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ORIGINAL ARTICLE

Improvement in Hypertension Symptoms and Measurement Readings of Blood Pressure with Non-Invasive Positive Pressure Ventilation in Hypertensive Patients having Obstructive Sleep Apnea/Hypopnea Syndrome (OSAHS)

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Abstract

Objective: Hypertension is a common comorbidity in obstructive sleep apnea/hypopnea syndrome (OSAHS). OSAHS can raise blood pressures to pre-hypertensive and hypertensive ranges, increase the prevalence of "non-dipping" overnight blood pressure patterns, and increase the risk of resistant hypertension. The gold standard treatment for OSAHS is non-invasive ventilation through CPAP. The aim of this study is to investigate the effects of non-invasive positive pressure ventilation/CPAP on symptoms of hypertension and the blood pressure measurements in hypertensive patients having OSAHS.

Patients and methods: We conducted a retrospective study among 10 male patients with OSAHS (group 1) and co-morbid hypertension and 10 control subjects (group 2) with the same disease, the first 10 patients received non-invasive positive pressure ventilation therapy while the controls did not. The data was collected during duration of 2 months (1 month - before treatment and 1 month - after treatment. The AHI (apnea-hypopnea index)/RDI (respiratory disturbance index) and 6 times per day blood pressures measurements, keeping a close watch on general hypertension symptoms through a customised questionnaire.

Results: When both the group's data were compared it showed a considerable decline in;

• Mean AHI (apnea hypopnea index) - upto 1.2 events/hour.

• Mean RDI (respiratory disturbance index)-upto 1.8 events/hour.

• Mean blood pressure measurements (ranging from 2-6 mmHg).

• Systemic manifestations of hypertension.

Conclusion: Our study shows that the treatment with non-invasive continuous positive pressure ventilation in OSAHS patients having co-morbidity of hypertension lead to a decrease in 24 hours ambulatory blood pressure levels, showing relatively modest impact on overall blood pressure values (avg. 2-4 mmHg), patients with high AHI/RDI showed larger improvements.

The incidence of general symptoms of hypertension (eg. lightheadedness, morning headache, nosebleeds, blurry vision etc.) was also found to be significantly reduced.

Keywords

Hypertension symptoms, Blood pressure measurements, Non-invasive positive pressure ventilation, CPAP, AHI, RDI, Obstructive sleep apnea/hypopnea syndrome, OSAHS

Introduction

Obstructive sleep apnea (OSA) is a disorder that is characterised by obstructive apneas, hypopnea, and/or respiratory effort-related arousals caused by repetitive collapse of the upper airway during sleep [1]. There is a scarcity of published data on the global prevalence of obstructive sleep apnea, a disorder associated with major neurocognitive and cardiovascular sequelae. OSA is the most common sleep-related breathing disorder. OSA is most common among older males, but it can also affect females and children. The incidence rises following menopause such that rates are similar in postmenopausal individuals.

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The estimated prevalence approximately 15 to 30% in males and 10 to 15% in females, when OSA is defined broadly as an apnea-hypopnea index (AHI) greater than five events per hour of sleep. When more stringent definitions are used (eg. AHI ≥5 events per hour plus symptoms or AHI ≥ 15 events per hour), the estimated prevalence is approximately 15% in males and 5% in females. Global estimates using five or more events per hour suggest rates of 936 million people worldwide with mild to severe OSA, and 425 million people worldwide with moderate to severe OSA, between the ages of 30 and 69 years of age [2].

The prevalence of OSA also varies by race [3,4]. OSA is more prevalent in African Americans who are younger than 35 years old compared with White Americans of the same age group, independent of body weight. The prevalence of OSA in Asia is similar to that in the United States, despite lower rates of obesity. The prevalence appears to be increasing and may relate to the increasing rates of obesity or increased detection rates of OSA. In one study, the estimated prevalence of OSA between 1990 and 2010 increased from 11 to 14% in adult males and from 4 to 5% in adult females [5-7].

