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Effect of Sleep Position and Body Mass Index on Severity of Sleep Apnea

Yatış Pozisyonu ve Vücut Kitle İndeksinin Uyku Apnesinin Ağırlığı Üzerine Etkileri

Original Investigations
Özgün Araştırmalar

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Abstract

Objective: To examine the effects of sleep position and body mass index on obstructive events in adults with obstructive sleep apnea syndrome (OSAS).

Methods: The sleep studies of 51 adults with OSAS (apnea-hypopnea index >5/h) were retrospectively evaluated. The study population was classified into obese (body mass index (BMI) >30 kg/m^2) and non-obese (BMI<30 kg/m^2) subjects. Sleep positions were classified as supine and non-supine (prone, left lateral, right lateral). Data on total obstructive apnea-hypopnea index (AHI), AHI by position, AHI by BMI, rapid eye movement (REM) and non-REM sleep AHI, and REM and non-REM sleep AHI by position were evaluated.

Results: The mean age was 46.75±10.93 years and 90% of subjects were males. Total sleep time was 366.49±62.50 minutes. The mean AHI was 33.97±25.45. The mean BMI was 31.17±5.76 kg/m^2. There was no significant difference between the obese and non-obese groups' age and AHI (p>0.05). There was no statistically significant difference between non-obese cases and the supine and non-supine values of the obese subjects (p>0.05). There was no difference in the AHI index in the obese and non-obese group in the supine and non-supine position and in NREM periods (p>0.05). The AHI was worse in REM periods. The AHI was worse in all obese and non-obese subjects in the supine position (p<0.05-0.01).

Conclusion: In OSAS the AHI was higher in the supine position. Obesity had no additional effect. On the other hand in all subjects while REM, NREM, AHI situations were indifferent, obese subjects AHI index in REM period is worsen.

Key Words: Sleep apnea, body position, body mass index, sleep stage

Özet

Amaç: Polisomnografide tıkayıcı tipte uyku apnesi saptanan olguların yatış pozisyonu ve vücut kitle indeklerinin uyku apnesine etkisinin incelenmesi planlandı.

Yöntemler: Tıkayıcı tipte uyku apnesi saptanan apne-hipopne indeksi (AHİ) >5 51 erişkin olgunun uyku çalışmaları geriye dönük olarak incelendi. Olgular vücut kitle indekslerine göre obez vücut kitle indeksi (VKİ) >30 kg/m^2 ve obez olmayan (VKİ<30 kg/m^2) olmak üzere iki gruba ayrıldı. Ayrıca yatış pozisyonları da supin ve supin olmayan (prone, sağ yan, sol yan) olarak iki grupta incelendi. Olguların total apne-hipopne indeksleri (AHİ), AHİ'lerinin yatış pozisyonu ve VKİ ile ilişkisi, REM ve non REM uykusundaki AHİ'leri değerlendirildi.

Bulgular: Olguların %90'ı erkek olup ortalama yaşları 46.75±10.93'dü. Toplam uyku süresi 366.49±62.50 dakika idi. Ortalama AHİ 33.97±25.45'dir. Ortalama VKİ 31.17±5.76 kg/m^2 idi. İstatistiksel olarak obez ve obez olmayan gruplar arasında AHİ, yaş ve yatış pozisyonları açısından anlamlı fark saptanmadı (p>0.05). Uyku evreleri açısından obez ve obez olmayan grupların; supin ve supin olmayan pozisyonlarındaki AHİ NREM'de farklılık göstermemekte fakat REM'de AHİ'leri kötüleşmekte idi. Bütün olguların AHİ'leri supin pozisyonda daha kötüleşmekte olduğu saptandı (p<0.05-0.01).

Sonuç: Tüm tıkayıcı tipte uyku apnesi saptanan olguların apneleri supin pozisyonda kötüleşmekte olduğu ancak obezitenin bu duruma ek bir katkısı olmadığı gözlemlendi. Bir diğer açıdan da tüm olguların AHİ'leri yatış pozisyonlarına ve uyku evrelerine göre değişmemekle birlikte obez olguların AHİ'lerinin REM peryodunda daha kötüleştiği saptandı.

Anahtar Kelimeler: Uyku apnesi, vücut pozisyonu, vücut kitle indeksi, uyku evresi

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Introduction

Obstructive sleep apnea syndrome (OSAS) is a chronic condition characterized by frequent episodes of upper airway collapse during sleep. This collapse results in substantially reduced (hypopnea) or complete cessation (apnea) of airflow despite ongoing breathing efforts. It is estimated to affect approximately 3-7% of the adult population (1). The prevalence of OSAS has been reported to increase with increasing body mass index (BMI). The aetiology and pathophysiology of the disorder is believed to be multifactorial.

