Relationship between Apnea-Hypopnea Index and Red Cell Distribution Width in Patients with Obstructive Sleep Apnea Syndrome

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Abstract

Objective: The aim of this study was to assess the association between Apnea- Hypopnea Index (AHI) and Red Cell Distribution Width (RDW) in patients with Obstructive Sleep Apnea Syndrome (OSAS) and to investigate whether RDW can be a predictor of disease severity before polysomnography.

Methods: This study was designed as retrospective and cross-sectional. Between January 2018 and March 2018, 109 consecutive patients with symptoms of snoring and sleep apnea included in this study. The study population was divided into four groups: (i) Mild OSAS described as; AHI 5-14.9, (ii) moderate OSAS described as; 15-29.9, (iii) severe OSAS described as; AHI > 30 and (iv) control group described as AHI between 0-4.9 according to polysomnography (PSG). Those with systemic disease that would affect RDW were excluded. Laboratory results and demographic data were extracted retrospectively.

Results: Of the patients included in the study, 83 (76%) were male and 26 (24%) were female. The mean age was 45.3 (43.7 for males and 50.8 for females), the mean Body Mass Index (BMI) was 30.3 (min: 19 - max: 51), the mean AHI was 22.6 (min: 0, max: 103) and the mean RDW was 13.5 (min: 12, max: 15.9). In our study, the RDW value was significantly higher in patients with OSAS compared to the control group. In the subgroup analysis, the highest RDW values were found in the severe OSAS group. Unlike the results from other studies, the lowest RDW value was found in the moderate OSAS group. However, no statistically significant difference was found between the groups. The severity of the disease was not correlated. This may be because the patient population is relatively small or there may be a distribution inequality between groups.

Conclusions: There is a relationship between OSAS and RDW but more comprehensive, prospective and multi-centered studies must be performed.

Introduction

Obstructive Sleep Apnea Syndrome (OSAS) is the most common sleep disorder. In Spain, 3-6% of the population have symptoms of snore with 24-26% of them were above AHI ≥ 5 and were diagnosed with OSAS [1]. OSAS is characterized by recurrent partial or complete upper airway obstruction resulting in a hypoxia-reoxygenation cycle and arousals during sleep.

Hypoxia, the main factor in the pathogenesis, leads to increased hypercapnia and intrathoracic pressure, activation of the sympathetic nervous system, deterioration of cerebral blood flow, elevation of blood pressure and disturbance of sleep. This results in inadequate sleep, abnormal motor activity, headache and fatigue [2]. Because of all these metabolic changes, endothelial dysfunction occurs and there is an increased risk of cardiovascular and cerebrovascular events. Tachycardia or rhythm disturbances may occur during sleep [3]. PSG is the gold standard test in OSAS diagnosis. The disease grade is classified according to the AHI values in the polysomnography report. Those with AHI ≤ 5 are considered as simple snoring, AHI: 5-14.9 are mild OSAS, those with AHI: 15-29.9 are moderate OSAS, those with AHI ≥ 30 are severe OSAS [4].

RDW shows irregularities between the shapes of erythrocytes. Oxidative stress caused by hypoxia causes irregularity in erythrocyte morphology. In systemic diseases such as iron deficiency anemia, folic acid deficiency, vitamin B12 deficiency and chronic liver disease, RDW levels increase because of oxidative stress [5]. High RDW values are an important biomarker of cardiovascular mortality and morbidity risk, before myocardial infarction [6,7]. Given the inflammatory nature of OSAS, it is thought to be associated with RDW.

The aim of this study was to evaluate the association between RDW and AHI in patients with OSAS and to determine whether RDW could be a predictor of disease severity before PSG.

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Table 1: Age, BMI, AHI, RDW values of sub groups.

	Group-1 (n=24)	Group-2 (n=21)	Group-3 (n=25)	Control group (n=39)
Age (average)	46.5	48.7	48.9	40.6
BMI (average)	30.8	29.8	34.4	27.7
AHI (average)	10.5	22.3	66.5	2.1
RDW (average)	13.5	13.2	13.9	13.3

Materials and Methods

The study included 109 patients admitted to Adana City Training and Research Hospital otolarhinolaryngology clinic between January 2018 and March 2018, with a complaint of snoring and symptoms of sleep apnea. All patients underwent PSG in the sleep laboratory of otolarhinolaryngology clinic.