According to the 2007 American Academy of Sleep Medicine Manual, apneas were defined as a reduction of 90% or more of baseline nasal airflow with duration of at least 10 seconds, and hypopnea as a nasal flow reduction of 30-90% of baseline, lasting at least 10 seconds accompanied by an oxygen desaturation of ≥ 4%. In line with the American Academy of Sleep Medicine recommendation, moderate or severe OSA was defined by an apnea- hypopnea index (AHI) ≥ 15/h irrespective of symptoms, Hypertension but not OSA per say, is also associated with increased arterial stiffness. Hypertension was highly prevalent and poorly controlled.

Studies performed in the past 10-20 years have identified several OSA-related factors that can account for this marked increase [8]. First, although detectable in lean and normotensive patients, OSA is highly prevalent in patients with obesity and hypertension in whom it is often the cause of resistance to treatment. And also vice versa i.e. Hypertension is an increasingly prevalent co-morbid condition in OSA patients, this being called secondary hypertension. Second, OSA patients are characterised by a non-dipping blood pressure (BP) pattern and nocturnal hypertension [9] sympathetic activation [10], and an increased BP variability [11].

The gold standard of treatment in OSAHS is use of CPAP therapy [12], for most people, an appropriate CPAP pressure is between 6 and 14 cm H_2O, with an average of 10 cm H_2O. The settings are subjected to customizations according to patients' conditions such as adherence to the therapy, his/her attitude towards the treatment modality and the markers of severity (AHI/RDI).

The aim of this study is to investigate the effects of non-invasive positive pressure ventilation/CPAP on symptoms of hypertension and the blood pressure measurements in hypertensive patients having OSAHS.

Patients and Methods

Patients

We selected 35 male patients all having active OSAHS, evaluated then for severity of the disease (moderate to severe disease), presence of hypertension with active symptoms [13] we found out that 10 patients out of those selected had only mild disease, 5 patients either did not have hypertension or did not have recognizable symptoms, these 15 patients were excluded.

We were then left with only 20 patients out of which only 10 patients had co-morbid secondary hypertension and 10 only had OSAHS (control). All the patients were males of age ranging from 30 years to 45 years (mean age 37.5 years).

Methods and study design

All 20 patients were divided into two groups 1) hypertensive group and 2) OSAHS only group.

All the patients were equipped with a home CPAP device with integrated sleep monitoring system (the AHI and RDI was calculated with the data obtained from the sleep monitoring device), the patients were also asked to measure their blood pressures 6 times a day at regular intervals with a digital sphygmomanometer. A questionnaire was also provided to the patients who included questions about the quality of sleep, daytime sleepiness, hypertension symptoms and other general questions. The data was collected during duration of one month both before treatment and after treatment, also requiring the patients to visit the polyclinic once every week for a thorough examination along with the data obtained with above mentioned investigations, to be submitted which was used to deduce the outcome of the study.

Treatment modality

The treatment modality used in both group 1 and group 2 patients was continuous positive pressure ventilation daily for 1 month (treatment period) at night during sleep period with the help of a CPAP machine. Pressure settings were individually customised for each patient, ranging from 6 to 14 mm H_2O, with an average of 10 mm H_2O (minor personalised pressure adjustments were allowed) [14].

Group 1 patients, since they had existing secondary hypertension, most of them were taking antihypertensive drugs at moderate doses for a long time, the use of which cannot be neglected, hence producing little surges/deviation of blood pressure measurements, to dissolve the effect of these medications on our results we took blood pressure measurements 6 times a day.

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Table 1: Characteristics of patients before treatment (observed over a month).