The collapse of the upper airways is modified by a number of factors. In subjects with obstructive sleep apnea less negative pressure is needed to create a collapse of the upper airways compared to normal individuals (2). This increased collapsibility in OSAS subjects may be due to an anatomically narrow pharynx, an altered reflex response or altered neuromuscular control (3). These factors may change as body position changes during sleep.

The importance of body position in the pathogenesis of sleep apnea has been highlighted in several studies, but with contradictory results (3-5). In our study we investigated the influence of sleep position within sleep stage rapid eye movement (REM) or non-rapid eye movement (non-REM) and according to body mass index by evaluating the polysomnography (PSG) of 51 subjects with OSAS.

Methods

The protocol of this retrospective study was approved by the institutional review board of the Bakirköy Training and Research Hospital. The consecutive sleep studies of 51 adults with an OSAS apnea-hypopnea index (AHI) >5 who attended our sleep laboratory unit were evaluated. The subjects arrived at the sleep unit around 20:00 and the PSG recording lasted from 22:00 till 6:00. The PSG recordings were performed using the Somnologica® (Embla Systems, Inc., Broomfield, CO, USA) system, which evaluated the following variables: electro-oculogram (two channels); electroencephalography (EEG - four channels); electrocardiography (ECG); electromyogram (EMG) of submental muscles and both anterior tibialis leg muscles; airflow (with nasal or oral thermistor); and thoracoabdominal respiratory effort. Arterial oxyhaemoglobin saturation was measured using a pulse oximeter placed on the subject's finger. Snoring sounds (one channel) were recorded via a microphone located above the subject's head.

Body position was confirmed by direct recording of the subjects. Changes in position lasting more than 5 seconds were considered as valid changes. Sleep body positions were classified as supine and non-supine (prone, left lateral, right lateral). Sleep staging was scored in 30-s epochs according to standard guidelines (6). Each epoch was analysed for the number of apneas and hypopneas. An apnea was defined as the absence of airflow for >10 s. Events were scored as hypopneas when a visible reduction in airflow lasting at least 10 s was associated with a 4% decrease in arterial oxyhaemoglobin saturation. The AHI was defined as the number of apneas and hypopneas per hour of sleep. A sleep study finding for OSAS was considered positive when the AHI was more than five events per hour. The severity of sleep apnea was classified according to the American Academy of Sleep Medicine task force. The severity of sleep apnea was classified as mild if the AHI ranged from 5 to 15/h, moderate when the AHI ranged between 15 and 30/h, and severe when the AHI was >30/h. Subjects were also classified according to their body mass index.

Body mass index was calculated as weight in kilograms divided by the square of height. The obese group included patients with a BMI ≥30 kg/m^2 and the non-obese group included those with a BMI <30 kg/m^2. The values measured in the supine and non-supine position as well as REM and NREM sleep values were compared between obese and non-obese groups. A comparison of supine and non-supine position, and REM and non-REM sleep values according to AHI severity was also conducted.

Statistical analysis

The NCSS 2007&PASS 2008 Statistical Software (Utah, USA) was used for the statistical analysis. Descriptive statistical methods (Average, Standard deviation) were used to evaluate the data, and the Kruskal Wallis test was used for inter-group comparison of the parameters that do not demonstrate distribution. The Mann-Whitney U test was used to determine the group responsible for a difference. The Wilcoxon sign test was used for within-group comparisons. The results were evaluated according to a confidence interval of 95%, and a significance level of $p<0.05$.

Results

The data of 51 subjects were analysed in this study. There were 46 men and 5 women, aged between 18 and 73 years (mean 46.25 years). Total sleep time was 366.49±62.50 minutes. The mean AHI was 33.97±25.45. The mean BMI was 31.7±5.76 kg/m^2. Among the OSA subjects 17 were classified as mild, 8 as moderate and 26 as severe OSAS. According to the BMI, 25 subjects were obese and 26 subjects were non-obese.

There were significant differences between the mean non-supine AHI (27.0±29.9) and supine AHI (44.5±29.6) ($p=0.01$). There was no significant difference between obese and non-obese age and AHI ($p>0.05$). There was no significant difference between obese and non-obese supine and non-supine values and NREM values ($p>0.05$), nor were there any differences in their AHI ($p>0.05$). The AHI was worse during REM periods. The AHI was worse in all subjects when in the supine position ($p<0.05$-0.01) (Table 1).

According to the AHI there are highly statistically significant difference between supine position ($p<0.01$). In the binary comparisons that were conducted to determine the source of the significance, supine levels of mild cases was lower in significance than the moderate and severe cases ($p=0.005$; $p=0.001$); the supine values of the moderate cases were lower in significance than the severe group ($p=0.009$). According to the AHI, there are highly statistically difference between non supine values ($p<0.01$); in the binary comparisons that were made to determine the source of the significance, the supine levels of the mild cases were significantly lower than the severe subjects ($p=0.003$) while they have been found to demonstrate no significant difference than the AHI moderate cases ($p=0.370$) (Table 2).

