ORIGINAL ARTICLE

Obstructive sleep apnea in hypertensive adults

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Abstract

Background: Systemic hypertension is a common condition affecting middle aged and elderly individuals. Studies have shown that about half of the patients who have essential hypertension have OSA and half of the patients having OSA have essential hypertension. Therefore, this study was conducted to study OSA in hypertensive patients (untreated and treated).

Material and Methods: Subjects with history of Hypertension (with or without treatment) were included in the study. Sleep questionnaire was administered, anthropometric measurements taken and patients were subjected to whole night polysomnography.

Observation and Results : 40% of untreated hypertensives and 38% of treated hypertensives had AHI greater than 5. Further it was found that severity of OSA increased as the Systolic, Diastolic Blood pressure increased. BMI, Male sex and treated-untreated hypertension were associated with sleep apnea.

Conclusion: Study demonstrated clear association between OSA and hypertension with upto 40 % hypertensives showing OSA.

Introduction

Sleep is one of the most extensively studied medical disorders of the twentieth century. Two reports published in the early twentieth century within few years of each other revolutionized our thinking about sleep and wakefulness. Normal pattern of human sleep was first discovered by Davies, Harvey and Hobart in 1937–1939. Before this, sleep was considered a passive state—an intermediate state between wakefulness and death. Today we know that sleep is an active and complex state. Herman Hans Berger recorded different electrical activities in the human brain during awake and sleep state in 1928. Though obstructive sleep apnea (OSA) has been mentioned in literature since the time of Charles Dickens, in his description of fat boy Joe in *The Posthumous Papers of Pickwick Club*, it is only in the past three decades that this entity has been clinically defined. OSA and systemic hypertension are common conditions affecting middle-aged adults and elderly. Both conditions are associated with significant morbidity and mortality. An association between OSA and hypertension has been documented.

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A growing body of evidence suggests that OSA is a major contributing factor in the development of hypertension. About one half of patients who have essential hypertension have OSA, and about one half of patients who have OSA have essential hypertension.

Material and Methods

This study was conducted in the Department of Chest Diseases at a tertiary-care center in Mumbai, Maharashtra, India, after approval from the ethics committee of the hospital. Hypertensive patients were screened from the medicine department. Patients aged more than 18 years from both sexes and diagnosed with hypertension with no comorbid illness (Cardiac, renal or Respiratory) were asked to undergo polysomnography studies. Of the 85 patients meeting the criteria, 50 agreed to undergo polysomnography studies.

Hypertensive patients with a blood pressure (BP) of more than 180/110 mm Hg were not included in the study. Also, patients who had other cardiac (congestive heart failure, myocardial infarction, etc.), respiratory, renal, and CNS (stroke) conditions were excluded from the study. Fifty diagnosed hypertensive patients of either sex and aged more than 18 years were studied.

After carefully noting history and a thorough clinical examination, the patients were asked to answer a questionnaire on sleep and were subjected to polysomnography studies. A written informed consent was obtained from all the patients included in the study.

The patients were evaluated for the presence of sleep apnea with the help of polysomnography studies. A conventional measure, apnea–hypopnea index (AHI), was used to define the presence of OSA. An AHI of more than 5 was considered to be suggestive of OSA. The patients who were smokers and having respiratory illness such as chronic obstructive pulmonary disease, stroke, and heart failure were excluded from the study.

The questionnaire

All the patients who were selected for the study answered the following questionnaire.

Presence of:

- Snoring
- Excessive daytime sleepiness
- Non-refreshing sleep
- Irritability
- Morning headache
- Nocturia, bed wetting
- Sensation of choking at night and repeated wakefulness
- Abnormal limb movements
- Accident prone
- Changes in sexual behavior
- Psychological problems, personality changes, loss of memory, intellectual deterioration
- History of aggravating factors such as alcoholism, sleep deprivation, any medications (sedative, hypnotics)

In addition, detailed history about other coexisting illness was noted and a thorough clinical examination was carried out. Anthropometry of all the patients was recorded, and height and weight were measured using standard equipment. Body mass index for each patient was calculated using the following formula:

$$BMI=\frac{\text{Weight in kg}}{(\text{Height in m})^2}$$

Neck circumference was also measured for each subject.