	OSAHS + Htn. Group (group 1)/n = 10										OSAHS only - Group (Group 2)/n = 10									
Characteristics	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Pt.9	Pt.10	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Pt.9	Pt.10
Age (in years)	31	31	34	37	41	30	37	36	38	44	45	43	31	32	33	34	39	30	34	32
Mean AHI (events/hour)	16	17.8	20.4	15.7	21	23.2	6.7	10.1	12.1	13.6	15.3	14.7	17.2	23.3	30.1	19.2	12.7	18.5	17.6	7.8
Mean RDI (events/hour)	16.8	17.8	20.6	15.8	21.7	25.2	7	11.2	12.2	13.7	18	17.3	17.2	24	31	20.5	12.10	18.7	11.8	10
Mean blood pressure (mean of 6 reading/day) in mmHG (systolic/ diastolic)	135/80	141/89	139/82	145/90	136/78	136/85	150/92	146/84	147/110	162/98	111/68	120/78	125/80	120/81	127/78	123/77	119/69	121/81	128/80	117/79
	Clinical features of hypertension																			
Headaches	+	+	-	+	+	-	-	+	-	+	+	-	-	-	-	-	-	-	-	-
Dizziness	-	-	-	+	+	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-
Vision problems	-	-	+	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Nausea	+	-	+	+	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
Vomiting	+	-	+	+	+	+	-	+	+	+	-	-	-	-	+	-	-	-	-	-
Nose bleed	-	+	+	-	+	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
Fatigue or confusion	+	+	-	+	+	+	+	+	-	+	+	-	-	-	-	-	-	-	-	-
Chest pain	-	+	-	-	+	-	+	-	-	+	-	-	-	-	-	-	+	-	-	-
Dyspnea	+	+	-	+	+	-	-	+	+	-	+	-	-	+	-	+	-	+	-	-
Palpitations	-	+	-	-	-	+	+	-	-	+	-	-	-	-	-	-	-	-	+	-

Results

After a thorough examination, collection of data, and plotting of the data, the following data was obtained. The data obtained is represented in tabular format for better understanding where table 1 display the characteristics of patients before treatment, and table 2 consists of data of the same patients post 1 month of treatment. Patients has been assigned numbers from 1-10 in both groups individually, for sake of convenience.

As we see in table 1 that before treatment of OSAHS had been initiated with CPAP group 1 patients have considerably more hypertension symptoms the group 2 patients (for detailed assessment see discussion part).

When compared with table 1, table 2 shows a considerable decline in;

1. Mean AHI (apnea hypopnea index)
2. Mean RDI (respiratory disturbance index)
3. Mean blood pressure measurements (ranging from 2-6 mmHg)
4. Systemic manifestations of hypertension.

Discussion

In group 1 and group 2 patients before treatments, we can see that almost all of the patients have moderate to severe OSAHS with 1 month mean AHI ranging from 6.7 to 30.1 events/hour of sleep. Where as in the same patients post treatment we can observe a significant decline in AHI readings, this is because the CPAP machine counters the negative pressure build up in the pharynx during inspiration. This negative pressure during inspiration along with decreased muscle tome during sleep due to activation of parasympathetic system sometimes leads to collapse of the walls of pharynx which leads to acute apnea episodes interrupting the sleep and waking the person, if not collapse, the walls of pharynx may be pulled inwards towards the lumen of pharynx leading to rubbing and fluttering of the walls against each other this manifests as snoring. CPAP in this case prevents this collapse/partial collapse and prevents the manifestations of the disease. Leading to a better quality of sleep hence, decreasing day time sleepiness and fatigue hence a better quality of life [15].

If you're having particular difficulties tolerating pressure, some machines have special adaptive pressure functions to improve comfort. You might also benefit from using a humidifier along with your CPAP system.

CPAP may be given at a continuous (fixed) pressure or varied (auto-titrating) pressure (APAP). In fixed CPAP, the pressure stays constant. In auto-titrating CPAP [16] the levels of pressure are adjusted if the device senses increased airway resistance [17].

Bi-level positive airway pressure (BPAP), another type of positive airway pressure, delivers a preset amount of pressure when you breathe in and a different amount of pressure when you breathe out. On the other hand there are several risk factors which has been associated with OSAHS like obesity, smoking, congenital anatomical anomalies etc. in counter of which lifestyle changes may help a lot again improving the quality of life in such patients [18].

Hypertension on the other hand is a common comorbidity with OSAHS, pathology of which is attributed to the arterial stiffening caused due to recurrent episodes of apnea/hypopnea [19]. Our study it showed that the measurements of blood pressures in such patients has shown a considerable improvement i.e. decline of blood pressure by an average of 2-4 mmHg.

