Obstructive Sleep Apnea: Relationship of Some Clinical Parameters to Severity of the Disease

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Abstract

Background: Although essential before surgery, in-lab polysomnography and in-hospital sleep studies cannot be done indiscriminately for all patients with potential diagnosis of obstructive sleep apnea (OSA). Some clinical parameters may be used to select patients for these studies, thus increasing their cost-effectiveness.

Objective: Studying the relationship of body mass index (BMI), modified Mallampati index (MMI), tonsil size and thyroid-mental distance (TMD) to the grade of OSA.

Study Setting: Tertiary referral hospital.

Patients and Methods: Thirty consecutive patients (20 men and 10 women) in the age range of 30 to 60 years with snoring for at least 3 months and observed cessation of respiration during sleep were included. SAMTM monitor (Intercare Technologies, Inc, Milwaukee, WI) was used for an eight-hour in-hospital sleep study.

Results: There was a statistically significant relationship between BMI, MMI and tonsil grade and the grade of OSA ($p=0.01$, $p=0.036$, $p=0.05$ respectively). No statistically significant relationship was found between TMD and grade of OSA ($p=0.456$).

Conclusion: In patients with potential diagnosis of OSA, BMI, MMI and tonsil size grade are helpful in selecting patients for in-hospital sleep studies.

Key Words: Sleep apnea – Obstructive – Diagnosis.

Introduction

COST-EFFECTIVENESS of in-hospital sleep studies has been questioned when they are indiscriminately used in all patients with potential diagnosis of obstructive sleep apnea (OSA) [1]. Beside the standard polysomnography, many commercially available portable sleep monitors are used to determine the severity of OSA. They are becoming more widely accepted and validated [2].

Outpatient surgeries as laser assisted uvulopalatoplasty and palatal radiofrequency ablation are more suitable for patients with mild to moderate OSA [3,4]. Moreover, the classic uvulopalatopharyngoplasty (UPPP) when performed on unselected group of patients with OSA has only around 50% success rate in reducing the apnea index [5]. For these surgeries to be successful, they should only be done in patient with significant retro-palatal obstruction [6]. Therefore, assessing the severity of apnea and the site of obstruction is essential before all types of surgery [7].

Increased body weight and certain head and neck features may provide the physician with clues to the probability OSA and its degree. Modified Mallampati index (MMI) and tonsil size have been used to grade oropharyngeal crowding [8]. Thyroid-mental distance (TMD) is used by anesthesiologists to predict difficulty of endotracheal (ET) intubation and it has been studied in patients with OSA [9,10]. These parameters are the subject of this study. Their relationship with grade of OSA is studied.

Patients and Methods

This study was done in Suez Canal University hospital in the period of 1st of October 2006 to 30th May 2007. Thirty consecutive patients (20 men and 10 women) in the age range of 30 to 60 years with snoring and observed cessation of respiration during sleep for at least 3 months (as reported by bed partner) were included.

Patients with chronic nasal obstruction, craniofacial anomalies (e.g. retrognathia or micrognathia), patients with cardiac, respiratory or thyroid disease
and patients with previous oropharyngeal surgery were excluded from the study.

Patients were asked to attend the study with their partners if available. Medical history and sleep habits were investigated. The history covered: Snoring, apneic episodes during sleep, restless sleep, choking during sleep, morning headaches, daytime somnolence, memory impairment, nervousness, personality changes, anxiety, depression, enuresis, impotence and loss of libido.

The weight and height of the patients were recorded and the BMI was calculated using the formula \( \text{BMI} = \frac{\text{Weight (kg)}}{\text{height (m}^2)} \). The obesity was graded as follows:
- Grade 0 (underweight) : <20 \( \text{kg/m}^2 \)
- Grade 1 (normal) : 21-25\( \text{kg/m}^2 \)
- Grade 2 (overweight) : 26-30\( \text{kg/m}^2 \)
- Grade 3 (obese) : 31-40\( \text{kg/m}^2 \)
- Grade 4 (severely obese) : <40\( \text{kg/m}^2 \).

MMI was determined by asking the patients to widely open the mouth with the tongue left in its place at rest. MMI was graded as follows:
- Grade 1: Tonsils, pillars and soft palate visible.
- Grade 2: Uvula, pillars visible.
- Grade 3: Only part of the soft palate visible.
- Grade 4: Only the hard palate visible.

