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OBSTRUCTIVE SLEEP APNEA

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SUMMARY
Obstructive sleep apnea (OSA) is a disabling disorder that leads to life-threatening cardio-pulmonary events during sleep. It is the most common form of respiratory failure during sleep and is a multi system disorder involving metabolic,respiratory and mental abnormalities. The present paper reports the medical aspects of the syndrome and reviews the literature.

Key Words: Obstructive Sleep Apnea, Pickwickian Syndrome.

INTRODUCTION
The association of excessive sleepiness and respiratory failure in obese patients was recognized and termed as "Pickwickian Syndrome" in 19th century. During the past 30 years it is understood that sleep has major effects on breathing patterns. During the past 15 years investigations on breathing during sleep have led to a better understanding of the importance of respiratory muscles and thorax and upper airway in allowing adequate gas exchange during sleep (1).

Obstructive sleep apnea is a disabling disorder that leads to life-threatening cardio-respiratory events during sleep. It is the most common form of respiratory failure during sleep and is a multi system disorder involving metabolic, respiratory and mental abnormalities. This disorder characterized by recurrent episodes of cessation of breathing despite a continuation of thoraco-abdominal respiratory affects.

Etiology: Obstructive sleep apnea occurs because of occlusion of the upper airway during sleep. Usually the site of upper airway occlusion is the pharyngeal region. The activity of upper airway muscles is often depressed in sleep and this is one factor which plays a role in the increased air flow in the upper airways that normally occurs during sleep. This suggests that obstructive sleep apnea occurs through an imbalance in activity of the upper airway and the chest wall (1).

In etiology, obesity plays a major role and weight reduction is shown to improve OSA. Whereas this improvement is associated with increase in pharyngeal areas, sectional area and a reduced tendency of the pharynx to collapse at low lung volumes.

Although women are more overweight than men males prodominate among patients with OSA (10:1 - 24:1). In obese men, there is a decrease in total testesterone level. However a compensatory decrease in sex hormone binding also occurs. Therefore free concentrations of testesterone remains normal. Overweight men with symptomatic OSA have significantly higher pharyngeal inspiratory air flow resistance.

Benzodiazapines of hypnotic doses do not induce sleep related disturbances however alcohol worsens breating disturbances in sleep.

The low incidence of sleep-disordered breathing among pre-menopausal women and increased incidence of sleep-disordered breathing among post-menopausal women has focused increased interest on progestational hormones and their role in the sleep apnea syndrome. It has been postulated that progestational hormones are protective against sleep-disordered breathing and nocturnal oxygen desaturation (2).

Pathogenesis: Sleep itself induces a number of physiologic changes that significantly alter respiration. These changes are determined by the physiologic changes associated with rapid eye movement (REM) and non-rapid eye (NREM) movement sleep. NREM sleep is associated with a decrease in respiratory rate and a slight decrease in alveolar ventilation. During NREM sleep the carbondioxide curve is slightly depressed. REM sleep represents a period of considerable physiologic turbulance. The respiratory and cardiac rates become more variable, the ECG shows an activated pattern, brain O_2 consumption is increased and ventilation appears to be significantly altered. Probability of upper airway obstruction during REM sleep appears to be high (3).

The combined chemical stimulation resulting from hypoxia and hypercapnia produces an arousing stimulus. These arousal responses are markedly decreased during REM sleep.

Oropharyngeal patency during sleep is dependent on the dilating force of genioglossus, the main tongue

protrusion muscle. Its action appears to overcome the negative pressure generated by the chest wall muscle (4).

Slight protrusion of tongue maintain airway patency during inspiration. Individuals with OSA have impaired genioglossal function, allowing the prolapse of tongue against the posterior pharyngeal wall with inspiratory effort during sleep (3). In another hypothesis it is claimed that there is a decrease in respiratory neural drive prior to the unset of airway occlusion (5,6). The precise timing of muscular activation of the upper airway is crucial to normal respiratory function (1).

According to another theory airway occlusion occurs when pharyngeal negative inspiratory pressure exceeds the dilating forces of the upper airway muscles (7).

Nasal airway plays an important role in airway occlusion. Nasal obstruction results in increased resistance to airflow, which, in turn results in increased respiratory effort and greater suction pressure (8). There is marked improvement in patients with OSA after septoplasty for a deviated nasal septum (9).

