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ORIGINAL ARTICLE

The Relationship between Obstructive Sleep Apnea Syndrome and Neutrophil–Lymphocyte and Platelet–Lymphocyte Ratios

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Abstract

Introduction: Obstructive sleep apnea syndrome (OSAS) is a condition characterized by hypoxemia or arousal associated with apnea or hypopnea due to partial or complete collapse of the upper airway. This study aimed to assess the correlation between the diagnosis and severity of OSAS and the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR).

Methods: This retrospective analysis included 65 patients who underwent polysomnography at Sultan II. Abdulhamid Han Training and Research Hospital. Patients with simple snoring and controls had an apnea–hypopnea index (AHI) of <5, patients with mild OSAS had an AHI of 5–14.9, those with moderate OSAS had an AHI of 15–29.9, and those with severe OSAS had an AHI of ≥30. Lymphocyte, neutrophil, and platelet counts were obtained from complete blood count parameters measured before polysomnography. NLR and PLR were calculated accordingly.

Results: A total of 65 patients were included in the study. Eighteen patients (28%) with AHI<5 constituted the control group, and 47 patients (72%) with AHI≥5 constituted the OSAS group. Among the 47 patients with OSAS, 17 (36%) had mild OSAS, 15 (32%) had moderate OSAS, and 15 (32%) had severe OSAS. The mean NLR was 2.39±1.59 in patients with OSAS and 1.96±1.21 in patients without OSAS, with no statistically significant difference (p=0.68). The mean PLR was 141.56±139.97 in patients with OSAS and 98.66±27.91 in patients without OSAS, also showing no statistically significant difference (p=0.95). NLR and PLR did not differ significantly among patients with mild, moderate, and severe OSAS (p=0.185 and p=0.149, respectively).

Discussion and Conclusion: In this study, NLR and PLR were not associated with either the diagnosis or the severity of OSAS.

Keywords: Neutrophil-to-lymphocyte ratio; platelet-to-lymphocyte ratio; sleep apnea.

Apneas and hypopneas in ventilation are hallmarks of the relatively common sleep-related condition known as obstructive sleep apnea syndrome (OSAS). Its prevalence varies between 6% and 17% in the general population and can reach 50% in older age groups. Its incidence has been reported as 24% in adult males and 9% in females aged 30–60 years. It has also been reported that, in some countries, the prevalence has reached 50%, affecting approximately 1 billion individuals globally [1–3].

OSAS is a condition in which the upper airways recurrently collapse, resulting in either a significant reduction in airflow (hypopnea) or a complete cessation of airflow

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(apnea) [4]. Obesity, increased neck circumference, advanced age, and male sex are established risk factors [5]. OSAS is a significant risk factor for cardiovascular diseases, particularly hypertension, coronary artery disease, heart failure, and stroke, as endothelial dysfunction represents a key pathophysiological mechanism [6]. Polysomnography (PSG) demonstrating an apnea–hypopnea index (AHI) of 5 events per hour is considered diagnostic [2].

OSAS, independent of obesity, leads to increased levels of proinflammatory cytokines (tumor necrosis factor-α [TNF-α], interleukin-6 [IL-6], and interleukin-8 [IL-8]) and chemokines. In addition, continuous positive airway pressure (CPAP) treatment has been shown to significantly reduce these inflammatory markers [2]. In particular, IL-8 plays a crucial role in neutrophil and monocyte migration to the vascular endothelium [7].

OSAS can also directly affect the cardiovascular system by increasing coagulation factors and platelet activation and may affect the central nervous system by increasing blood–brain barrier permeability [8]. Two important indicators of systemic inflammatory response are the neutrophil-to-lymphocyte ratio (NLR) and the platelet-to-lymphocyte ratio (PLR), which have been widely studied in conditions such as sepsis, malignancy, rheumatological diseases, and trauma [9]. OSAS also induces endothelial dysfunction through hypoxic stress and enhances systemic inflammation. Therefore, the aim of this study was to evaluate the relationship between NLR and PLR and the diagnosis and severity of OSAS.

