Correlation between predictors of obstructive sleep apnea in patient with sleep disturbance

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Abstract:

Study objectives: To compare the relative usefulness of the different predictors of obstructive sleep apnea (OSA), and to determine if a combination of these indices improves the prediction of OSA in comparison with the apnea-hypopnea index (AHI) measured by polysomnography in patient with sleep disturbance.

Design: Retrospective chart review

Interventions: body mass index (BMI), Berlin Questionnaire (BQ) and oxygen saturation were the different indices used to predict the possible diagnosis of OSA in patients presenting with sleep disturbance.

Participants: Patients who underwent polysomnography for suspicion of OSA.

Measurements and results: according to the AHI the patients were divided into four groups; negative, mild, moderate and severe. The BMI also in four groups normal ١٨.٥ – ٢٤.٩, overweight from ٢٥ – ٢٩.٩, obese ٣٠ -٣٤.٩ and above ٣٥ is extreme obesity. As for The BQ the patients where divided into low and high risk patients for OSA. The oxygen saturation results divided into two group's above ٨٨% and less than ٨٨%.

Conclusion: we propose a score of eight combining BMI, BQ and oxygen value with specificity of ٩٥% for OSA, this can help in the selection of patient with high priority for polysomnography.

Key Words: sleep disturbance, polysomnography, Berlin Questionnaire, oxygen saturation, body mass index, apnea hypopnea index.

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Introduction:

Obstructive sleep apnea hypopnea syndrome (OSAHS) is a sleep breathing disorder characterized by recurrent airflow obstruction caused by a total or partial collapse of the upper airway. (١).

Sleep-disturbance includes a broad range of symptoms, from slight snoring to severe cases of obstructive sleep apnea**.** Snoring and sleep apnea are common disorders that affect both men and women. Snoring is a sign of upper airway obstruction and obstructive sleep apnea (OSA), with excessive daytime sleepiness as the most prevalent symptom.(٢).

The obstructive sleep apnea (OSA) syndrome is a major health problem affecting ٢ to ٤% of the middle-aged population (٣). The recognition of sleep apnea as a health problem has grown in the community, and the number of subjects who seek medical help for problems with snoring and with concern about apnea and daytime sleepiness is increasing (٤). At present, polysomnography is considered the reference standard diagnostic test for this condition. However, long waiting times as well as the cost for polysomnography make primary care providers quite reluctant to order polysomnography. It is therefore

important to be able to better identify patients most likely to have significant OSA and thereby better focus the use of polysomnography. This study was designed to use a number of predictors to predict OSA in at-risk groups including demographics, questionnaires and overnight pulse oximetry.

Material and methods.

Subjects

The sleep records of one hundred twenty consecutive patients referred for overnight polysomnography to rule out OSA were reviewed for study.

Polysomnography

All patients underwent standard overnight polysomnography with recordings of EEG, electro-oculogram, submental and bilateral leg electromyograms, and ECG. Airflow was measured qualitatively by an oral-nasal thermistor and respiratory effort by thoracoabdominal piezoelectric belts. Measurement of arterial oxyhemoglobin saturation was performed with a pulse oximeter with the probe placed on the patient's finger. All signals were collected and digitized on a computerized polysomnography system.

Sleep stages were scored in ٣٠-s epochs using standard criteria. Each epoch was analyzed for the number of apneas, hypopneas, EEG arousals, oxyhemoglobin desaturation, and disturbances in cardiac rate and rhythm. Apnea was defined as the absence of airflow for at least ١٠ s. Hypopnea was defined as a visible reduction in airflow lasting at least ١٠ s associated with either a ٤% decrease in arterial oxyhemoglobin saturation or an EEG arousal. An arousal was defined according to the criteria proposed by the Atlas Task Force. Apneas and hypopneas were classified as obstructive if respiratory effort was present, and central if respiratory effort was absent during the event. The AHI was defined as the number of apneas and hypopneas per hour of sleep. Recent recommendations for cutoff levels on AHIs are as follows: Mild - ٥-١٥ episodes per hour, moderate - ١٥-٣٠ episodes per hour and severe - More than ٣٠ episodes per hour

Pulse Oximetry:

Pulse oximetry data were collected as part of the polysomnography. The oximetry data were then extracted from the computerized polysomnography system for further off-line analysis.