Tonsils also were evaluated and graded as follows:
- Grade 0: No tonsilar tissue visible (or tonsillectomy).
- Grade 1: Tonsils hardly visible behind the anterior pillars.
- Grade 2: Tonsils clearly visible behind the anterior pillars.
- Grade 3: Tonsillar tissue protruding in the oropharynx.
- Grade 4: tonsils obstructing the oropharyngeal aperture.

TMD was measured with the head in the upright seated position at the end or expiratory phase and without swallowing. A right angle caliper was used to measure the vertical and horizontal distance between the thyroid notch and the mental prominence. The TMD was the hypotenuse of the right-angle triangle thus formed. Two categories were defined: Patients with TMD \( \leq 60\) mm and patients with TMD >60\( \) mm.

The SAMTM monitor (Intercare Technologies, Inc, Milwaukee, WI) was used for sleep study. The patient was admitted overnight. The monitor was carried to his room and sensors were connected. A gauge sensitive to stretching was applied around the chest at the level of xiphisternum to quantify respiratory effort. Airflow sensor was fixed below the nose with a headgear. Pulse-oximeter was used on the left thumb to monitor pulse rate and oxygen saturation.

The sleep partner or the nurse turned the monitor on when the patient fell asleep and they turned it off if the patient woke up at any time. In the morning, the monitor was taken to the computer room and the stored data were downloaded.

Apnea was defined as cessation of airflow for at least 10 seconds. Apnea index (AI) indicating number of apneic spells per hour of sleep was calculated. An AI of 5-20 indicated mild OSA, 21-40 moderate OSA and over 40 severe OSA. Relationship of OSA grade with MMI, tonsillar size, obesity grades and TMD was studied using chi square and Fisher’s exact tests. The statistical significance was set at 5%.

**Results**

The study included 20 men (66.5%) and 10 women (33.5%). The age ranged from 30 to 60 years with mean of 45.5 years. Twenty-one patients (70%) were above 40 years. Table (1) shows the symptoms prevalence in the study group. All patients (100%) had loud snoring, choking during sleep and daytime sleepiness.

<table>
<thead>
<tr>
<th>Table (1): Prevalence of symptoms in the study group.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Symptom</strong></td>
<td><strong>No.</strong></td>
<td><strong>%</strong></td>
</tr>
<tr>
<td>Loud snoring</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>Choking during sleep</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>Daytime sleepiness</td>
<td>30</td>
<td>100</td>
</tr>
<tr>
<td>Short temper</td>
<td>8</td>
<td>26.7</td>
</tr>
<tr>
<td>Morning headache</td>
<td>5</td>
<td>16.7</td>
</tr>
<tr>
<td>Anxiety/depression</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>Memory impairment</td>
<td>2</td>
<td>6.7</td>
</tr>
</tbody>
</table>

MMI and tonsil size grades in the study group are shown in Tables (2,3). Twenty-eight patients (93%) had MMI grade 3 and 4. Twenty two patients (73%) had tonsil size grade 2 and 3. Non of patients had grade 4 tonsil size. The BMI of the study group ranged from 24.3 to 72.3\( \text{kg/m}^2 \) (mean 39.1±8.9\( \text{kg/m}^2 \)). Twenty-three patients (76.5%) were obese or severely obese (Table 4). The TMD ranged from 31 mm to 89 mm (mean=62±16 mm) (Table 5).

The AI ranged from 12 to 79 with a mean of 34.5 (±17.4). Eighteen patients (60%) had mild to
moderate OSA and 12 patients (40%) had severe OSA. There was a statistically significant relationship between BMI, MMI and tonsil grade and the grade of OSA \((p=0.01, p=0.036, p=0.05\) respectively). The higher the BMI, MMI and the tonsil size, the higher the grade of OSA. No statistically significant relationship was found between TMD and grade of OSA \((p=0.456)\).

<table>
<thead>
<tr>
<th>Grade of apnea</th>
<th>MMI Grade II</th>
<th>MMI Grade III</th>
<th>MMI Grade IV</th>
<th>No. of pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild &amp; Moderate</td>
<td>2</td>
<td>15</td>
<td>1</td>
<td>18</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>7</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>No. of pts</td>
<td>2</td>
<td>22</td>
<td>6</td>
<td>30</td>
</tr>
</tbody>
</table>

Table (2): MMI grades and their correlation with the severity of apnea.

