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ORIGINAL ARTICLE

Diabetics with Obstructive Sleep Apnea need Higher Positive Airway Pressures

[1]Sapna E Sreedharan, [2]Pragati Agrawal, [3]Chembakode A Anees, [4]MJ Pradeep, [5]P Sankara Sharma
[6]Ashalatha Radhakrishnan

ABSTRACT

Introduction: Continuous positive airway pressure (CPAP) is the only proven therapy for moderate to severe obstructive sleep apnea syndrome (OSAS). The CPAP requirements can widely vary among individuals. We studied the demographic, clinical, and polysomnographic (PSG) predictors of high CPAP requirement (pressures >10 cm H_2O) in a cohort of patients with OSAS.

Materials and methods: Consecutive patients with PSG-proven moderate to severe OSAS attending the Sleep Clinic, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, India, were prospectively recruited for the study from November 2014 till October 2015. After informed consent, demographic data, risk factor profile, and PSG data were extracted using a structured pro forma. All the patients underwent overnight CPAP titration in the sleep laboratory as per guidelines. The patients were grouped into two, those requiring CPAP ≤ 10 and >10 cm H_2O. Pearson correlation and chi square tests were used to study the association between variables.

Results: A total of 64 patients (55 male, 9 female) with OSAS underwent CPAP titration during the study period. Mean age of the study group was 53.81 ± 12.01 (26–85 years) and majority were overweight by Asian standards [mean body mass index (BMI) 29.31 ± 5.01]. Mean apnea-hypopnea index (AHI) of the cohort was 62.28. Average CPAP requirement was 11.82 cm H_2O. We found that neck circumference, presence of diabetes mellitus (DM), and AHI severity were independent predictors for higher PAP requirements, while gender, BMI, and other vascular risk factors were not predictive of high PAP requirements.

Conclusion: Diabetes mellitus and neck circumference are better predictors of higher CPAP requirements in Indian population than BMI. Those with higher AHI required more pressures while apnea duration failed to show an association with higher PAP.

Keywords: Diabetes mellitus, Neck circumference, Obstructive sleep apnea, Positive airway pressure therapy.

[1]Associate Professor, [2]Consultant, [3,4]Sleep and Neurotechnologist [5,6]Professor

[1-4,6]Department of Neurology, Comprehensive Centre for Sleep Disorders, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, Kerala, India

[5]Department of Biostatistics, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram Kerala, India

Corresponding Author: Sapna E Sreedharan, Associate Professor, Department of Neurology, Comprehensive Centre for Sleep Disorders Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, Kerala, India Phone: +919061989994, e-mails: sapnaerat@yahoo.com sapnaerat@sctimst.ac.in

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INTRODUCTION

Obstructive sleep apnea syndrome, traditionally considered as mainly affecting obese people in developed countries,[1] is increasingly being diagnosed in resource-poor countries as well.[2,3] Major changes in lifestyle and dietary habits in less developed countries like India have led to the emergence of obesity and metabolic syndrome in epidemic proportions among the population. Currently, it is estimated that more people die of noncommunicable diseases in India mostly attributable to lifestyle changes.[4] With increasing life expectancy and aging of the population, we are seeing chronic noncommunicable diseases in epidemic proportions in urban as well as rural India.[5]

Continuous positive airway pressure therapy is the only proven therapy for moderate to severe OSAS across different studies.[6] It is associated with not only short-term benefits in the form of improvement in daytime alertness and concentration, but also reversal of metabolic effects in the long term.[7] However, the benefit of CPAP therapy closely depends on compliance and hours of usage. Up to 50% of patients have been found to be noncompliant to CPAP therapy at 1 year follow-up.[8] High positive pressures can lead to more patient discomfort and less compliance, thus negating the beneficial effects of CPAP therapy with additional increase in the cost of therapy. Only a few authors have looked into predictors of high PAP requirement in OSAS and we could not find any data from the Indian subcontinent.

AIM

Our objective was to study the demographic, clinical, and PSG predictors of higher (>10 cm H_2O) PAP requirement in a cohort of moderate to severe OSAS. We also sought to look into the impact of vascular risk factors on PAP requirement in OSAS of comparable severity.

