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Investigation of Arterial Blood Gas in Radial Artery in Patients with Observative Sleep Apnea Syndrome

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Abstract
Objective: Apnea developing during sleep prevents gas exchange in the body for 10 seconds or more. As a result, there is a significant decrease in partial oxygen pressure (PaO2) and a significant increase in partial carbon dioxide pressure (PaCO2). Patients with Obstructive Sleep Apnea Syndrome (OSAS) have systemic hypertension, heart failure, arrhythmia, chronicle artery disease, cerebrovascular diseases, and sudden death. The aim of this study is to determine the undiagnosed OSAS by looking at arterial blood gas changes in the radial artery.Materials and Methods: In this study, the patients were divided into two groups according to the severity of OSAS (the first group consisted of 13 patients, Apnea-Hypopnea Index 5 Ap15 and the second group consisted of 11 patients, Apnea-Hypopnea Index 16 and above). Blood samples were taken from radial arteries of patients in two groups. Arterial blood gases between groups; PaO2, PaCO2, arterial oxygen saturation (SaO2), hydrogen ion concentration (pH) values and accompanying diseases were examined.Results: There was no significant difference between the arterial blood gases values of patients in two groups. This suggests that arterial blood gas values in the blood taken from the radial artery alone cannot diagnose or fail to diagnose OSAS. However, patients in the two groups; 88% chronic obstructive pulmonary disease (COPD) was found as the concomitant disease. This suggests us thinking that the abnormal blood gas values (PaO2 level below normal limits and PaCO2 level above normal limits) is associated with COPD which accompanies the disease with OSAS.Discussion: Identification and treatment of OSAS prevent the development of complications associated with OSAS and may provide treatment for OSAS. Undiagnosed OSAS may be considered in the presence of abnormalities in the examination of arterial blood gas in the radial artery in patients presenting with OSAS findings (such as snoring, witnessed apnea, daytime sleepiness etc.) and accompanying COPD.This paper is just a sample template for the prospective authors of IISTE Over the decades, the concepts of holons and holonic systems have been adopted in many research fields, but they are scarcely attempted on labour planning. A literature gap exists, thus motivating the author to come up with a holonic model that uses exponential smoothing to forecast some quantitative variables in labour-intensive production. These varying parameters include the machine utilisation that reflects the demand and the worker absenteeism and turnover that constitute the disturbance. Collective equations are formulated to periodically compute the number of workers required. For model validation purpose, twenty-four-month data analysis is conducted on a mock-up basis.
Keywords: OSAS; Polysomnography; PaO2; PaCO2; SaO2
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1. Introduction

Although we spend most of our life (average 1/3) in sleep, the information about sleep is quite new. Sleep studies gained a new dimension with Hans Berger's electroencephalography (EEG) recording in 1929(Berger, 1930). Gastaut's polysomnography record in 1965 was a major step towards the investigation of sleep disorders on behalf of science.

Obstructive Sleep Apnea Syndrome (OSAS) is understood when Sleep Apnea Syndrome is uttered. OSAS is a syndrome characterized by a decrease in oxygen saturation in the blood due to the occurrence of apnea or hypopnea in OSAS(Dewan et al, 2015). As a result, hypoxemia, hypercapnia and night sleep disorders occur.

The ASDA (American Sleep Disorders Association), in 1997, described the OSAS as “a syndrome characterized by episodes of recurrent upper airway obstruction during sleep and often a decrease in blood oxygen saturation”. Apnea developing during sleep prevents the gas exchange in the body for 10 seconds or more. As a result, there is a significant decrease in PaO2 level in arterial blood gas and a significant increase in PaCO2(Ryan and McNicholas, 1994).

The prevalence of OSAS increases by age similar to Chronic Obstructive Pulmonary Disease (COPD) (Cosio et al, 2014; Vestbo et al, 2013). The common age range when OSAS is witnessed in the world is between 40 and 65 years.

The prevalence of obstructive sleep apnea syndrome in the general population is approximately 3-7% for adult males and 2-5% for adult females. In addition, the prevalence of the disease is higher in overweight or obese people and the elderly(Force, 1999). Based on this result, approximately 2-3 million people with OSAS patients are estimated to live in Turkey. As a result of a survey conducted in North India in 2006, the prevalence of the

OSAS was estimated to be 3.6% (male 4.9% and female 2.1%). This study was carried out in a semi-urban Indian population without differentiating between different socio-economic strata (Sharma, S. K and Ahluwalia, G, 2010).