Polysomnography

All the patients were subjected to whole- night polysomnography. The AHI was calculated as the number of apnea and hypopnea events divided by the number of hours of sleep. On the basis of the AHI, obstructive sleep apnea–hypopnea syndrome was classified as follows:

AHI < 5/hour	No OSA
5/hour d" AHI < 15/hour	Mild OSA
15/hour d" AHI < 30/hour	Moderate OSA
AHI e" 30/hour	Severe OSA

Results

The study group included 50 patients, of which 29 were men and 21 were women. After conducting polysomnography studies, it was found that of the 29 male patients, 23 (79.3%) had OSA and 6 (20.7%) had

normal polysomnography. Of the 21 female patients, 11 had OSA whereas 10 had normal polysomnography. c^2-Test was applied to find out statistical correlation of gender and OSA .The test was statistically significant with *p*-value of 0.004. Men showed a higher prevalence of OSA than women. Worsnop *et al.*[1] carried out a study in 93 patients that compared hypertensive patients and normotensive individuals for the presence of OSA. Male patients in the studied population had statistically significant higher incidence of OSA ($p = 0.007$) as compared to female counterparts.

Age and OSA status

The patients selected for the study were 18 years and above of age. A correlation was sought between age and OSA status of the patients (Table 1). This was analyzed using Pearson's correlation test, which was found to be statistically insignificant ($p = 0.167$). This may be due to small sample size of the study. However, the studies by Israel *et al.*[2] and Stradling and Crosby[3] show that prevalence of OSA is two to three times higher in older age group as compared to middle age group. The study carried out by Worsnop *et al.*[1] also showed an increasing AHI with age in hypertensive patients.

Evaluation of morphological parameters in the form of neck circumference has been found to be a good predictor of OSA. In our study of 50 patients, a correlation was found between AHI and neck circumference using the Pearson's correlation test ($p = 0.001$), which was found to be statistically significant (Fig. 1). That is, as the neck circumference increased, the severity of OSA also increased.

All the patients included in the study (50 hypertensives) had at least one of the presentations of OSA, ranging from snoring to irritability to hypersomnolence (Fig. 2).

Snoring has been shown to have a strong association with OSA in most reports. Of the 50 patients, 37 (74%) snored, and OSA was present in 32 (86.5%) of the snorers. Correlation between snoring and OSA was found to be statistically significant using c^2-test ($p < 0.001$). Binary logistic regression analysis was done to check whether the presence of snoring was associated with the presence of OSA, and it was found to be statistically significant, thereby implying that snoring is an independent risk factor for OSA. In the study conducted by Deegan and Mac Nicolas, the predictive value of positive and negative history for snoring was 63 and 56% respectively[16]. Also, Stradling and Crosby[3] have reported a fivefold increase in daytime sleepiness with increase in snoring.

Hypersomnolence or excessive daytime somnolence was found in 26 (52%) of 50 patients. Of these 26 patients, 23 (88.5%) had OSA. It was found to be statistically significant using c^2-test ($p = 0.001$). Hypersomnolence has been found to be have a strong correlation with the presence of OSA, which was corroborated in our study also.

Non-refreshing sleep was also one of the most common presentations, which was found in 21 (42%) of 50 patients. Of these 21 patients, 19 (90.5%) had OSA. Non-refreshing sleep showed statistically significant correlation with OSA using c^2-test ($p = 0.004$).

Irritability during daytime was reported in 5 (10%) of 50 patients. Of these five patients, four had OSA. Irritability did not show statistically significant ($p = 1.00$) correlation with OSA. Morning headache was a complaint in 7 (14%) of 50 patients. All the seven patients had AHI more than 5. This did not show statistically significant correlation between morning headache and OSA.

In our study, 8 (16%) of 50 patients had nocturia; of these, 7 patients had OSA. The *p*-value was found to be 0.409 using Fisher's exact test. Nocturia showed no statistically significant correlation with OSA in our study, although there are studies that report one-third of the patients of OSA would have nocturia.

Of the 50 patients, 12 (24%) were alcoholic; of these, 11 (91.7%) had OSA. Of 38 nonalcoholic patients, 23 (60.5%) had OSA. A correlation was sought between OSA and alcoholism and was found to be insignificant ($p = 0.074$).

A correlation was sought between BMI and AHI (Table 2). No statistically significant correlation could be found between AHI and BMI ($p = 0.7$), although there are studies conducted by Worsnop *et al.*[1] that showed statistically significant correlation between AHI and BMI.

