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Original Article

Internal Medicine Section

Clinical Prediction of Obstructive Sleep Apnea (OSA) in a Tertiary Care Setting

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ABSTRACT

Objectives: To prospectively evaluate the utility of clinical parameters in snorers in predicting obstructive sleep apnea (OSA) or for prioritizing patients for overnight polysomnography (OPS).

Period and setting: August 2004 to June 2006; Sleep Laboratory, Institute of chest Diseases, Medical College, Kozhikode

Design: Loud habitual snorers with one other symptom suggestive of OSA were subjected to 10 channel overnight polysomnography. OSA was diagnosed as per American Academy of Sleep Medicine criteria. Parameters having significant association with OSA and subsequently, independent predictors were determined statistically. For continuous variables, cut off values were obtained. A decision model for prioritizing patients for OPS was devised based on the predictors.

Results: 90 patients completed the study. 71 participants had OSA. Age, sex and neck circumference were the independent predictors of OSA with neck circumference having the greatest prediction value. The cut offs for age and neck circumference in predicting OSA was determined to be 50years and 15.5 inch respectively. Based on these predictors, a decision model for prioritizing symptomatic snorers waiting for OPS was formulated.

Conclusion: Neck circumference >15.5 inches, age above 50years and male sex independently predicted the risk of OSA in our study group. Symptoms were insignificant predictors of OSA.

Key Words: Obstructive sleep apnea, Clinical predictors

INTRODUCTION

Sleep apnea is a sleep disorder which is characterized by abnormal pauses in the breathing or instances of abnormally low breathing during sleep. Obstructive Sleep Apnea (OSA) is a common disorder which affects the general population. Snorers are more likely to have OSA, although all snorers need not have clinically significant OSA. Overnight Polysomnography (OPS) is the "gold standard" investigation for diagnosing OSA, but its use is limited, as it is time consuming, expensive and inconvenient. Hence, for effective resource utilization and to limit the number of unnecessary polysomnographies, it would be better if we could predict the likelihood of OSA, based on certain simple clinical parameters, so that the priority for overnight polysomnography may be given to those high risk candidates. There is a paucity of studies which have aimed at assessing the clinical predictors of OSA in the Indian population. Here, our endeavour was to assess the value of the clinical and anthropometric data for predicting OSA and to find the independent predictors of OSA, if any, in a group of patients with features which were suggestive of OSA, who attended the pulmonary medicine outpatients department of the medical college, Kozhikode, which is a tertiary level referral centre in northern Kerala.

OBJECTIVES

Primary objective: To look for the independent clinical predictors of OSA in loud habitual snorers with suggestive symptoms in a tertiary care setting in north Kerala, India.

Secondary objective: To develop a decision model for prioritizing the snorers with symptoms which were suggestive of OPS.

STUDY DESIGN AND SETTING

A cross-sectional study which was conducted at Institute of Chest Diseases, Medical College, Kozhikode, Kerala, India, a tertiary care teaching institution, during the period from August 2004 to June 2006.

MATERIALS AND METHODS

Inclusion criteria: All the patients with the habit of loud habitual snoring, with at least one other symptom which was suggestive of OSA, which included nocturnal awakenings, witnessed apnoeas (as was observed by the partner/spouse), excessive daytime sleepiness (EDS) which was assessed by the Epworth Sleepiness Score (ESS), early morning headache, and daytime fatiguability.

Exclusion criteria: Patients are excluded from this study if they did not consent to the study, or if any technical failure occurred during the procedure, or if they could not sleep during the procedure.