Obstructive sleep apnea has been involved in the etiology of many diseases such as hypertension, coronary artery disease, congestive heart failure and stroke. Previous studies on whether obstructive sleep apnea is an independent cardiovascular risk factor is confusing. However, with the emergence of large epidemiological studies and well-controlled clinical studies, it has now revealed that a significant risk of obstructive sleep apnea, particularly hypertension, has a significant risk in the emergence of various cardiovascular diseases (Punjabi, 2008). In addition, OSAS is strongly associated with type 2 diabetes mellitus and hyperlipidemia (Sokwalla et al, 2017). In particular, there is evidence that untreated OSAS may contribute to pathophysiological mechanisms such as hypertension, cardiac ischemia, myocardial infarction, congestive heart failure, and stroke (Kohler and Stradling, 2010). Patients with OSAS also have a high relationship with patients having systemic hypertension. Previous studies have shown that approximately 50% of OSAS patients have hypertension (Silverberg DS et al. 1998), and approximately 30% of hypertensive patients have OSAS (Williams et al, 1985). The most important of all is sudden death due to cardiac and cerebral causes in patients with OSAS.

Patients with OSAS are usually obese, with a thick neck (> 43 cm neck circumference in males, > 38 cm in females) and short stature (Ryan and McNicholas, 1994). Fat deposits in the upper respiratory in obese people tract narrow the airway and lead to obstruction. A decrease in muscle activity is witnessed in the region and as a result, this leads to hypoxic and apneic episodes resulting in sleep apnea. This results in a decrease in the amount of PAO2 in tissues and blood (Xiaoli et al, 2014).

COPD is the most common disease accompanying with OSAS. The coexistence of OSAS and COPD is know as “overlap syndrome” (Flenley, 1985). However, whether COPD occurs in patients with OSAS or OSAS occurs in patients with COPD is still controversial (Ryan and McNicholas, 1994). The presence of COPD in patients with OSAS was found to increase the death risk seven-fold (Lavie et al, 2007).

Over the past two decades, the development of sleep medicine and the availability of advanced diagnostic tools have led to better recognition and treatment of the disease. Continuous positive airway pressure (CPAP) therapy, which is included in OSAS treatment options, was first initiated in 1981 (Sullivan et al, 1981). In addition, there is weight management, mandibular progression devices and numerous upper respiratory surgical approaches for treatment. In addition to the general measures to be recommended to all patients, CPAP devices are still the most effective and most successful treatment modality for OSAS treatment (Spicuzza et al, 2015).

Polysomnography (PSG) is used for the definitive diagnosis and classification of patients with obstructive sleep apnea syndrome. No studies on the possible correlation between classification by PSG and arterial blood gases were found in the literature review. In addition, whether there is a possible correlation between the number and severity of the diseases caused by OSAS with the classification PSG will be investigated.

2. Material and Methods

In order to carry out the study, approval was obtained from Ethics Committee of Yuzuncu Yil University Medical Faculty (decision dated 12.01.2010 and numbered 10).

The study was carried out in the Sleep Laboratory of Chest Diseases Department of the Research Hospital at Yuzuncu Yil University.

The study included 24 patients with OSAS, whose age range was 40-65 years, with Apnea-Hypopnea Index (AHI> 5), 15 females (62.5%) and 9 males (37.5%). The patients were divided into two groups (the first group consisting of 13 patients were Apnea-Hypopnea Index between 5-15(group I) and the second group consisting of 11 patients with Apnea-Hypopnea Index 16 and higher(group II). Patients usually applied to the sleep laboratory for reasons such as snoring, witnessed apnea, excessive daytime sleepiness, lack of adaptation in their work (for employees), and headache. The procedure was described in detail before patients underwent PSG. The patients were informed that if they were using hypnoic medications, they should be discontinued at least 5 to 10 days before they underwent PSG, and if they used drugs that would affect their sleep (barbiturates, benzodiazepines, etc.), they should stop using them on the day of PSG. The patients were taken into the sleep laboratory about 1 hour before the session so as not to feel themselves foreigners.

The PSG procedure was performed under the supervision of a technician and in the spontaneous sleep of the patients in the sleep laboratory. Patients were left alone in the room after the electrodes were connected to them for the parameters to be recorded on the computer during sleep. All night's sleep was recorded into the computer by technician.

Fasting blood samples were taken from their radial artery between 08: 00-09: 00 after the PSG. Allen test was performed while taking blood from the radial artery. Blood samples taken from patients were analyzed in the Biochemistry Laboratory of Research Hospital of Yuzuncu Yil University Medical Faculty within 5 minutes. Arterial blood samples were taken before the treatment of the patients.