Berlin Questionnaire: (٥) developed in ١٩٩٦, includes a series of questions about risk factors for sleep apnea, including snoring behavior, wake time sleepiness or fatigue, and obesity or hypertension. The questionnaire consists of ٣ categories related to the risk of having sleep apnea.

Patients can be classified into High Risk or Low Risk based on their responses to the individual items and their overall scores in the symptom categories.

Question	Response
١-Has your weight changed?	Increase Decreased No change
٢-Do you snore?	Yes No Do not know
٣-Snoring loudness	Loud as breathing Loud as talking Louder than talking Very loud
٤-Snoring frequency	Almost every day ٣ to ٤ times per week ١ to ٢ times per week ١ to ٢ times per month Never or almost never
٥-Does your snoring bother other people?	Yes No
٦-How often have your breathing pauses been noticed?	Almost every day ٣ to ٤ times per week ١ to ٢ times per week ١ to ٢ times per month Never or almost never
٧-Are you tired after sleeping?	Almost every day ٣ to ٤ times per week ١ to ٢ times per week ١ to ٢ times per month Never or almost never
٨-Are you tired during waketime?	Almost every day ٣ to ٤ times per week ١ to ٢ times per week ١ to ٢ times per month Never or almost never
٩-Have you ever fallen asleep while driving?	Yes No
١٠-Do you have high blood pressure?	Yes No Do not know

Categories and scoring:
Category ١: items ١, ٢, ٣, ٤, ٥.
Item ١: if '**Yes**', assign **١ point**
Item ٢: if '**c**' or '**d**' is the response, assign **١ point**
Item ٣: if '**a**' or '**b**' is the response, assign **١ point**
Item ٤: if '**a**' is the response, assign **١ point**
Item ٥: if '**a**' or '**b**' is the response, assign **٢ points**
Add points. Category ١ is positive if the total score is ٢ or more points
Category ٢: items ٦, ٧, ٨ (item ٩ should be noted separately).

Item ٦: if '**a**' or '**b**' is the response, assign ١ **point**
Item ٧: if '**a**' or '**b**' is the response, assign ١ **point**
Item ٨: if '**a**' is the response, assign ١ **point**
Add points. Category ٢ is positive if the total score is ٢ or more points
Category ٣ is positive if the answer to item ١٠ is 'Yes' OR if the BMI of the patient is greater than ٣٠kg/m٢.
High Risk: if there are ٢ or more Categories where the score is positive
Low Risk: if there is only ١ or no Categories where the score is positive

Body mass index: defined as weight (kg) divided by height (m) squared, i.e., kg/m٢).

Statistical Analysis

Data were statistically described in terms of range, mean ± standard deviation (± SD), median, frequencies (number of cases) and percentages when appropriate. Comparison of quantitative variables between the study groups was done using Kruskal Wallis analysis of variance (ANOVA) test. For comparing categorical data, Chi square (χ^2) test was performed. Exact test was used in stead when the expected frequency is less than ٥. A probability value (*p* value) less than ٠.٠٥ was considered statistically significant. All statistical calculations were done using computer programs Microsoft Excel ٢٠٠٣ (Microsoft Corporation, NY, USA) and SPSS (Statistical Package for the Social Science; SPSS Inc., Chicago, IL, USA) version ١٥ for Microsoft Windows.

Results:

The study group consisted of ١٢٠ consecutive subjects, selected on the basis of presenting symptoms suggestive of significant sleep disturbance, who then underwent polysomonography. When comparing the subjects; ١٠٢ of the ١٢٠ patients where male and ١٨ females.