Symptoms which were suggestive of OSA were sought through a detailed interview which involved the patient and also the partner. A thorough history, followed by a complete physical examination which including anthropometry (neck circumference and BMI) was done. The neck circumference was measured 2cm below the cricoid cartilage, at the level of the cricothyroid membrane. BMI was calculated from the height and weight, based on the formula BMI=Wt.(in kg) / ht. (in m)^2. OPS is arranged for all the patients with a clinical indication as has mentioned above. Each patient undergoes an attended overnight polysomnography in a sleep laboratory. The results are analyzed by a software and they are also scored manually. Apneas are defined as complete cessation of the airflow >10 s. Hypopnoeas are defined as a reduction of >50% in one of the three respiratory signals – either the airflow signal or the respiratory or abdominal signals of respiratory inductance plethysmography, with an associated fall of >3% in the oxygen saturation, with or without an arousal. OSA is diagnosed if a patient has a cumulative apnoea hypopnoea index (AHI) of $\geq$5. Those with OSA are further grouped, based on the AHI, into three classes of severity, as mild OSA (AHI: 5 to 15), moderate OSA (AHI: 15 to 30), and severe OSA (AHI>30), as per the American Sleep Disorders Association (ASDA) criteria. The various clinical parameters which were analyzed were age, sex, witnessed apnoeas, nocturnal choking episodes, excessive daytime sleepiness, hypertension, body mass index and neck circumference, which were compared between those with OSA and those without OSA. By using appropriate statistical tests (the Student's t-test for a quantitative analysis and the Chi square test for qualitative variables), the features that had a significant association with OSA were found out. The independent predictors of OSA were determined by multivariate logistic regression analysis. Appropriate cut-offs for the continuous variables were obtained by plotting the Receiver Operating Characteristic (ROC) curve. Subsequently, a decision model was developed for the prioritizing snorers with suggestive symptoms.

OBSERVATIONS

A total of 93 patients were initially enrolled into the study, out of which 3 were excluded, based on the exclusion criteria. Among the study group, males constituted a majority (73%) as compared to females. The average age of the study group was 48 years, the mean body mass index (BMI) was 29.25 and the mean neck circumference (NC) was 15.74 inches. By Overnight Polysomnography (OPS), OSA was diagnosed in 71 (79%) patients of the study cohort. Their distribution, based on their severity, has been shown in [Table/Fig-1].

Severity	Number	Percentage
Mild	21	23
Moderate	18	20
Severe	32	36

[Table/Fig-1]: Distribution based on severity

The various parameters that were considered for the analysis, their comparative statistics between the 2 groups and the level of significance is given in [Table/Fig-2]. The qualitative variables were compared by the Chi square test and the quantitative variables by the Student's t-test. The parameters which had a significant association with OSA were age, sex and neck circumference, which was found by bivariate analysis. It was interesting to note that none of the symptoms or BMI had a significant association with OSA. The proportion of the obese in the OSA group (42.3%) was comparable to that in the non-OSA group (47.4%), with the non-obese patients constituting a majority in both the groups (57.7% and 52.6% respectively). There was no statistically significant difference between the two groups with regards to the symptom association [Table/Fig-2]. By multivariate regression analysis, the neck circumference was found to be the best predictor of OSA with the highest odds ratio (l.9703). The other independent predictors were age (O.R.: 1.09) and male sex (the female sex being protective with an O.R. of 0.2684). The probability of a patient with all the three predictors to have OSA was found to be 22.4% (Cox and Snell r^2 value: 0.224) [Table/Fig-3]. Receiver operating Characteristic (ROC) curves [Table/Fig-4] were plotted, which showed a neck circumference of 15.5 inch or more and age of >50 years, which had the best balance of the sensitivity and the specificity. Thus, in summary, the independent clinical predictors of OSA in this study group included neck circumference (15.5 inch), age (50 years) and the male sex. A score of one for each of these 3 factors when they were totaled, provided a simple way of combining the risk, to produce an OSA prediction score, the highest score being three (all the 3 predictors being present) and the lowest being zero (none of the 3 predictors being present). If the score was high, the specificity was very high, resulting in less number of false positive sleep studies, but as the sensitivity was compromised, there was a chance of missing a few diseased subjects. A score of one placed the patient at a low risk for OSA, thus placing him/her lower down in the priority list for OPS.