Especially in children polysomnographic studies show that adenoid-tonsillar hypertrophy causes a respiratory disturbance during sleep. Hypocapnia can produce apnea during sleep. The same degree of hypocapnia fails to cause apnea either during wakefulness or REM sleep.

Clinic: The relative incidence of the syndrome in a healthy population is between 1-4% (10). Humans of all ages and either sex without evident disease may exhibit obstructive or central apneas at sleep onset or during periods of REM sleep. However apneic episodes are generally less than 15 seconds and not repetitive. The maximum frequency of apneas observed in young healthy subjects is approximately 8 per hour of sleep (11,12).

In the sleep apnea syndrome, both sleep and respiration are disturbed. The patient who has clinically obvious sleep apnea will have apneas that last more than 15 seconds, are repetitive and associated with dramatic reduction in arterial O_2 saturation (1).

The most common complaints are excessive day time sleepiness, irritability and/or depresson and snoring (3) (Table I).

Table I. Clinical features of Sleep Apnea Syndrome

Symptoms
—snoring
—excessive day time sleepiness
—intellectual deterioration
—personality changes
—morning headaches
—hallucinations, automatic behaviour
—dyspnea (especially in exercise)

Signs
—reduced sleep latency by EEG
—obesity
—cardiac arrythmias
—pulmonary hypertension
—polycythemia
—hypertension
—edema

Disease expression in the individual may be related to a combination of four factors (13) (Table II).

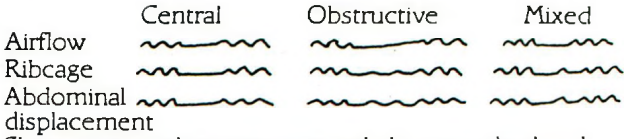
Table II. Factors related to disease expression in the individual
1- Characteristic of gas exchange
2- The arousal thresholds
3- The pattern of respiratory disturbance
4- The age

Snoring in early life leads to the insidious development of the hypersomnolance and cardiovascular disease which are present in adult patients with obstructive sleep apnea (14).

Pulmonary hypertension is not a rule in sleep apnea syndrome patients (15). But in cystic fibrosis, patients with severe airflow obstruction and day time hypoxemia undergo marked sleep-related oxygen desaturation (16). Sleep related disorders are more common in elderly and especially in demented subjects (17-20).

DIAGNOSIS In 1966 airway occlusion during sleep was described in obese patients with day time somnolesce and snoring (18). Sleep apnea can be classified as central, obstructive and mixed. Differantial diagnosis between them are of essential importance for evoluation and treatment of the patient. In each of them airflow through the nose and mouth are absent indicating apnea. In central apnea respiratory effort (rib cage and abdominal displacement) are absent. During an obstructive apnea efforts by the chest wall muscles are present throughout the entire episode of apnea (Fig 1).

Fig I. Diaphragmatic form of 3 patterns of apnea



Sleep sonography is an easy and cheap method and it may become the most commonly employed method to detect the irregularity of respiration during sleep (21). Abnormal breath sounds were detectable on auscultation over the upper airway in 55% of patients with OSA (22).

In patients with repeated OSA, a respiratory sleep study that measures only arterial O_2 saturation and indices of the ventilation will provide a definitive diagnosis in about two-third of patients (19).

Cine CT provides a rapid, non-invasive and simple means of diagnosis and imaging the patho-physiology of non-fixed upper airway diseases (23). In determination of the obstructive site in obstructive sleep apnea combination of fiberoptic pharyngoscopic examination in conjunction with the cine CT scanning provides more useful information (24).

Sleep monitoring consists of simultaneous recording of numerous physiologic variables. The electroencephologram, the electro-oculogram and electromyogram are necessary to determine the sleep stages. The cardio-pulmonary measures recorded are airflow at the nose and mouth, throcic breathing movement, oxygen saturation via ear oximetry and electrocardiographic activity (Table III).

Table III. Parametres that are recorded in polysomnography
—electroencephologram
—electrooculogram
—electromyogram
—air flow at the nose and mouth
—throcic breathing movements
—oxygen saturation
—ECG

Although average duration is approxiamately 25-30 sec, it is not uncommon for arterial oxygen partial pressure to drop into 20 secs during episodes of obstructive apneas. In diagnosing sleep apnea a team work of a sleep physiologist, an otolaryngologist, a pulmonologist and a neurologist is needed (3).

In polysomnography, first four hour testing results in sleep are exactly the same with all night testing (25).

