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The Correlation of Physical Parameters and Apnea-Hypopnea Index in OSA Suspected Thai Patients

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Abstract

Most Asian countries have limited resources for polysomnography. Risk factors for Obstructive Sleep Apnea (OSA) in Asian populations may be different from the Western countries. Knowing the physical risk factors for OSA may be a helpful tool for clinicians to select suitable patients to be tested for OSA. We enrolled consecutive OSA-suspected patients between October 1st, 2006 and September 30th, 2007. Physical factors including Body Mass Index (BMI), Neck Circumference (NC), and Waist Circumference (WC) were recorded. The correlations of BMI, NC, WC and Apnea-Hypopnea Index (AHI) were executed. Various cut points of BMI, NC, and WC were calculated for sensitivity and specificity of severity of OSA. During the study period, there were 66 patients enrolled. All three parameters (BMI, NC, and WC) were significantly correlated with AHI. The highest correlation index was between BMI and AHI (0.604), whereas the correlation index of AHI-WC and AHI-NC were 0.571 and 0.440, respectively. Only BMI and WC, but not NC, were significantly related to severity of OSA. The BMI of more than 25 kg/m^2 had the highest sensitivity (93.8%) for severe OSA, whereas WC more than 101.8 cm had the highest specificity (92%). In conclusion, BMI, WC, and NC are correlated with AHI in OSA suspected Thai patients. BMI and WC, but not NC, were associated with severity of OSA. In resource-limited facilities, these parameters may be helpful for clinicians to evaluate the risk of OSA more appropriately.

Keywords: Body mass index; Waist circumference; Neck circumference; Association; Obstructive sleep apnea; Severity

Introduction

Obstructive Sleep Apnea (OSA) is defined as Apnea-Hypopnea Index (AHI) more than 5 times/hour by polysomnography. The prevalence of OSA is 4% in males and 2% in females of general population [1-3]. It is a strong risk factor for hypertension, coronary artery disease, and stroke [4-6]. However, OSA is under diagnosed and neglected in clinical practice [7] particularly in Southeast Asian countries where healthcare resources are limited.

Common risk factors of OSA include older age, male gender, obesity, craniofacial anomalies, and particular diseases such as hypothyroidism. Among those risk factors, obesity is the major risk factor in the Western countries. Neck Circumference (NC) more than 43 cm is related with severity of OSA in American patients. The sensitivity and specificity of this cut point are 67% and 83%, respectively [3]. Data for these physical factors and OSA is still limited in Southeast Asian populations. We evaluated the correlation of various physical factors and OSA in Thai patients that would be clinically helpful for selecting patients to perform polysomnography in a resource-limited setting.

Materials and Methods

We enrolled consecutive patients (age 25-60 years) with history of snoring or suspected of OSA at Department of Otolaryngology, Faculty of Medicine, Chiang Mai University between October 1st, 2006 and September 30th, 2007. The exclusion criteria were patients with craniofacial anomalies or one of the following diseases: hypothyroidism, acromegaly, vocal cord paralysis, post-polio syndrome, neuromuscular disorders, Marfan's syndrome, Down syndrome, Pierre-Robin syndrome, and amyloidosis.

All eligible patients were tested with Somnocheck® V2.04 and recorded for baseline characteristics, Body Mass Index (BMI), NC, and Waist Circumference (WC). OSA was defined if the AHI was more than 5 times/hour. The severity of OSA was classified by AHI as mild (AHI 5-14.9 times/hour), moderate (AHI 15-29.9 times/hour), and severe (AHI>30 times/hour), respectively. The Somnocheck® device has been shown to be highly correlated with polysomnography (r = 0.98) [8].

NC and WC were measured by the same physician and tape throughout the study period. The landmark for NC and WC were upper border of cricothyroid membrane of each patient in sitting position and umbilical line, respectively. The study protocol was approved by the institute review board of Chiang Mai University and all patients signed informed consent prior to the study participation.

Statistical analysis

The correlation of BMI, NC, WC and AHI were executed by Pearson correlation coefficient and Fisher Exact test. Various cut points of BMI, NC, and WC were calculated for sensitivity and specificity of severity of OSA.

Results

During the study period, there were 66 patients met the study criteria. The mean (S.D.) age of all patients was 51.4 (8.2) years. Of those,

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48 patients (72.7%) were male and had at least one underlying diseases. The most three common underlying diseases were hypertension (23 patients, 34.9%), dyslipidemia (21 patients, 31.4%), and allergic rhinitis (10 patients, 15.1%), respectively. Abnormal physical signs were found in 55 patients (83.7%). The most three common anatomical findings were redundant soft palate (46 patients, 69.8%), long uvula (27 patients, 40.7%), and enlarged tonsils (12 patients, 18.6%), respectively.

According to the Asian classification of obesity, 9 patients (13.6%), 11 patients (16.7%), 32 patients (48.5%), and 14 patients (21.2%) were classified as normal, overweight, obesity class 1, and obesity class 2, respectively. The mean (S.D.) of NC and WC were 38.8 (3.2) cm and 91.6 (11.6) cm, respectively.

There were 58 patients (87.9%) with AHI more than 5 times/hour. Of those, 25 patients (37.9%) had mild OSA, while 17 patients (25.8%) and 16 patients (24.2%) had moderate and severe OSA, respectively.

All three parameters (BMI, NC, and WC) were significantly correlated with AHI by Pearson correlation method. The highest correlation index was between BMI and AHI (0.604), whereas the correlation index of AHI-WC and AHI-NC were 0.571 and 0.440, respectively.