MATERIALS AND METHODS

The study was conducted in the Comprehensive Sleep Disorders Centre (CSDC), Department of Neurology, Sree Chitra Tirunal Institute for Medical Sciences and Technology, Thiruvananthapuram, South India, which caters to over 1,000 patients with various sleep disorders annually, over half being OSA. We have three qualified sleep technologists and do over 400 PSGs and 200 CPAP titrations every year. Consecutive patients attending CSDC with complaints of snoring, witnessed apneas, and excessive daytime sleepiness (EDS) were screened for the study. The EDS was quantified using vernacular (Malayalam) translation of Epworth sleepiness scale with score ≥10 as abnormal.[9] The study period was 1 year, from November 2014 till October 2015. The study was approved by the institutional ethics committee. Demographic and clinical profile including BMI, neck circumference, and details of their sleep perception were extracted using a structured pro forma. The BMI was defined as per International Obesity Task Force guidelines as ≥25 kg/m^2 as overweight and ≥30 as obesity.[10] Neck circumference ≥38 cm in males and ≥35 cm in females were taken as abnormal.[11] Details of vascular risk factors, alcohol and tobacco use, and use of hypnotics were also collected. All the patients underwent supervised overnight video-PSG followed by CPAP titration using BIO-LOGIC sleep system (Heinen & Löwenstein, Bad Ems, Germany). Sleep studies were scored as per the American Academy of Sleep Medicine (AASM) 2012 guidelines.[12] Severity of OSA was classified into mild (AHI 5–15/hour), moderate (15–30), and severe (>30/hour).[13] Patients with moderate to severe OSA (AHI ≥15 events/hour) underwent CPAP titration under supervision of an experienced sleep technologist and was graded as per AASM guidelines.[6] In those patients who required bilevel PAP, inspiratory PAP was taken for calculating optimal pressures. Subjects who underwent PAP titration were divided into two groups, those with positive pressure requirement ≤10 cm H_2O *vs* those with PAP >10 cm H_2O.

Statistical Analysis

Statistical analysis was done using Statistical Package for the Social Sciences version 16 software (SPSS Inc., Illinois, Chicago). Variables were expressed in means and percentages. Fischer exact test and chi square test were used to test significance of association between variables. All variables with a p-value <0.1 were carried forward for multivariate modeling using binary logistic regression by forward conditional method.

Omnibus tests for model coefficients were used to test for significance of the model. The Cox and Snell R squared value of the best model was reported.

RESULTS

A total of 64 patients with moderate to severe OSA who underwent CPAP titration during the period were included in the study; 24 patients had low PAP requirement and 40 required PAP > 10 cm H_2O to achieve optimal/good titration. All of our subjects were titrated using full face mask. Majority were male, in their fifth decade of life and was overweight. Baseline characteristics including symptoms and risk factor profile and their statistical significance are given in Table 1.

When analyzing PSG characteristics of the patients before CPAP titration, we found that fraction of slow wave and rapid eye movement (REM) sleep as well as wake after sleep onset (WASO) was comparable between the two groups, while AHI severity and long apneas were more found in subjects who required higher PAP. Also nocturnal hypoxemia was more significant in the higher PAP group. The detailed PSG characteristics of the two groups are given in Table 2.

Multivariate analysis showed that only presence of diabetes, large neck circumference, and AHI severity were predictors of higher PAP requirements in our patient cohort (Table 3).

DISCUSSION

Positive airway pressure therapy is the only proven therapy for moderate to severe OSA.[14] However, a major problem with the treatment is ensuring adequate compliance, which ranges from 28 to 83% across different studies.[15-18] Shapiro and Shapiro[19] in a review have reported influence of factors like age, social stigma on compliance in OSAS, while the impact of OSA severity has yielded conflicting results. European authors have found that higher mask leak may have a negative impact on PAP usage.[20]

A few algorithms for predicting PAP requirement based on OSA severity and anthropometric measures are available; however, none are comparable to traditional PAP titration.[21,22] We sought to look into predictors of high PAP requirement in a cohort of subjects with moderate to severe OSAS, which will help in identifying the subset of subjects who may need bilevel ventilation, which will increase the cost of therapy. In developing countries like ours where medical cost is largely borne by patients themselves, affordability is a key factor to ensure acceptance and compliance to therapy.