3. Statistics

Descriptive statistics for the features under consideration were expressed as mean, median, standard deviation, minimum and maximum value. In terms of these features, Mann-Whitney U test was used to compare the groups. Spearman correlation coefficient was calculated in each group to determine inter-feature relationships. One-way analysis of variance was used to compare parametric values between groups. Statistical significance level was taken as 0.05.

4. Results

In our study, it is seen that the most common disease accompanying with OSAS is COPD. This result that we have reached is supported by the literature information (Pissulin et al, 2018; Soler et al, 2015). The presence of COPD was found in an average of 88% of cases (Table 1). Hypertension was present in 69% of the patients in the first group and hypertension was found in 45% of the second group.

As seen in Table 2, only a significant positive correlation was found between PaO2 and SaO2 in Group I parameters ($r = 0.942$, $p < 0.01$). According to this result, in patients with an apnea-hypopnea index below 16, SaO2 is found to increase significantly as the PaO2 value increases. No significant differences were found between the groups in terms of other clinical features (hypertension, cardiac arrhythmia, diabetes mellitus, gastroesophageal reflux, peptic ulcer).

The correlation coefficients between the parameters measured in two groups are given in Table 2 and 3. The results of arterial blood gas of the subjects are given in Table 2.

Table 1. Distribution of groups according to clinical characteristics of cases.

Diseases	**available (Yes:1/No:2)**	**Group I [N;%]**	**Group II [N;%]**	P*
COPD	**1**	11;84,6	10;90,9	0.642
	2	2;15,3	1;9	
HT	**1**	9;69,2	5;45,4	0.239
	2	4;30,7	6;54,5	
CA	**1**	2;15,3	2;18,1	0.855
	2	11;84,6	9;81,8	
DM	**1**	3;23	4;36,3	0.476
	2	10;76,9	7;63,6	
GR	**1**	1;7,6	1;9	0.910
	2	12;92,3	10;90,9	
PU	**1**	0	2;18,1	0.065
	2	13;100	9;81,8	
ST	**1**	12;92,3	10;90,9	0.910
	2	1;7,6	1;9	
Snore	**1**	11;84,6	9;81,8	0.855
	2	2;15,3	2;18,1	
Headache	**1**	8;61,5	8;72,7	0.562
	2	5;38,4	3;27,2	
WA	**1**	10;76,9	5;45,4	0.113
	2	3;23	6;54,5	
ESS (10 points and above)	**1**	3;33,3	5;55,5	0.343
	2	6;66,6	4;44,4	

* Chi-square test.

CA: Cardiac arrhythmia ,**CODP:** Chronic obstructive pulmonary disease,**DM:** Diabetes Mellitus,**ESS:** Epworth sleepiness scale,**GR:** Gastroesophageal reflux,**HT:** Hypertension ,**PU:** Peptic ulcer ,**ST:** Smoking or working in tandoor,**WA:** Witnessed apnea

Table 2. Parameters between correlation coefficients of group I

	pH	**$PaCO_2$**	**PaO_2**	**SaO_2**
pH	1,000			
$PaCO_2$	-0,204	1,000		
PaO_2	0,001	-0,477	1,000	
SaO_2	0,162	-0,506	0,942**	1,000

****: p<0.01**

Table 3. Parameters between correlation coefficients of group II

	pH	**$PaCO_2$**	**PaO_2**	**SaO_2**
pH	1,000			
$PaCO_2$	-0,148	1,000		
PaO_2	0,169	0,130	1,000	
SaO_2	0,543	-0,359	0,177	1,000

5. Discussion

Sleep is a necessary and biological process for optimal health that interrupts the communication of the organism with the environment. In this process, the body rests, the cells are repaired, renewed and memory functions are arranged to allow a new day. A healthy sleep regulates metabolism and strengthens immunity. It also plays an important role in the regulation of hormones and cardiovascular systems and in the physiology of brain functions (Consensus, 2015; Research, 2006).

The stages of sleep are historically divided into the phases of rapid eye movement (REM) and four stage (Stage 1-4) non-rapid eye movement (NREM) (Allan Hobson, 1969). REM sleep is the stage of dreams. The NREM phase consists of mild sleep (stages 1 and 2) and slow wave sleep (SWS), called as deep sleep stages (Stages 3 and 4). There is a decrease in the REM sleep period due to arousal occurrence. Because patients with OSAS have transition from superficial sleep (NREM, stage 1 and 2) to dream (REM) sleep phase, patients either wake up or undergo lighter sleep from deep sleep due to apnea or obstruction. Thus, patients have to start a new day either half or without seeing their dreams. This leads to excessive daytime sleepiness due to sleep hunger. In addition, patients with OSAS begin a new day at night without fully resting both physically and psychologically as a result of asphyxia and arousals (Ryan and McNicholas, 1994). This can also lead to an over-day sleep in the OSAS patients, deterioration of their living standards, and reduced daily performance.