Parameter	Mean Value		
	OSA	Non-OSA	P value
Age (in yrs)	49.3	41.6	0.02
BMI	29.23	29.32	0.95
Neck Circumference	15.95	14.94	0.001
	Proportion having the parameter		
	OSA	Non-OSA	P value
Sex (M:F)	80%	47%	0.004
Excessive Day Sleepiness	66%	46%	0.13
Witnessed apneas	59%	37%	0.08
Nocturnal Choking	72%	63%	0.47
Hypertension	49%	47%	0.881

[Table/Fig-2]: Comparative statistics for the parameters analyzed

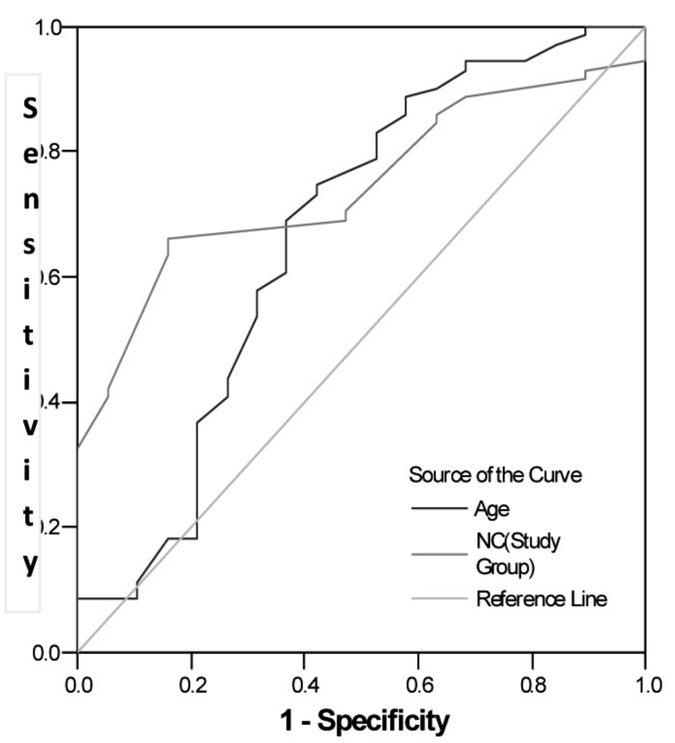
Term	Odds Ratio (O.R.)	95% C.I.	S. E.	P-Value
Age	1.0902	1.0302 - 1.1536	0.0289	0.0028
Neck Circumference	1.9703	1.1557 - 3.3589	0.2722	0.0127
Sex	0.2684	0.0781 - 0.9217	0.6296	0.0367
Constant	*	*	4.7857	0.0087

[Table/Fig-3]: Summary of multivariate logistic regression analysis
Cox & Snell r^2 : 0.224

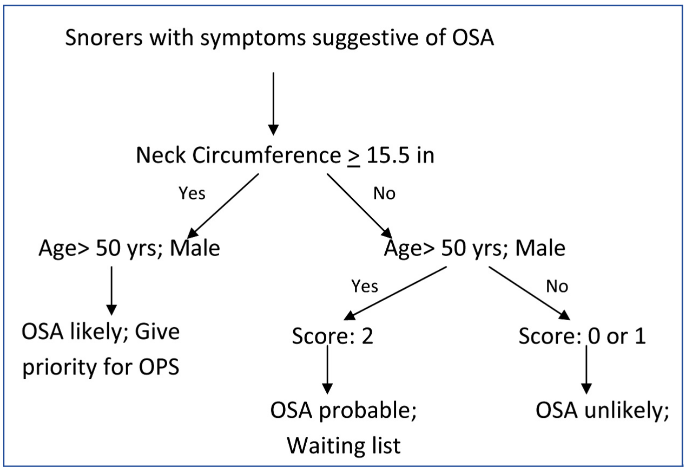
With the help of the above observations, a decision model for prioritizing the patients who were waiting for OPS [Table/Fig-5] was developed, which may be applicable to ours as well as other similar settings, where a high patient turnover mandates prioritization for effective resource utilization.