The relation of the body mass index to the AHI p value was ٠.٠٥٤ which is not clinically significant (Table ١).

Table ١: Cross table revealing the relation between different groups of body mass index and AHI:

BMI/AHI	Apnea Hypopnea Index				Total
	-ve	Mild	Moderate	Severe	
١٨.٥-٢٤.٩	١١	٤	١	٣	١٩
٢٥-٢٩.٩	٩	٧	٢	٨	٢٦
٣٠-٣٤.٩	١١	٧	١	٩	٢٨
=/>٣٥	٨	٨	٥	٢٦	٤٧

However Chi square test was highly significant in the Berlin Questionnaire (table ٢)and the oxygen saturation(table ٣) in a p value < ٠.٠٠٥ (p value ٠.٠٠٠).

Table ٢: cross table revealing the relation between the Berlin Questionnaire and AHI:

B.Q/AHI	Apnea Hypopnea Index				Total
	-ve	Mild	Moderate	Severe	
High risk	٧	١٣	٩	٤٢	٧١

Low risk	٣٢	١٣	٠	٤	٤٩

Table ٣: cross table revealing the relation between o٢ saturation and AHI

O٢ value/AHI	Apnea Hypopnea Index				Total
	-ve	Mild	Moderate	Severe	
>٨٨%	١٨	٣	٢	٢	٢٥
<٨٨%	٢١	٢٣	٧	٤٤	٩٥

Discussion:

The present results indicate that combination of different indices may improve the prediction of obstructive sleep apnea whenever the polysomonography in not available. It is well known that polysomonography is the gold standard method for evaluation and diagnosis of sleep apnea (٤).

In this retrospective study for ١٢٠ consecutive subjects presenting with symptoms suggestive of significant sleep disturbance they underwent polysomonography ١٠٢ where males and ١٨ females, obstructive sleep apnea has been assumed to be a condition associated primarily with males (٦).

However the body mass index had a positive correlation with AHI. Obesity is considered a major risk factor for the development and progression of OSA (٧). Obesity increases the risk of OSA developing by approximately ١٠-fold from a range of ٢ to ٤% in the general adult population, to up to ٢٠ to ٤٠% in those with a body mass index (BMI) > ٣٠ (٨). It is possible that obesity may worsen OSA because of fat deposition at specific sites. Fat deposition in the tissues surrounding the upper airway appears to result in a smaller lumen and increased collapsibility of the upper airway, predisposing to apnea (٩). Moreover, fat deposits around the thorax (truncal obesity) reduce chest compliance and functional residual capacity, and may increase oxygen demand (١٠). Visceral obesity is common in subjects with OSA (١١). However, the relationship between OSA and obesity is complex. Although there is compelling evidence showing that obesity, as well as visceral obesity, may predispose to OSA, and that losing weight results in OSA improvement, recent studies suggest that OSA may itself cause weight gain (١٢).

Also the Berlin Questionnaire reveals that only ٧ subjects with high risk score regarding the Questionnaire for obstructive sleep apnea had negative AHI in comparing to ٦٤ subject with high risk score have different grades of AHI. ٣٢ subject with low risk score and have negative AHI in comparison to ١٧ subject with low risk score and have positive sleep study. This means that there is a positive correlation between BQ and AHI. Similar to this was the O٢ saturation which has positive correlation with AHI. Fietze et

al (٢٠٠٤) (١٣) has shown the oxygen desaturation index is correlated with the apnoea–hypopnoea index. They proposed oxygen desaturation index > ٥ as a priority to undergo polysomonography, but they presented only a small number of cases which were thirty five of whom only ١٨ underwent polysomonography.

