Detection of the level of obstruction in patients with obstructive sleep apnea

Essay
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Abstract

Obstructive sleep apnea (OSA) is the intermittent cessation of breathing during sleep due to the collapse of the pharyngeal airway. Obstructive sleep apnea is a complex disease whose etiology is multifactorial and because the final common pathway for this disease, whether caused by neurologic, muscular, anatomic, or other etiology, is obstruction of the upper airway during nocturnal respiration, The identification of the sites of upper airway obstruction in patients with obstructive sleep apnea is the cornerstone in choosing the appropriate surgical intervention.

Identification of the sites of UA occlusion during sleep has been attempted by a variety of techniques including, upper airway measurements, endoscopy, radiology, and physical examination.

The aim of this study is to analyze and compare between each of the above-mentioned techniques as regards advantages and disadvantages in detection of the level of obstruction in obstructive sleep apnea patients.

Keywords: Obstructive sleep apnea, Oropharynx, Sites of obstruction, Sleep apnea.

List of abbreviations

- **aOCT** anatomic Optical Coherence Tomography
- **AHI** Apnea Hypopnea Index
- **AI** Apnea Index
- **CPAP** Continuous Positive Airway Pressure
- **CSA** Cross-sectional area
- **CT** Computed Tomography
- **ECG** Electro Cardio Graphy
- **EDS** Excessive Daytime Sleepiness
- **EEG** Electroencephalogram
- **FLASH** Fast low-angle shot
- **IL-6** Interleukin-6
- **MRI** Magnetic Resonance Imaging
- **OCT** Optical Coherence Tomography
- **OSA** Obstructive sleep apnea
- **OSAS** Obstructive Sleep Apnea Syndrome
- **PAS** Posterior airway space
- **PSG** Polysomnography
- **REM** Rapid eye movement
- **TNF**-a Tumor necrosis factor-a
- **UPPP** Uvulopalatopharyngoplasty
- **VE** Virtual Endoscopy
- **3 D** 3 Dimensional

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Introduction

In obstructive sleep apnea (OSA) there is a continuing respiratory effort despite cessation of airflow at the level of the mouth and nostrils at least 10 seconds during sleep due to the collapse of the pharyngeal airway and considered pathological if obstructive episodes occur more than 5 times per hour sleep. Any condition causing narrowing of the upper airway may lead to obstructive sleep apnea. **(Pringle and Croft, 1993**)

Twenty four percent of healthy middle aged men and 9% of healthy middle aged women have evidence of obstructive sleep apnea, however 4% of men and 2% of women are symptomatic and have the syndrome. **(Young et al, 1993)**

OSA is a complex disorder of abnormal airway control during sleep caused by disordered pharyngeal muscle dilation tone and decreased airway size. OSA patients have either localized or diffuse airway collapse at the oropharynx and or hypopharynx. OSA is associated with increased mortality related to cardiovascular events in untreated patients (**Partinen et al, 1988**).

Surgical treatment should target at the suspected site. Nasal surgery is helpful in only a small percentage of patients. Palatal surgery such as uvulopalatopharyngoplasty (UPPP) has been shown to have less than 20% success rate in unselected patients and up to 50% for carefully selected patients (**Doghramji et al, 1995**).

The identification of the sites of upper airway (UA) obstruction in patients with obstructive sleep apnea is the cornerstone in choosing the appropriate surgical intervention. **(Hudgel et al, 1991)**

Detection of the sites of upper airway obstruction have been attempted by a variety of techniques including:

1- Acoustic reflection.

Acoustic reflection is a noninvasive technique based on analyzing reflected sound waves from the respiratory system, which provides a calculation of the upper airway area as a function of distance from the incisors. **(Bradley et al, 1986)**

2- Fluoroscopy.

Fluoroscopy has been used to study upper airway closure during sleep in patients with sleep apnea and has demonstrated that in most patients airway closure occurs in the retropalatal region. **(Katsantonis and Walsh, 1986)**

3- Cephalometry.