DISCUSSION

Our study identified certain simple clinical parameters that could predict the presence of OSA in snorers with suggestive symptoms, among a group of patients who attended a tertiary care setting in north Kerala, India. The utility of similar studies which were conducted in the western population is limited in our setting, as the race and the race related differences in the craniofacial morphology have been shown to have a significant impact on the development and the perpetration of OSA. This points to the relevance of our study. Neck circumference was found to be the most important predictor of OSA in our study group. This finding was in concordance with that of John B Dixon et al [1], but it contrasted the findings of other researchers [2] The fact that neck circumference was a predictor which was independent of BMI has been substantiated by several authors, who in their studies on the role of neck circumference and gender differences in sleep apnoea, concluded that



[Table/Fig-4]: ROC curve for age and neck circumference



[Table/Fig-5]: A decision model for prioritization of symptomatic snorers for Polysomnography

several factors other than obesity and upper airway fat might contribute to OSA [3,4,5].

The fact that the male sex has a significant association with OSA, could be due to various reasons. Several studies [6,7] have demonstrated sex differences in the structure and the physiological behaviour of the upper airway, with females having increased activity of the genioglossus muscle which protects their airway from collapsing during sleep. Female hormones also seemed to have a protective role. Other reasons included, a difference in upper airway caliber, the smaller neck size in women and the smaller size of the critical soft tissue structures in women. Whittle et al., [8] observed that the total neck soft tissue volume was significantly greater in men than in women.

Age was another predictor of OSA, with a majority of the OSA subjects being between 50–60 years of age in our study group. Thereafter, in the subsequent age groups, there was a sharp decline in the prevalence of OSA. This finding was consistent with the experience of most sleep of the clinics which looked after patients with OSAHS, where the peak age of presentation was about 50 years and the prevalence was found to fall off quite steeply above this age [9]. This was probably because the older patients simply did not complain about their symptoms.

In addition to merely identifying the clinical predictors of OSA, this study also brought to light, certain other important aspects. BMI was not a predictor of OSA in our study, thus emphasizing the need to suspect this condition in non-obese subjects as well. Also, none of the symptoms predicted the presence of OSA. The probable reason could be selection bias, as due importance might not have been given to certain symptoms and to the presence of co-existing diseases like gastro oesophageal reflux disease or asthma, that might have contributed to these symptoms. Thus, the symptoms or BMI by themselves may not be reliable in selecting the patients for polysomnography. Also, screening for co-existing conditions as have been mentioned above, also is necessary before subjecting the patients to OPS.

Provided that prospective studies validated our findings, the selection of the patients based on these predictors and the application of the decision model, may be helpful in avoiding at least a few unnecessary or false positive polysomnographies.

This study was probably the first of its kind in our region and it hoped to achieve its aim effectively, so that it could be useful and applicable to various centres which were specialized in sleep disorders, especially so to those institutions where a high patient turnover requires prioritization for a time consuming investigation like OPS. In this regards, this study has got great relevance in our setting.

CONCLUSION

(1) Even though overnight polysomnography remains the gold standard for the confirmation of the diagnosis of this condition, a high index of suspicion by the treating clinician is required to identify it early enough to prevent significant morbidity.

(2) Age of >50 years, the male sex and a neck circumference of ≥ 15.5 inches were the independent predictors of OSA in this study.

(3) The body mass index and the disease symptoms were poor predictors of OSA in this study.

(4) The decision model which was developed based on these clinical predictors could be helpful in prioritizing the patients who wait for overnight polysomnography, thus saving time and resources to a great extent. A prospective validation is required for this aspect.

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