Figure 3 shows that of the 14 patients with a normal BMI, 9 had OSA. Of these nine patients, only one had mild OSA. The remaining eight patients had moderate-to-severe OSA. This shows that moderate-to-severe OSA can be present in the setting of a normal BMI.

OSA has been identified as an independent risk factor for hypertension, with a linear relationship existing between OSA and hypertension. It has been shown that treated or untreated hypertensive patients are more likely to have AHI of 5 or more than the normotensive individuals. Of the 50 patients, 34 (68%) had OSA (AHI > 5) (Fig. 4).

Silverberg *et al.*[4] have stated that at least one half of the patients with essential hypertension have OSA. In a study carried out by Worsnop *et al.*[1], 38% of treated and untreated hypertensives had AHI > 5.Grunstein and coworkers[13] have found that in subjects with OSA, AHI was a determinant of BP independent of obesity. Carlson and coworkers [14]found that OSA was an independent risk factor for hypertension. Our study corroborates with the finding of the earlier-mentioned studies in which there is a high prevalence of apnea in hypertensive patients.

A correlation was sought between AHI and systolic BP (Fig. 5), which was found to be statistically significant ($p < 0.001$). That is, as the systolic BP increases, the AHI also increases, indicating a linear correlation between the two.

Statistically significant correlation was also found between AHI and diastolic BP ($p = 0.003$); that is, as the diastolic BP increases, the AHI also increases, indicating a linear correlation between the two (Fig. 6). Many studies have achieved a reduction in BP by relieving OSA with nasal continuous positive airway pressure (CPAP), suggesting a direct causal link.