We categorized all patients and severity of OSA by level of BMI, WC, and NC (Tables 1-3). Only level of BMI and WC were statistically correlated with severity of OSA (p value < 0.05). All patients with BMI more than 30 kg/m^2 had AHI more than 5 times/hour (Table 1). Patients with WC less than 75.5 cm were not severe OSA, while patients with WC more than 101.8 cm were moderate or severe OSA (Table 2). Level of NC was not statistically related with level of AHI (Table 3).

The BMI of more than 25 kg/m^2 had the highest sensitivity for severe OSA, whereas WC more than 101.8 cm had the highest specificity (Table 4).

Discussion

This study showed that BMI, WC, and NC were all statistically correlated with AHI but only BMI and WC were statistically related with severity of OSA in the Thai population.

BMI, WC, and NC are parameters that associated with obesity. From the analysis, BMI was the factor that mostly correlated with AHI (correlation coefficient 0.604). Only nine patients (13.6%) had normal BMI. Of those, only one patient had severe OSA. This patient had enlarged tonsils (grade 3) that may enhance severity of OSA. For those patients with BMI more than 30 kg/m^2 with snoring or symptoms of OSA, all of them had OSA. The BMI cut point of 25 kg/m^2 had sensitivity of 93.8% for severe OSA. Therefore, Thai patients with snoring or symptoms of OSA had BMI more than 25 kg/m^2, the likelihood of having severe OSA is 93.8%. Previous report also showed that BMI was negatively related with night time desaturation in OSA patients [9].

BMI	AHI<5	AHI 5-14.9	AHI 15-29.9	AHI ≥ 30	Total
18.5-22.9	2	4	2	1	9
23.0-24.9	1	8	2	0	11
25.0-29.9	5	12	9	6	32
≥ 30	0	1	4	9	14
Total	8	25	17	16	66

Note. AHI: apnea-hypopnea index

Table 1: The correlation between Body Mass Index (BMI) and severity of obstructive sleep apnea (p value < 0.05).

AHI (Events / Hr.) / WC (cm)	AHI<5	AHI 5-14.9	AHI 15-29.9	AHI ≥ 30	Total
62.5-75.5	3	4	1	0	8
75.6-88.6	2	7	4	2	15
88.7-101.7	3	14	8	7	32
≥ 101.8	0	0	4	7	11
Total	8	25	17	16	66

Note. AHI: Apnea-Hypopnea Index

Table 2: The correlation between Waist Circumference (WC) and severity of obstructive sleep apnea (p value < 0.05).

AHI (Events/Hr.) / NC (cm.)	AHI<5	AHI 5-14.9	AHI 15-29.9	AHI ≥ 30	Total
32.0 - 36.0	2	8	2	1	13
36.1 - 40.1	4	14	7	6	31
≥ 40.2	2	3	8	9	22
Total	8	25	17	16	66

Note. AHI: apnea-hypopnea index

Table 3: The correlation between Neck Circumference (NC) and severity of obstructive sleep apnea (p value>0.05).

Parameters	Sensitivity	Specificity
BMI>25 kg/m^2	93.8	38.0
WC>101.8 cm	43.8	92.0
NC>40.2 cm	56.3	74.0

Note. BMI: Body Mass Index; WC: Waist Circumference; NC: Neck Circumference

Table 4: Sensitivity and specificity of various parameters for severe OSA.

WC was also correlated with AHI and severity of OSA in OSA suspected Thai patients. All patients with WC more than 101.8 cm had moderate or severe OSA. This cut point had lower sensitivity but higher specificity for severe OSA compared to BMI. If one had WC more than 101.8 cm with snoring, the specificity for severe OSA is 92%.

Neck circumference more than 43 cm is related with severity of OSA in American patients. The sensitivity and specificity of this cut point are 67% and 83%, respectively [3]. Unlike a study from the Western country, NC was not significantly associated with severity of OSA in Thai patients. It also had the lowest correlation coefficient (0.440) compared to BMI and WC [3]. Previous studies showed that NC was the most significant factor correlated with severity of OSA and survival factor of stroke [10,11]. However, a study from Asia [12] did not find the correlation of NC and the severity of OSA similar to the present study. NC therefore may not be correlated with OSA severity in Asian population.

Even though BMI and WC were strongly correlated with severe OSA, the diagnosis of OSA is still needed to be confirmed by polysomnography. These results will be helpful for clinicians in facilities without polysomnography devices. Currently, there are very few hospitals that sleep study is available. It would be worthy to refer patients with snoring or symptoms of OSA who have BMI more than 25 kg/m^2 or WC more than 101.8 cm to sleep specialists. Another caution for our study is that we excluded patients with craniofacial anomalies and the diseases mentioned in the exclusion criteria. In other words, this study may not apply to OSA patients from anatomical abnormalities.

There are some limitations in the present study. Study variables were only physical parameters. Other factors such as symptoms of

OSA or complications of OSA were not included in the analysis as risk factors for OSA. Some factors however may not be valid such as daytime sleepiness symptoms, or unexplained nocturia. In contrast, physical parameters were measurable and can be used universally. Secondly, the statistical analyses showed only the correlation of physical factors and AHI but not as the independent factor for OSA. Further studies should be conducted in larger sample size and analyzed by advanced statistical method such as multiple logistic regression analysis.

Conclusion

BMI, WC, and NC are correlated with AHI in OSA suspected Thai patients. BMI and WC, but not NC, were predictors for severity of OSA. BMI is the most valuable parameter for the prediction of severe OSA. In resource limited facilities, these parameters may be helpful for clinicians to evaluate the risk of OSA more appropriately.

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