Cephalometry is a standardized lateral radiograph of the head and neck examining upper airway bony and soft tissue structure. **(Bacon et al. 1990)**

4- Nasendoscopy.

Nasendoscopy is a widely available technique commonly performed by otorhinolaryngologists to evaluate the nasal passages, oropharynx, and vocal cords. **(pringle and Croft, 1993)**

5- Computed Tomography (CT).

Computed Tomography provides excellent imaging of the airway, soft tissue, and bony structures from the nasopharynx to larynx. **(Burger et al, 1992).**

6- Catheters.

Catheters positioned in the upper airway can measure pressure differences during an apnea to localize the sites of obstruction. **(Shepard and Thawley, 1990)**

7- Magnetic Resonance Imaging (MRI).

MRI is useful for imaging patients with obstructive apnea because it provides excellent upper airway and soft tissue resolution including adipose tissue. **(Abbey et al, 1989)**

Since each particular technique has its unique advantages and disadvantages, no single method considered as the standard investigation of obstructive sleep apnea patients.

Aim of the work

The aim of this study is to analyze and compare between each of the above-mentioned techniques as regards advantages and disadvantages in detection of the level of obstruction in obstructive sleep apnea patients.

Chapter I

Obstructive Sleep Apnea Syndrome (OSAS)

Obstructive sleep Apnea syndrome history:

Since **1980s**, sleep disorders (and especially obstructive sleep apnea) have become well recognized. Numerous articles have been written in otolaryngology as well as in the pediatrics and internal medicine. Obstructive sleep apnea (OSA) was well described in the classic syndrome (obesity, hypersomnolence) in Charles Dickens' classic work the Pickwick papers. (**Koopmann and Moran, 1990**)

In **1889 William Hill** also described this syndrome as his following statements illustrates:" The stupid looking lazy kid who frequently suffers from headaches at school, breathes through his mouth instead of his nose, snores and is restless at night, and wakes up with a dry mouth in the morning, is well worthy of the solicitous attention of the school medical officer.

In 1957 a classic description of the electroencephalogram (EEG) in eye movement patterns of overnight sleep in humans using the term rapid eye movement (REM) sleep in describing the cyclic nature of REM and non REM sleep have been published. **(Dement and Kleitman, 1957)**

In 1959 Cole and Alexander described the relationship between obesity, chronic hypoventilation and pulmonary hypertension.

In **1965 Menashe et al** described cor pulmonale secondary to obstructive tonsil and adenoid. In the same year **Gastaut and his associates** began to classify sleep induced apnea syndrome based upon the respiratory pattern seen during sleep.

In 1973, Sleep apnea as a syndrome was first described by Guilleminault et al. **(Guilleminault et al, 1973)**

Studies on unmatched normal subjects established an apparent narrow band of normality for numbers of apneas per hour of sleep, and the originally definition of sleep apnea (>٥/h of >١٠ seconds apneas) became internationally accepted. **(Kryger et al, 1989)**

Important definitions:

Primary snoring

Patients who snore, but are not found to have apneas, hypoventilation or excessive arousals from sleep on polysomnography, have been called primary snorers.

2-Obstructive hypopneas

In an obstructive hypopnea the airflow is reduced at the level of the mouth and nostrils despite breathing effort.

3-Obstructive hypoventilation

In children hypopneas often account for the main part of obstructive event; obstructive events are often periods of partial air way obstruction and prolonged hypoventilation instead of clear-cut apneas.

4-Centeral apneas

A central apnea diagnosed when there is a lack of breathing effort concomitant with loss gas exchange.

5-Mixed apneas

A mixed apnea begins with a central apnea proceeding with an obstructive component. Mixed apneas are usually included in the category of obstructive apneas.

6-Desaturation

A decrease in the blood oxygen level, desaturation may follow all types of apnea

(Guilleminault et al, 1996)