Materials and Methods

A total of 65 patients who were evaluated at the Chest Diseases outpatient clinic of Sultan II. Abdulhamid Han Training and Research Hospital and underwent polysomnography at the sleep center between November 2018 and November 2019 were retrospectively included in the study. Patients with a history of malignancy, rheumatological or hematological diseases, or chronic liver disease that could affect neutrophil, platelet, or lymphocyte counts were excluded. Ethical approval for the study was obtained from the Ümraniye Training and Research Hospital Ethics Committee (Decision No: 238).

A ≥90% reduction in airflow from baseline lasting at least 10 seconds was defined as apnea. Hypopnea was defined as a ≥30% reduction in airflow from baseline lasting at least 10 seconds, accompanied by ≥3% oxygen desaturation or arousal on electroencephalography (EEG).

Based on AHI values, the study population was divided into four groups. Patients with AHI<5 were defined as the simple snoring and control group, whereas those with AHI≥5 were defined as the OSAS group. For OSAS severity classification, patients with AHI values of 5–14.9 were classified as mild OSAS, those with 15–29.9 as moderate OSAS, and those with ≥30 as severe OSAS.

Neutrophil, lymphocyte, and platelet counts were obtained from complete blood count parameters measured before PSG. The neutrophil count was divided by the lymphocyte count to calculate the NLR, and the platelet count was divided by the lymphocyte count to calculate the PLR.

Statistical Analysis

Descriptive analyses, including frequency distributions, percentages, mean values, interquartile range (IQR), and median values, were used to summarize the data. The Kolmogorov–Smirnov test was used to assess normality of distribution. For continuous variables, the Mann–Whitney U test was applied for non-normally distributed data, and the t-test was used for normally distributed variables. Comparisons of NLR and PLR among mild, moderate, and severe OSAS groups were performed using ANOVA. A 95% confidence interval was applied, and a $p<0.05$ was considered statistically significant.

Results

A total of 65 patients participated in the study. Eighteen patients (28%) were in the control group with AHI<5, and 47 patients (72%) were in the OSAS group with AHI≥5. When OSAS severity among the 47 patients was evaluated according to AHI values, 17 patients (36%) were classified as mild OSAS, 15 patients (32%) as moderate OSAS, and 15 patients (32%) as severe OSAS.

The mean NLR in patients with and without OSAS was 2.39±1.59 and 1.96±1.21, respectively, with no statistically significant difference ($p=0.68$). The mean PLR in patients with and without OSAS was 141.56±139.97 and 98.66±27.91, respectively, and this difference was also not statistically significant ($p=0.95$) (Table 1). Comparisons among patients with mild, moderate, and severe OSAS showed no statistically significant differences in NLR or PLR according to disease severity ($p=0.185$ and $p=0.149$, respectively) (Table 2).

Table 1. Comparison of NLR and PLR in patients with and without OSA diagnosis

	AHI score								
	<5				≥5				
	Mean	SD	Median	Min-max	Mean	SD	Median	Min-max	p
NLR	2.39	1.59	1.73	0.95-6.11	1.96	1.21	1.55	0.76-7.49	0.68
PLR	141.56	139.97	88.88	54.05-567.54	98.66	27.91	92.72	49.70-173.86	0.95

NLR: Neutrophil lymphocyte ratio; PLR: Platelet lymphocyte ratio; OSA: Obstructive sleep apnea; AHI; Apnea hypopnea score; Min: Minimum; Max: Maximum; SD: Standard deviation.

Table 2. The relationship between NLR and PLR and the severity of OSA according to AHI

	AHI score												
	<15				15-30				≥30				
	Mean	SD	Median	Min-max	Mean	SD	Median	Min-max	Mean	SD	Median	Min-max	p
NLR	1.86	0.83	1.65	1.17-4.18	2.04	1.83	1.35	0.76-7.49	2.02	1.01	1.76	1.19-5.20	0.185
PLR	106.58	35.41	97.23	57.47-173.86	87.24	24.50	85.71	49.70-143.51	99.03	17.30	94.51	69.60-139.04	0.149

NLR: Neutrophil lymphocyte ratio; PLR: Platelet lymphocyte ratio; OSA: Obstructive sleep apnea; AHI: Apnea hypopnea score; Min: Minimum, Max: Maximum; SD: Standard deviation.