After studying the positive correlation of these three indicators with OSA, a scoring system is proposed that can predict with relative accuracy the patients likely to have OSA. The value of the score is to identify those who need priority listing in cases of long waiting times for polysomnography. The scoring system is out of ٨ with the following items:

Body mass index	**١**	**١٨.٥-٢٤.٩**
	٢	**٢٥-٢٩.٩**
	٣	**٣٠.٣٤.٩**
	٤	**٣٥ and above**
Berlin Quest.	**١**	**High risk**
	٢	**Low risk**
Min. Value O_2 value	**١**	**More than ٨٨%**
	٢	**Less than ٨٨%**

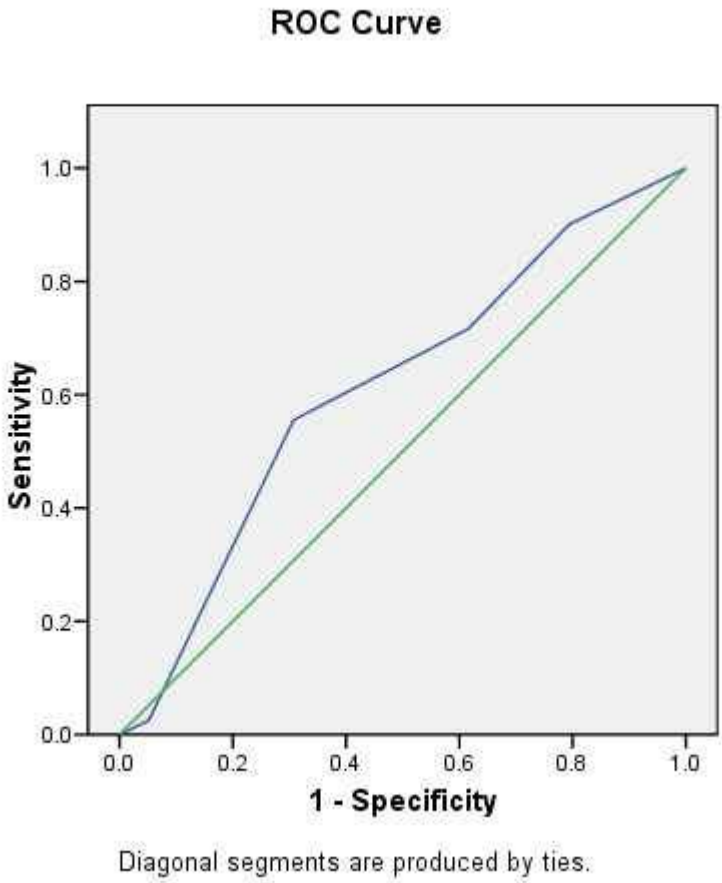
Where the total score is obtained at the end by adding the patient's score in each of the BMI Berlin questionnaire and minimum O_2 value.

Using ROC curve a cut off point of a score of ٧.٥ shows a specificity of ٩٥% for OSA, however a low sensitivity is also observed .

Coordinates of the Curve

Test Result Variable(s): Value

Positive if Greater Than or Equal To(a)	Sensitivity	١ - Specificity
٣.٠٠	١.٠٠٠	١.٠٠٠
٤.٥٠	٠.٩٠١	٠.٧٩٥
٥.٥٠	٠.٧١٦	٠.٦١٥
٦.٥٠	٠.٥٥٦	٠.٣٠٨
٧.٥٠	٠.٠٢٥	٠.٠٥١
٩.٠٠	٠.٠٠٠	٠.٠٠٠



Dixon et al (٢٠٠٣) study has found independent clinical predictors of significant sleep apnea. Combining these indicators by simply adding the number of positive predictive factors provides a BASH'IM score of ٠ to ٦. Any severely obese patient with a score ≥٣ is at very high risk of significant OSA. For a score of ٠ or ١, the risk would be very low, with no cases found in their study (٨). These are BASH'IM (BMI ≥ ٤٥, age, observed sleep apnea, HbAIc ≥ ٦%, fasting plasma insulin ≥ ٢٨ µmol/L, and male sex), an acronym reflecting the sleeping partner's common reaction to the problem. The advantage of our suggested score is its simplicity as no laboratory investigation is required.

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