Ours is a male-dominant cohort with mean age in the fifties, which is comparable with other studies from the West and Asia. Our cohort was overweight. Age above 55 years came as a predictor of high PAP requirement in univariate analysis, but did not come significant on

Table 1: Baseline characteristics

	PAP requirement ≤10 cm H_2O (n = 24)	*PAP requirement >10 cm H_2O (n = 40)*	*Total (n = 64)*	*p-value*
Age (years)	50.99	57.01	53.81 ± 12 (26–81)	0.002
Gender			55M:9F	
BMI absolute	28.1	30.01	29.33 (19.22–42.22)	0.244
Collar size	39.31 cm	40.32 cm	39.95	0.019
Witnessed apneas	25%	52%		0.04
Arousals with respiratory difficulty	33%	45%		0.12
EDS	70.3%	82.5%		0.12
Systemic hypertension	62.5%	60%		0.92
Type II DM	20.83%	55%		0
Dyslipidemia	30%	45%		0.04
≥2 risk factors	33.5%	52%		0.113
Smoking	41.6%	57.5%		0.22
Alcohol abuse	41.6%	60%		0.11

Table 2: Polysomnographic characteristics

	PAP requirement ≤10 cm H_2O (n = 24)	*PAP requirement >10 cm H_2O (n = 40)*	*Total (n = 64)*	*p-value*
AHI absolute value	29.94	61.33	47.9	0
WASO	60.11	89.6	78.54	NS
Slow wave sleep duration	22.63	16.56	18.84	NS
REM duration	16.87	14.17	15.18	NS
Arousal index absolute	32.17	53.11	45.25	0
Desaturation index	17.58	28.21	24.22	0.04
Cumulative sleep fraction when saturation <90%	6.6	20.06	15.15	0.001
Mean apnea duration	23.61	27.87	26.64	0.04
Maximum apnea duration	73.03	75.14	74.33	NS
Total apnea duration ≥20% of TST	20.75	41.15	33.72	0

NS: Nonsignficant; TST: Total sleep time

Table 3: Multivariate analysis

							95% CI for Exp (B)	
	B	*S.E.*	*Wald*	*df*	*Sig.*	*Exp (B)*	*Lower*	*Upper*
DM	1.637	0.714	5.252	1	0.022	5.141	1.267	20.853
AHI	0.046	0.015	9.904	1	0.002	1.048	1.018	1.078
Collar size					0.029			
Constant	–2.010	0.701	8.210	1	0.004	0.134		

Omnibus test of model coefficient $p < 0.001$; Cox & Snell's R square = 0.306

logistic regression modeling. We found that BMI had no significant association with higher PAP requirement. One previous report[23] had shown conflicting results. We found a significant association of PAP with neck circumference, which has not been previously reported. In Asians who are shorter and stouter than other ethnic people, with more central obesity, neck circumference is an independent predictor of PAP requirement, which came significant in multivariate analysis as well.

Our patient population had a high prevalence of vascular risk factors. The presence of hypertension, smoking, current or past alcohol usage, dyslipidemia, and three or more risk factors had no association with high PAP requirement. In multivariate analysis, only diabetes came out as a predictor of higher PAP requirement. This also has not been reported by any other authors. We know that OSA is independently associated with alteration in glucose metabolism and increased risk of type II DM, secondary to intermittent hypoxemia and sleep fragmentation. Wisconsin sleep cohort study found that DM was 2.3 times more prevalent in OSA, but failed to find an independent relationship between incident DM and OSA.[24] Makino et al[25] found that insulin resistance was independently associated with OSA severity. There is also evidence in the literature proving that CPAP can partially correct metabolic abnormalities in DM. However, the association of DM with CPAP requirement is still not known.

Severity of OSA was an independent predictor of PAP requirement in our study. This observation is similar to previous literature where AHI was consistently found to have a positive association with higher PAP need.[23,26,27] Other associations of higher PAP requirement reported in the literature are respiratory effort[28] and body position,[29] which could not be found in our study. Some have used a mathematical equation incorporating these parameters to predict pressure requirement.[27,29] However, subsequent studies did not find much utility for these formulas.[30]

Our study, the first of its kind from Indian subcontinent is not without its limitations. We assessed pressure requirement based on a single Level 1 PSG with CPAP titration. Even though we selected only those subjects with optimal and good titration for analysis and excluded those with suboptimal titration study, the pressure requirement found by a single overnight study cannot be taken as final. We had only a few female subjects in our study cohort and hence gender-based differences in pressure requirement could not be looked into. We also did not analyze follow-up of these subjects to see whether their long-term compliance and symptomatic benefit differ among the groups. Also we could not propose any formula or algorithm to predict pressure need with our data.

Albeit these limitations, our study brings to light some interesting observations about OSA, some of which may be unique to Indian population. We found that neck circumference rather than BMI better predicts higher pressure needs. In addition to OSA severity, DM emerged as an independent predictor of higher PAP requirement in our cohort. These information we believe will be of value for clinicians before sending patients for CPAP titration, to identify those who may require higher pressures and counsel them regarding costs and also sensitize sleep technologists when performing titration.

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