TREATMENT Simple measures like withdrowing of potential depressants such as antihistaminics or alcohol are sometimes effective in the treatment of OSA (26). Sleep apnea can be an early manifestation of some diseases like hypothyroidism and in this case treatment of the related disease can resolve the symptoms of OSA (27). Tracheostomy, nasal CPAP, and nocturnal O_2 administration have been the most commonly used treatment modalities for sleep apnea since its first definition (1).

a) Medical Treatment:
1- Weight loss: 60-70% of patients with OSA syndrome are obese who are defined as having body weight greater than 120% of predicted value. Even 5-10% decrease in body weight in some obese subjects can be accompanied by clinical and objective remission of sleep apnea syndrome. The improvement in symptoms is associated with an increase in pharyngeal crosssectional area and a reduced tendency of the pharynx to collapse at low lung volumes.

2- Medication: It is shown that progesterone preparations decrease the frequency of apneas with an unknown mechanism. Acetozolamide which increases breathing by causing a metabolic acidosis, is used in central apneas (28). Nicotine decreases the total number of apneas during sleep and reduces total time spent in apnea by increasing the activity of upper airway muscles over that of the chest wall muscle (29). Strychine which is a glycine antagonist reduces the duration and number of obstructive apneas (30). Tricyclic antidepressants have been used in theraphy of obstructive apneas because of their pharmacologic action in supressing REM sleep (31). Aminophylline in moderately severe OSA reduces the frequency of central or mixed apneas but does not alter the frequency or duration of obstructive apnea. Theophyline is widely used in the treatment of apnea of prematurity (32). Caffeine is an effective alternative to theophyline in the treatment of infants with persistant apnea of prematurity (33).

3- CPAP: Continuous nasal pressure applied to nose is effective in long term treatment of OSA (30). At low pressures, apneas; at high pressures, snoring disappears. Symptoms always reappear if CPAP is withdrowing completely. Today a compact, portable pressure sensing system was developed for home monitoring of patients with OSA treated with CPAP (34). Using external subatmospheric pressure apparatus with CPAP decreased desaturation during apneas but did not decrease the number of duration of apneas (35). There is no known contraindication of nasal CPAP theraphy.

4- Nocturnal O_2 Theraphy: It is claimed that oxygen prolonged apnea resulting in acute respiratory acidosis (36). However in other studies patients respond to chronic nocturnal administration. Chronic nocturnal O_2 administration in patients with sleep apnea results in a consistant improvement in oxyhemoglobin saturation during sleep and a small but consistant reduction in apnea frequency (37-38).

b) Surgical Treatment
1- Tracheostomy: Tracheostomy was first shown in the 1960's to eliminate most of the respiratory disturbances of sleep apnea by by-passing the site of obstruction (1). Tracheostomy is most effective in the treatment of obstructive and mixed apneas and their hypoxic complications (11). Tracheostomy is not well tolarated by many patients since it can effect the speech, exercise and social interraction of the subject (39). In patients with severe cardiac arrythmias, disabling day time sleepiness, progressive hypertension or failure to respond other treatments, tracheostomy becomes necessary (40).

2- Other Surgical Measures: Although tracheostomy has been viewed traditionally as the definite treatment

for OSA patient. tonsillectomy. adenoidectomy. septoplasty have all been employed in management of the syndrome (41). It is shown that in children tonsillectomy performed electively for sleep apnea decreases the frequencies of apneas (42). Recently a surgical procedure to treat obstructive sleep apnea by removing excessive tissues in oropharynx has been performed. It is called uvulapalotopharyngoplasty (UPPP). The UPPP is designed to relieve oropharyngeal obstruction by excising redundant soft tissues that involve the free margin of the soft palate. uvula and posterior lateral pharyngeal lateral wall. During UPPP procedure the tonsils if present are excised and excessive tissue along posterior pillar is removed (43).

However in some studies it has been found that 85% of patients are unresponsive to this procedure (44). UPPP has a reasonable chance of benefit in patients who are not extremely over-weight. Patients weighing more than 90 kg. have poorer results (45). In another study it was shown that snoring alone was completely recovered and there was 47% complete cure (46). Complications of this procedure are speech and swallowing difficulties, bleeding, infection, nasal regurgitation (47). Recently new surgical procedures like expansion hyoidplasty or mandibular osteotomy have been tried in a small number of patients (48).

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