Discussion

Polysomnography is considered the gold standard in the diagnosis of sleep disorders. A gold standard should have 100% sensitivity and specificity; however, like most other diagnostic tests, PSG is not ideal but rather the best available method for diagnosing OSAS. When evaluating a sleep study factors such as sleep position need to be taken into consideration. Breathing disturbances may vary according to sleep position. The results of this study demonstrate that in subjects with severe OSA, who had a large number of apneic events in both the supine and non-supine position, the apneic events occurring in the supine position were more severe than those occurring in the non-supine position. If positional worsening is detected, positional therapy will be considered among other treatment options.

George et al. (7) found that in obese sleep apnea subjects, apneas and hypopneas occur more frequently in the supine position.

Table 1. Comparison of values in supine, non-supine position, REM and non-REM sleep between obese and non-obese group

	Non-obese Ort±SD (median)	Obese Ort±SD (median)	*p
Supine	30.09±27.93 (38.05)	49.65±30.90 (52.8)	0.214
Non-supine	20.52±27.71 (8.58)	32.66±32.16 (30.75)	0.144
†p	0.004**	0.003**	
REM	31.92±27.77 (27.1)	46.67±28.98 (42.60)	0.048*
Non-REM	28.13±22.23 (26.70)	40.35±29.73 (33.15)	0.221
†p	0.330	0.313	

*: Mann-Whitney U test, **p<0.01
†: Wilcoxon signed Rank test
REM: Rapid eye movement, Non-REM: Non-rapid eye movement

Table 2. Comparison of supine and non-supine position, and REM and non-REM sleep values according to AHI severity

	AHI			
	Mild Ort±SD (median)	Moderate Ort±SD (median)	Severe Ort±SD (median)	*p
Supine	17.10±21.60 (10.80)	38.60±26.74 (30.10)	63.33±19.69 (64.60)	0.001
Non-supine	11.24±21.06 (6.39)	10.20±9.96 (7.43)	42.40±31.25 (35.48)	0.004*
†p	0.030*	0.063	0.002**	
REM	15.84±18.80 (10.90)	31.62±16.23 (31.40)	54.42±26.53 (54.10)	0.001**
Non-REM	12.10±19.77 (7.60)	20.68±6.54 (20.15)	53.12±20.23 (47.30)	0.001**
†p	0.244	0.123	0.677	

*: Mann-Whitney U test, **p<0.01
†: Wilcoxon signed Rank test
AHI: Apnea-hypopnea index, REM: Rapid eye movement, Non-REM: Non-rapid eye movement

This is true during NREM but not during REM sleep. According to their findings positional therapy may not be useful for subjects with severe OSAS. In their study fewer obese subjects were likely to show position-sensitive apneas than non-obese subjects. In our study there was no significant interaction between body position and sleep stage. However many factors (number of subjects, upper airway resistance, size of pharynx, position-induced reflexes) contribute to the rate of apneas. Further studies that include a large number of subjects and evaluate the effect of these factors on OSAS will be helpful.

Penzel et al. (3) also found no significant interaction between body position and sleep stage. They examined the effect of body positional collapsibility of the upper airways during all sleep stages for a possible reduction from the supine to lateral position. Their study indicated that upper airway collapsibility in either the lateral or supine position was not affected by sleep stage. No significant effects of position on upper airway resistance were found.

Oksenberg et al. (8) showed that the severity of OSAS is determined not only by the apnea+hypopnea index but also by the number of apnea or hypopnea events themselves. They stated that the probable physiological mechanism responsible for increased apnea severity in the supine position is related to the effect of gravity on the upper airway. It is known that in the supine posture, gravity increases the tendency of the tongue and soft palate to block the throat, which will cause breathing abnormalities.

There are limited data available on the effects of positional therapy in subjects with sleep apnea but our study demonstrated that all types of OSAS subject were worse in the supine position. Positional therapy may be a clinically effective method for selected OSAS subjects. Oksenberg et al. (9) recommended positional therapy mainly for older subjects who chose to use this form of therapy rather than continuous positive airway pressure treatment. The tennis ball technique is a type of positional therapy that was used in the abovementioned study.

Despite the fact that over half of OSAS subjects record changes in OSAS severity with body position, these data have not been used for treatment modalities. The importance of body position in the pathogenesis of sleep apnea has been demonstrated in several studies but the results were contradictory (3-5). Most studies in this area are small, non-randomized, uncontrolled and short term. Our study also involved a small number of subjects.

Conclusion

Polysomnography should always be interpreted in light of a subject's sleep position. Sleep position will worsen the apneic or hypopneic events in subjects with OSAS. Before choosing conservative positional therapy or more invasive surgical treatment, the presence or absence of positional change effects should be evaluated. In selected cases positional therapy should be used in conjunction with other treatments.

Conflict of interest

No conflict of interest was declared by the authors.

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