<table>
<thead>
<tr>
<th>Grade of apnea</th>
<th>Tonsil Grade 0</th>
<th>Tonsil Grade I</th>
<th>Tonsil Grade II</th>
<th>Tonsil Grade III</th>
<th>No. of pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild &amp; Moderate</td>
<td>0</td>
<td>7</td>
<td>10</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Severe</td>
<td>1</td>
<td>0</td>
<td>7</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td>No. of pts</td>
<td>1</td>
<td>7</td>
<td>17</td>
<td>5</td>
<td>30</td>
</tr>
</tbody>
</table>

Table (3): Tonsil grades and their correlation with the severity of apnea.

<table>
<thead>
<tr>
<th>Grade of apnea</th>
<th>Obesity Normal</th>
<th>Obesity Over-weight</th>
<th>Obesity Obese</th>
<th>Severely Obese</th>
<th>No. of pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild &amp; Moderate</td>
<td>3</td>
<td>3</td>
<td>8</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>Severe</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>No. of pts</td>
<td>3</td>
<td>4</td>
<td>9</td>
<td>14</td>
<td>30</td>
</tr>
</tbody>
</table>

Table (4): Obesity grades and their correlation with the severity of apnea.

<table>
<thead>
<tr>
<th>Grade of apnea</th>
<th>TMD &lt;60mm</th>
<th>TMD &gt;60mm</th>
<th>No. of pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild &amp; Moderate</td>
<td>10</td>
<td>8</td>
<td>18</td>
</tr>
<tr>
<td>Severe</td>
<td>5</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>No. of pts</td>
<td>15</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

Table (5): Thyroid-mental distance and their correlation with the severity of apnea.

Discussion

Relationship of the anatomic parameters with the severity of OSA has been reported previously [10]. These parameters can be used to increase the cost effectiveness of in-hospital sleep studies in patients with potential diagnosis of OSA. Alternatively, Muller maneuver was used to determine the degree of collapse at various levels in the upper airway. The pattern and degree of collapse observed during this maneuver is however, subjective and it depends on the patient’s effort and impression of the examiner [11].

Cephalometry has been studied in patients with OSA. It is not a familiar technique and it is difficult to analyze by the common clinician involved in the diagnosis and treatment of OSA [12]. However, it is of value in patients with craniofacial anomalies and before maxillo-mandibular surgery [13].

In our study, we found a statistically significant relationship between the grade of obesity and OSA grade. This has been reported previously [7]. Although a high BMI is not a prerequisite for OSA, it is the combination of obesity with other factors that leads ultimately to upper airway obstruction during sleep [14,15].

MMI is used by anesthesiologists to predict difficult ET intubation. Oropharyngeal exposure while the patient is opening his mouth gives an idea on the interrelated anatomical factors governing the path of ET tube. It is generally believed that patients with OSA are at risk of difficult ET intubation. Similarly, patients who are difficult to intubate are likely to suffer from OSA [10]. In this study, MMI was found to correlate with AI. Similarly, Erdamar et al. [8] found that MMI correlates with the severity of OSA and postoperative improvement of AI.

TMD correlates with difficult ET intubation. El-Ganzouri et al. [16] Inferior displacement of hyoid bone was found to correlate with severity of OSA in cephalometric studies [17]. In our study, we did not however, find a statistically significant relationship between the TMD and the AL. Friedman et al., (1999) reported the same result [10].

From Tables (2,3,4), it is evident that these clinical parameter (MMI, tonsil size grades and Obesity grades) can only be used to distinguish between mild-moderate and severe apnea. This is still helpful in choosing the type of surgery for OSA Although the efficacy of LAUP is variable, depending of the definition of postoperative improvement (e.g. 50% reduction of AI), it seems logical to limit this operation for mild and moderate OSA. UPPP can be reserved for patients with severe OSA [3].

We conclude that in patients with potential diagnosis of OSA, BMI, MMI and tonsil size grade are helpful in selecting patients for in-hospital sleep studies.
References