Discussion

Recurrent episodes of partial or complete upper airway collapse are a hallmark of OSAS, accompanied by apnea or hypopnea lasting longer than 10 seconds, resulting in hypoxemia or electroencephalographic arousals [10]. Increased rates of hypertension, type 2 diabetes mellitus, arrhythmia, heart failure, stroke, atherosclerotic heart disease, pulmonary hypertension, and dementia have all been associated with OSAS [10]. OSAS, similar to obesity, stimulates white adipose tissue and leads to the release of systemic inflammatory mediators. In addition, intermittent hypoxia related to OSAS is a key contributor to the release of inflammatory markers. Among these markers, adipokines and tumor necrosis factor-α (TNF-α), interleukin-6 (IL-6), and interleukin-8 (IL-8) play important roles in chronic systemic inflammatory processes. As a consequence, cardiovascular diseases related to endothelial dysfunction may develop [11]. Accordingly, the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) are used as indices reflecting inflammatory reactions and immune responses in various chronic diseases, including cancer, infections, and chronic obstructive pulmonary disease [12]. Therefore, this study evaluated the association between OSAS and NLR and PLR.

In 2015, Koseoğlu et al. [13] published a retrospective analysis including 284 patients. OSAS and control groups were defined using an apnea–hypopnea index (AHI) cut-off of 5, and mild, moderate, and severe OSAS groups were also established. While no relationship was found between NLR and OSAS, the OSAS group had lower PLR values than the control group. Additionally, PLR was observed to decrease as OSAS severity increased, and NLR was associated with nocturnal hypoxemia. In our study, although PLR was also lower in patients with OSAS than in the control group, this difference was not statistically significant. Furthermore, the relationship between hypoxemia and NLR and PLR was not evaluated in our study.

Erdim et al. [14] analyzed 180 patients in a study involving obese children, of whom 83 met the inclusion criteria. Obese patients had significantly higher NLR and PLR values than non-obese patients. In that study, the AHI cut-off for OSAS diagnosis in children was defined as 1. In contrast, in our study, patients with OSAS exhibited lower NLR and PLR values. Differences in study populations, including the inclusion of adults in our study versus pediatric patients in the other study, as well as differing diagnostic criteria for OSAS, may explain this discrepancy.

In a study conducted by Hizli et al. [15], 98 patients with OSAS and 28 controls were included, and OSAS severity was classified as mild, moderate, and severe, similar to our study. NLR and PLR were found to be ineffective in assessing both the diagnosis and severity of OSAS.

Although PLR values tended to decrease with increasing OSAS severity, this trend was not statistically significant. The findings of our study are consistent with these results. In that study, fibrinogen-to-albumin and C-reactive protein-to-albumin ratios were significantly higher in patients with moderate and severe OSAS compared with controls; however, these inflammatory markers were not evaluated in our study [15].

A total of 4518 cases from 17 studies were evaluated in the meta-analysis by Wu et al. [16] published in 2018; 1013 controls, 896 patients with mild OSAS, 832 with moderate OSAS, and 1588 with severe OSAS were included. In that study, a correlation was identified between OSAS and elevated NLR and PLR. In addition, increases in NLR and PLR were associated with worsening OSAS severity [16]. These findings contradict the results of our study. However, significant heterogeneity was reported for NLR, whereas heterogeneity was low in the moderate OSAS subgroup.

In a more recent meta-analysis by Attia et al. [17], 26 studies were evaluated. In that analysis, patients with OSAS had higher NLR and PLR values than control subjects. Similarly, heterogeneity was high for both inflammatory markers. In contrast to the findings by Wu et al. [16], OSAS severity was not correlated with either NLR or PLR in this meta-analysis [17]. The association of NLR and PLR with OSAS in that study represents another difference from our findings.

Conclusion

In the present study, NLR and PLR were not found to be associated with either the diagnosis or the severity of OSAS. This finding may be related to the limited sample size of the study. Conflicting results regarding this issue have also been reported in the literature. Although substantial evidence suggests that OSAS is associated with systemic inflammation, further studies are needed to clarify the role of systemic inflammatory markers in the diagnosis and assessment of OSAS severity.

Ethics Committee Approval: The study was approved by Ümraniye Training and Research Hospital Ethics Committee (No: 238, Date: 18.12.2019).

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