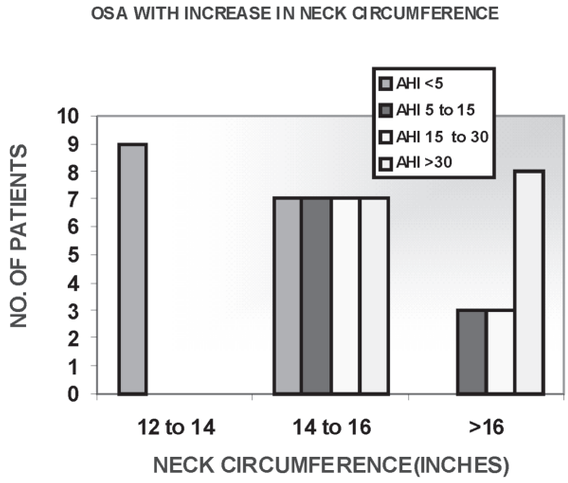

Figure 1: Correlation of OSA with Neck Circumference

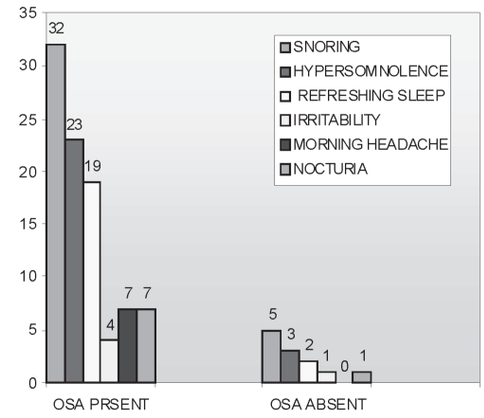

Figure 2: Correlation of Symptomalogy with OSA

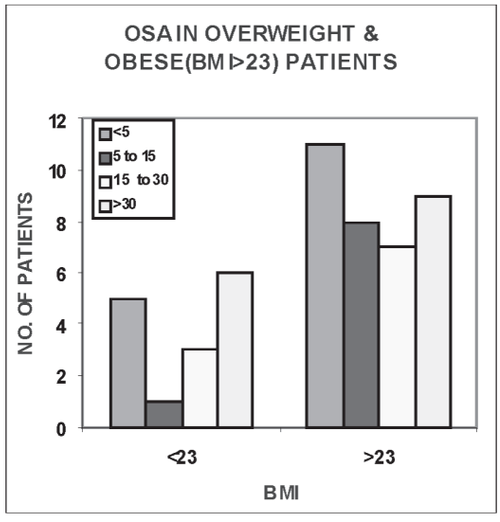

Figure 3: Correlation of OSA with BMI

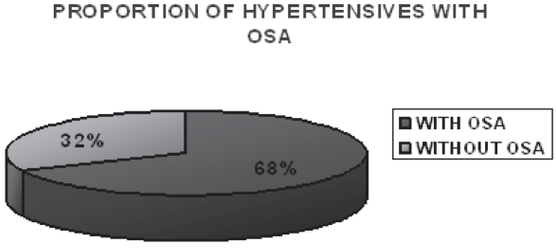

Figure 4: Distribution of OSA in Hypertensives

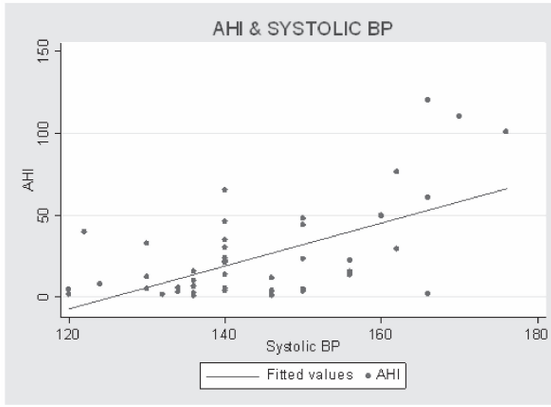

Figure 5: Correlation of Systolic BP with OSA

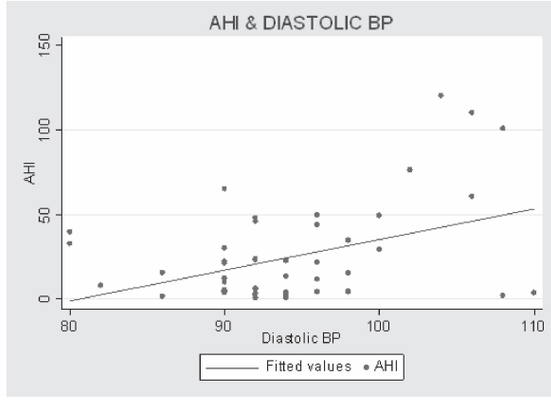

Figure 6: Correlation of Diastolic BP with OSA

Discussion

The mechanism responsible for association of hypertension and OSA is not clear, though several mechanisms have been hypothesized for the same. OSA has been identified as an independent risk factor for hypertension with a linear relationship existing between OSA and hypertension. It has been shown that treated or untreated hypertensive patients are more likely to have AHI of 5 or more than the normotensive individuals.

Our study attempted to find a correlation of hypertension with OSA. For this, 50 hypertensive patients were selected and polysomnography was performed. Of the 50 patients, 34 (68%) had OSA (AHI > 5).

Of the 50 patients, 27 (54%) were on antihypertensive medication and 23 (46%) were not receiving any antihypertensive medication. The presence of OSA was studied in these patients. It was found that of 27 patients

Table 1: AGE and OSA

Age (Years)	OSA status		Total
	Present	Absent	
18–40	5	6	11
40–60	19	10	29
>60	8	2	10
Total	32	18	50

χ^2-Test insignificant, $p = 0.167$

Table 2: BMI and OSA

BMI (categorical)	OSA status		Total
	Present, *N* (%)	Absent, *N* (%)	
Normal (<23 kg/m^2) (e”23 kg/m^2)	9 (64.3%)	5 (35.7%)	14 (100%)
Overweight and obese	25 (69.4%)	11 (30.6%)	36 (100%)
Total	34 (68%)	16 (32%)	50 (100%)

χ^2-Test insignificant, $p = 0.7$

who were on antihypertensive medications, 20 (74.1%) had OSA and 14 (60.9%) who were not receiving any antihypertensive medication also had OSA. There was no statistical significant difference ($p = 0.318$) in the presence of OSA among treated and untreated hypertensive patients.

Although limited by a small sample size, this study has shown an association between OSA and hypertension. It has been seen that there is a high prevalence of OSA in treated and untreated hypertensive patients. A population-based study carried by *et a* Hla KM, T B Young *l.*[15] showed that log odds of hypertension varied linearly with AHI.

In summary, our study suggests a correlation between hypertension and OSA, which is a known fact. It also suggests a linear correlation between increasing systolic and diastolic BP and severity of OSA, hence suggesting that uncontrolled hypertensive patients requiring multiple medications should be screened for the presence of OSA. Also, the study showed that patients with a normal BMI did have moderate-to-severe OSA, suggesting that all hypertensive patients with a normal BMI should also be screened for the presence of OSA.

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