Hypertension can be a critical boundary between healthy and sick, the use of CPAP in such patients (especially those with good adherence to the therapy) can improve the quality of life in such patients.

The variation in the data that you see in table 1 and table 2 need a multifactorial approach to explain, for instance; the age, the adherence to the therapy, the attitude of the patient towards the treatment etc. may make a considerable difference in the treatment success. Also on the other hand other factors like obesity, COPD, diabetes [20] etc., can play a role in defining the success of the treatment. Secondarily, symptoms like fatigue and sleepiness or dizziness are common features of both the OSAHS and hypertension, and as in our study you can see that these symptoms are still prevalent in such patients even after the treatment.

Although there are many other treatment modalities available for the treatment of OSAHS, for example mandibular advancement devices (MADs). MAD is an alternative treatment method that people can try. It works by temporarily moving the jaw and tongue forward, which reduces throat constriction and prevents sleep apnea and snoring. Moving the tongue forward increases airway space. Other examples include surgical removal of tissue. Uvulopalatopharyngoplasty (UPPP) is a procedure in which your doctor removes tissue from the back of your mouth and top of your 66 throat. Your tonsils and adenoids may be removed as well. UPPP usually is performed in a hospital and requires a general anesthetic and many more procedures are under research and are a subject for further discussion.

The end of this discussion it is safe to say that, yes CPAP provides benefits in not only OSAHS symptoms but also cause a considerable decline in blood pressure measurements and hypertension symptoms.

Conclusion

To conclude the study, we can testify that OSAHS with secondary hypertension responds well to CPAP therapy, provided that the treatment is well tolerated

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Table 2: Characteristics of patients after treatment (observed over a month).

	OSAHS + Htn. Group (group 1)										OSAHS only - Group (Group 2)									
Charecteristics	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.6	Pt.7	Pt.8	Pt.9	Pt.10	Pt.1	Pt.2	Pt.3	Pt.4	Pt.5	Pt.5	Pt.6	Pt.7	Pt.8	Pt.8
Age (in years)	31	31	34	37	41	30	37	36	38	44	45	43	31	32	33	34	39	30	34	32
Mean AHI (events/hour)	7	5.2	6.7	4	2	7	7.7	1.8	8.1	4.7	2.9	5	7.8	10.5	9	2	1.2	1.3	2.6	3.7
Mean RDI (events/hour)	7	5.33	6.9	4.2	2.8	8	7.7	2	9	5	3.2	5.1	8	11.3	9.4	2.1	1.8	1.5	3	4
Mean blood pressure (mean of 6 reading/day) in mmHG (systolic/ diastolic)	130/80	138/85	134/80	142/91	132/78	130/85	145/91	142/82	145/108	160/95	111/68	120/78	125/80	120/81	127/78	123/77	119/69	121/81	128/80	117/79
	Clinical features of hypertension																			
Headaches	-	+	-	-	+	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-
Dizziness	-	-	-	-	-	-	-	+	-	+	-	-	-	-	-	-	-	-	-	-
Vision problems	-	-	+	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	-
Nausea	+	-	+	+	-	+	+	+	+	-	-	-	-	-	-	-	-	-	-	-
Vomiting	-	-	+	-	-	-	-	+	-	-	-	-	-	-	+	-	-	-	-	-
Nose bleed	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Fatigue or confusion	+	+	-	+	-	+	+	-	-	+	+	-	+	-	-	-	+	-	-	-
Chest pain	-	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-	+	-	-	-
Dyspnea	-	+	-	-	+	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-
Palpitations	-	-	-	-	-	+	-	-	-	+	-	-	-	-	-	-	-	-	+	-

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and the patient have good adherence to the therapy [21]. Provided the two conditions are fulfilled the CPAP therapy is able to decrease the blood pressure up to 2-4 mmHg, produce a significant reduction in hypertension symptoms and improve the quality of life in such patients.

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