Obstructive Sleep Apnea Syndrome develops as a result of repeated apneas in sleep due to obstruction. Body resting, cell repair and regeneration are not completed since arousals (switching to a lighter sleep state or awake state during sleep) develop in patients with OSAS. Respiratory apneas may cause significant cardiac results due to acute gas exchange abnormalities (desaturation) and sleep divisions (Franklin et al, 1995; Su VYF et al, 2015). Male patients with obstructive sleep apnea have a higher risk of nasal cancer and prostate cancer than those without sleep disorders (Fang et al, 2015).

In our study, Epworth Sleepiness Scale (10 points and above was considered positive) was performed on 9 patients from each group. There was no significant difference between the groups but 44% of the total patients had positive results from Epworth Sleepiness Scale. This result supports that arousals impair the quality of life and adaptation of patients with OSAS. In a study that supports our study, it is reported that patients with OSAS often experience traffic and work accidents due to lack of attention in their daily lives. For example, approximately 20% of injuries from car accidents have been associated with driver sleepiness. Studies on traffic accidents have reported that OSAS patients had 2 to 7 times more accidents than normal population (Barbe F et al, 1998). In addition, sudden death in sleep may occur in patients with OSAS for cardiac and cerebral causes. Therefore, early diagnosis and treatment of patients with OSAS is important (He et al, 1988).

The location of polysomnography in the diagnosis of OSAS is indisputable. However, this method is costly, time-consuming and requires special team. In the world and in our country, there are few laboratories that can provide adequate studies about sleep and where polysomnography will be practised. Therefore, it is necessary to be selective in the determination of the people to be taken into the laboratory. Apnea-hypopnea index (AHI) is used to determine the severity of OSAS in patients undergoing polysomnography. The calculation of AHI is found by dividing the total number of apneas and hypopneas occurring in sleep by the duration of sleep (in hours). According to AHI, OSAS is subdivided into groups of less than 5 as normal, 5-15 as mild-grade OSAS, 16-30 as moderate OSAS, 31 or higher as severe OSAS.

Male gender is an important risk factor in OSAS. Due to the androgenic fat distribution of males, generally the amount of fat accumulated around the neck increases the risk of OSAS. In the epidemiological studies conducted in the eighties, the male / female ratio was reported to be 10/1 - 7/1, respectively (Stradling, 1995). In recent studies, the difference is not that high; and male / female ratio in all age groups is reported to be 3/1. In a screening study conducted on 6132 people, 37% of the cases diagnosed as OSAS were female and the remaining 63% were male (Nieto, 2000). In a study conducted in 2002, it was reported that 22.5% of 2437 people were female and 77.5% male (Kapsimalis and Kryger, 2002). In our study, male / female ratio was found to be about 1/2 (62.5% female, 37.5% male).

It has been reported that 50% of OSAS patients have systemic hypertension and 40% of patients with hypertension may have undetected OSAS (Baguet et al, 2006). In our study, systemic hypertension was detected in 58% of the patients in the two groups, which is consistent with other studies. In this study, no statistically significant difference was found between the groups according to smoking status. However, 91.6% of the OSAS patients in the two groups are smoking or exposed to high levels of smoke in the tandoor. In our study, there was

no statistically significant difference between groups according to body mass index (BMI). However, in our study, the patients in the two groups were 45.8% obese, 37.5% overweight and 16.6% normal according to their BMI values. These data suggest that OSAS can also be seen in non-obese individuals (BMI <30).

6. Conclusion

Apnea developing during sleep prevents the gas exchange in the body for 10 seconds or more. This results in a significant decrease in PaO2 level and a significant increase in PaCO2. Fasting blood samples of all patients participating in OSAS in our study were taken from radial arteries. After the analysis of the radial blood samples, arterial blood gas values were found to be abnormal. In addition, the presence of COPD was found in 88% of patients. Abnormal blood gas values (PaO2 levels below normal limits and PaCO2 levels above normal limits) were associated with concomitant COPD. In this case, undiagnosed OSAS can be investigated in the presence of abnormalities in the examination of arterial blood gas in the radial arteries of patients applying to the hospitals with OSAS-related findings (snoring, witnessed apnea, daytime sleepiness etc.) and accompanying COPD. We believe that more comprehensive studies are needed.

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