Those with any systemic disease that would affect the RDW were excluded from the study. Patient demographics and laboratory data were recorded. Sleep and physiological variables were monitored with Comet-PLUS Grass® (Astro-Med Industrial Park, West Warwick, USA) PSG. Electroencephalography can be performed with 10 channels (C3, C4, O1, O2, Fp1, Fp2, F3, F4, P3, P4), submental Electromyography (EMG), right and left eye electrooculography, electrocardiography, oronasal airflow (thermal sensor and nasal transducer), body position, thoracic and abdominal motion meter (inductance plethysmograph), arterial blood oxygen saturation with finger pulse oximetry, left and right leg motion sensors (EMG), and tracheal microphone were used.

Apnea was defined as reduction of air flow signal, more than 90% for at least 10 seconds, measured by the thermal sensor. Hypopnea was defined as a reduction in the nasal pressure signal, more than 30% over baseline and resulted in more than 3% desaturation or arousal compared to baseline, for at least 10 seconds. The study population was divided according to the AHI values; (i) mild OSAS; AHI: 5-14.9 (ii) moderate OSAS; AHI: 15-29.9, (iii) severe OSAS; AHI: > 30. Those with AHI between 0-4.9 were the control group. Statistical analysis was performed with IBM SPSS Statistics for Windows, version 22.0 (SPSS Inc., Chicago, IL, USA). AHI and RDW correlations were assessed by Pearson correlation test, RDW value between groups was assessed by Independent Samples test, $p < 0.05$ was considered statistically significant. For the study, permission was obtained from the ethics committee of our hospital.

Results

Of the patients included in the study, 83 (76%) were male and 26 (24%) were female. The mean age was 45.3 (43.7 for males and 50.8 for females), the mean Body Mass Index (BMI) was 30.3 (min: 19 - max: 51), the mean AHI was 22.6 (min: 0, max: 103) and the mean RDW was 13.5 (min: 12, max: 15.9). Patient characteristics, BMI, AHI and RDW values of the subgroups are given in table 1.

Discussion

OSAS is a syndrome characterized by recurrent partial or complete upper respiratory tract obstruction resulting in a hypoxia-reoxygenation cycle and arousals during sleep. Some studies have shown that platelet activation due to the hypoxia-reoxygenation cycle is associated with increased RDW and inflammation.

Sinem Medine et al. Investigated the relationship between RDW and OSAS in 108 patients. Study population was divided into the three groups; mild, moderate and severe according to the AHI index, Inpatients with severe OSAS (AHI ≥ 30) RDW values were found to be significantly higher. Positive correlation was also found between AHI and RDW values [5]. Leon et al. reported a prospective-controlled study involving 138 patients and RDW values in the OSAS group were significantly higher than the control group ($p = 0.223$). It was also found that AHI was positively related to RDW in patients with OSAS ($p = 0.02$). Another study by Ozsu et al. reported that RDW values were found to be higher in patients with OSAS in 137 patients. Significant correlation was found between RDW and AHI. Furthermore patients with cardiovascular risk were found to have higher RDW values. In this study, RDW was thought to be associated with cardiovascular risk in OSAS patients [8].

Kıvanç et al. Examined 300 patients with OSAS and there relationship between cardiovascular diseases (hypertension, arrhythmia, coronary artery disease) and Neutrophil Lymphocyte Ratio (NLR), Platelet Lymphocyte Ratio (PLR), Mean Platelet Volume (MPV), RDW. Similar to our study, patients divided into three groups; mild, moderate and severe according to their AHI scores and identified patients with AHI ≤ 5 as the control group. NLR, PLR and MPV values were not statistically different among the groups, but the RDW values were significantly higher in patients with cardiovascular risk factors ($p \leq 0.05$). As a result of the study, a relationship between OSAS and comorbid diseases were found with increased RDW [9].

Kurt et al. Investigated the relationship of OSAS with Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), C-Reactive Protein (CRP) and RDW in 137 patients. RDW was found to be significantly higher in the group with AHI ≥ 30 but they couldn't find any relationship with other parameters. This study concluded that AHI did not correlate with CRP, MPV and RDW, but a positive correlation with PDW, showing platelet activation was thought to be a marker of OSAS severity [10].

In our study, the RDW value was significantly higher in patients with OSAS compared to the control group. In the sub-group analysis, the highest RDW values were found in the severe OSAS group. Unlike the results from other studies, the lowest RDW value was found in the moderate OSAS group. However, we did not find statistically significant difference between the groups. The severity of the disease was not correlated with PDW. The explanation of this result may be that the patient population is relatively small or there may be a distribution inequality between groups.

Conclusion

RDW increases are seen in patients with OSAS. Further comprehensive studies involving a large number of patients are needed to determine its association with AHI and its usefulness as a biomarker.

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