial. The risk factors include obesity, anatomic and post-inflammatory upper airway abnormalities, inadequate sleep hygiene, as well as maxillary and mandibular hypoplasia.2Patients with obstructive sleep apnoea report snoring, witnessed apnoeas, waking up with a choking sensation, and excessive sleepiness. Other common symptoms are non-restorative sleep, difficulty initiating or maintaining sleep, fatigue or tiredness, and morning headache. Indicators include a family history of the disease or physical attributes suggestive of obstructive sleep apnoea-example, a small oropharyngeal airway or markers of obesity (example-large neck circumference) [1]. In a study by *Tsuiki et al 2008*[6], reported that obesity and craniofacial abnormalities synergistically increase pharyngeal airway collapsibility during general anesthesia and paralysis. Structurally, the pharyngeal airway is surrounded by soft tissue such as the tongue, which is enclosed by bony structures such as the mandible and cervical vertebrae. Under suppression of pharyngeal dilator muscle contraction during sleep and anesthesia, the anatomical balance between the soft-tissue volume inside the bony enclosure and the bony enclosure size seems to determine the pharyngeal airway size. Accordingly, the anatomical imbalance between upper airway soft-tissue volume and bony enclosure size may result in pharyngeal airway obstruction during sleep andanesthesia.6

Assessment of upper airway space is a routine procedure in orthodontic diagnosis and treatment planning. Various techniques including cephalometry, computed tomography, cine computed tomography, fluoroscopy, acoustic reflectance, and fibre optic pharyngoscopy can be used to assess the upper airway in patients. These techniques, however, are usually applied to awake or upright patients, where the mechanisms controlling upper airway patency may be different from the dynamics of obstruction in a sleeping patient who is lying down.7

Somnofluoroscopy, where the pharyngeal airwayis visualized while the patient is asleep (without sedation) with monitoring of sleep stage and airflow, may provide information onthe dynamic function of the upper airway and the level of occlusion during sleep.7

CBCT-Cone-Beam CT equipment has become more efficient, reducing acquisition time and developing specific software, which provides improved image processing and analysis of three-dimensional images of the structures comprised in the maxillofacial region.8 In a comparison between **CT and lateral cephalometric radiographs** in assessing the pharyngeal airway space, Abouda et al found a significant correlation between sagittal area obtained from the radiographs and the volume obtained from CBCT, although the latter showed greater variability in patients with similar airway space in lateral cephalometric radiographs. This is expected since cephalometric analysis of conventional lateral radiographs only measures pharynx height and depth and therefore does not allow cross-sectional (i.e., width) examination.8

MRI cephalometry-Magnetic resonance imaging (MRI) provides excellent soft tissue resolution and three-dimensional reconstruction thus can be used as diagnostic modality for OSA. In a study by N. L. N Moorthy et al 2014, both cases of obstructive sleep apnea and control subjects were subjected to MRI examination of pharynx using 1.5 Tesla Magnetom® Avanto MRI scanner. They observed significantly lower cross-sectional area and antero-posterior diameters of the upper airways at retro-palatal and retro-glossal levels in patients with OSA and thus concluded MRI cephalometry may be helpful in identifying the subset of OSA patients who will be benefited by curative surgical intervention.9

Direct and fiberoptic visualization-Visual inspection of the UA is an important part of the evaluation of every patient suspected of having OSA.
The nose should be carefully examined for septal deviation, polyps, and narrowing with inspiratory collapse at the level of the nasal valve. Examination of the oropharynx with the patient in the supine position will more accurately reflect the extent of anatomical narrowing. Visualization of the entire UA is not possible by direct inspection, although it is inexpensive, easily performed and yields relevant information. Fiberoptic pharyngoscopy solves this problem, permitting examination of the entire UA with the mouth closed and the UA muscles more relaxed. The use of topical anesthesia is considered to have minimal effects on UA dimensions.[10]

Acoustic reflection technique-The technique was originally described by Jackson et al and further modified by Fredberg et al, who used this technique to measure tracheal cross-sectional areas in human subjects. The technique is based on sending sound waves along the respiratory tract. As they travel through the airways, they are partially reflected whenever there is a change in airway cross-sectional area. A microphone positioned at the mouth measures the intensity of the reflections and records their time of arrival relative to the incident wave. Knowing the wave speed and the arrival time of the reflections, the distance from the mouth into the airway can be calculated. Knowledge of the reflection coefficients permits computation of U A cross-sectional area.1[0]

Polysomnography-A typical laboratory-based polysomnogram includes measures of (1) airflow through the nose using a nasal cannula connected to a pressure transducer or through the nose and mouth using a thermal sensor; (2) respiratory effort using thoracic and abdominal inductance bands; (3) oxygen hemoglobin microphone affixed over the trachea or by filtering out low-frequency signals from the nasal cannula-pressure transducer system; (5) sleep stage and arousal using electroencephalogram, electrooculogram, and chin electromyogram; (6) electrocardiogram findings; (7) body position; and (8) leg movement.1[1]

Home sleep apnea testing

Several types of home sleep apnea testing are in clinical use. Level III sleep studies record a minimum of three channels of data while the patient sleeps at home. Level III studies usually monitor airflow, snoring, respiratory excursion, body position, heart rate and oxygen saturation, but some validated devices use surrogate measurements for these variables, such as tonometry or actigraphy, and the technology is constantly evolving. Level III studies do not record sleep; therefore, severity of OSA is estimated using the respiratory event index, which is the number of desaturation events per hour of total recording time.[12]

2. Conclusion

Obstructive sleep apnea can present serious health risks, and a physician, using a sleep study must diagnose it. Indeed, orthodontists seem to be positioned ideally to provide treatment for a large percentage of patients who suffer from less threatening forms of obstructive sleep apnea.1[3] Comprehensive management of upper airway sleep disorders requires an interdisciplinary approach where an orthodontist can play a significant role in the team approach to the management of mild to moderate OSA.1[4] An orthodontist can diagnose, plan and help growing children by predicting potential sleep apnoea and instituting the right course of treatment.1[4]

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