

Examination of Pan-Immune-Inflammation Value and Lymphocyte-Monocyte Ratio in Sudden Sensorineural Hearing Loss

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ABSTRACT

Background: Studies about inflammation indices are becoming increasingly common. Inflammation is thought to play an important role in the aetiopathogenesis of sudden sensorineural hearing loss. **Aim:** In this study, we aimed to compare sudden sensorineural hearing loss patients and patients in a control group in terms of pan-immune-inflammation value and lymphocyte-monocyte ratio and to determine the relationship of these indices with sudden sensorineural hearing loss. **Methods:** The research was designed as a retrospective, case-control study. The archival records of patients diagnosed with sudden sensorineural hearing loss between 1 January 2018 and 1 May 2023 were scanned. Within the scope of the study, age, gender, amount of hearing loss, hearing loss accompanied by vertiginous symptoms, hearing loss accompanied by tinnitus, full blood count results, pan-immune-inflammation value and lymphocyte-monocyte ratio were analysed between the groups. Statistical analyses were performed using the independent samples *t*-test, Chi-square test and Pearson correlation analysis. **Results:** Leukocyte, neutrophil, platelet and pan-immune-inflammation values were found to be significantly higher in patients with sudden sensorineural hearing loss (*P* values: 0.023, <0.001, 0.010, <0.001, respectively). Lymphocyte and monocyte values were significantly lower (*P* values: <0.001, 0.006, respectively). There was no significant difference in terms of lymphocyte-monocyte ratio (*P* = 0.455). There was no relationship between tinnitus, vertiginous symptoms and blood parameters. There was a positive correlation between neutrophil value and the amount of hearing loss (*P* = 0.036). **Conclusion:** In our study, the pan-immune-inflammation value was significantly higher in sudden sensorineural hearing loss patients. A statistically significant relationship was detected between high neutrophil values and the amount of hearing loss. These results can be evaluated on the basis of the inflammation-ischaemia relationship in the aetiopathogenesis of sudden sensorineural hearing loss.

KEYWORDS: *Inflammation indices, lymphocyte-monocyte ratio, pan-immune-inflammation value, sudden sensorineural hearing loss*

INTRODUCTION

Sudden sensorineural hearing loss (SSNHL) is a sensorineural type of hearing loss of 30 dB or more at three consecutive frequencies within three days. For hearing loss to be defined as SSNHL, in addition to these criteria, hearing loss must not be caused by aetiological factors such as otitis, trauma, tumour, ototoxic drug use, or acoustic trauma. Debates continue on the aetiopathogenesis of SSNHL. Vascular pathologies,

viral infections, intracochlear membrane rupture and autoimmune mechanisms are the most suspected causes. None of these factors has been proven.^[1] For this reason,


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studies about the aetiopathogenesis of SSNHL remain popular.

Inflammation indices, calculated using parameters in the full blood count (FBC), are frequently discussed in ear, nose and throat diseases studies. Neutrophil-lymphocyte ratio (NLR), platelet-lymphocyte ratio (PLR), and systemic immune inflammation index (SII) are the most commonly used indices. There are many studies examining SSNHL in terms of these indices.^[2-4] Pan-immune-inflammation value (PIV), one of the inflammation indices, is obtained by multiplying the neutrophil, platelet and monocyte values and dividing by the lymphocyte value. This index is also called the aggregate index of systemic inflammation (AISI) in some studies.^[5] Lymphocyte-monocyte ratio (LMR) is found by dividing the lymphocyte value by the monocyte value.

PIV, or AISI, has been discussed in current studies in terms of various malignancies, and inflammatory and systemic diseases.^[6-8] The similarity with NLR, PLR and SII is that they include lymphocyte count in the denominator. Therefore, it is expected there will be a parallel relationship with these three indices. By including the monocyte count in the calculation, it is thought to reflect the inflammatory status more comprehensively.^[7] Neutrophil and platelet values are not used when calculating LMR. Since the index focuses on lymphocytes and monocytes, it is more specific for inflammatory conditions in which these cells play a role.

There is no study in the literature examining the relationship between SSNHL with PIV and LMR. In this study, we aimed to compare SSNHL patients and patients in the control group in terms of PIV and LMR and to determine the relationship of these indices with SSNHL.

MATERIALS AND METHODS

Ethics

This retrospectively designed case-control study began after obtaining ethics committee approval, numbered 148 dated 22.06.2023, from Süleyman Demirel University Faculty of Medicine Clinical Research Ethics Committee. The principles of the Declaration of Helsinki were followed in this study.

Study design

The archive records of patients diagnosed with SSNHL between 1 January 2018 and 1 May 2023 at Süleyman Demirel University Faculty of Medicine, Department of Ear, Nose and Throat Diseases were scanned. Patients diagnosed with SSNHL formed the study group. A control group was created from patients who

were operated on between the same dates. Criteria for inclusion in the SSNHL group were no pathology detected during ear examination, sensorineural type hearing loss of 30 dB or more at three consecutive frequencies occurring in less than 3 days, unilateral hearing loss, temporal bone contrast-enhanced magnetic resonance examination performed after the diagnosis of SSNHL and no pathology detected, diagnosis of SSNHL determined with pure tone audiometry performed in our clinic and the relevant audiometry being accessible by archive search, having FBC among blood tests performed on the day of SSNHL diagnosis, and being over 18 years of age. Exclusion criteria for the SSNHL group were the presence of central neurological findings accompanying hearing loss, a history of head trauma before the onset of hearing loss, a history of acoustic trauma and/or barotrauma before the onset of hearing loss, known ear pathology, previous ear surgery, pathology detected on temporal bone contrast-enhanced magnetic resonance examination, previous SSNHL, a history of malignancy, a history of ototoxic drug use, active infectious disease and systemic inflammatory disease. In parallel with the age and gender of the patients included in the SSNHL group, two patients were included in the control group for each patient in the SSNHL group, based on admission order and the determined criteria. Criteria for inclusion in the control group were no pathology detected on ear examination and FBC among routine blood tests performed before septoplasty operation. Exclusion criteria for the control group were having a history of SSNHL, a history of malignancy, active infectious disease, systemic inflammatory disease, obstructive sleep apnoea syndrome and sinonasal inflammatory disease accompanying septum deviation.

PIV was calculated by multiplying the neutrophil, monocyte and platelet counts and dividing this by the lymphocyte count. LMR was calculated by dividing the lymphocyte count by the monocyte count. The amount of hearing loss was calculated by subtracting the pure tone average of the healthy ear from the pure tone average of the ear with hearing loss. The pure tone average was determined from the arithmetic average of the thresholds at 500 Hz, 1000 Hz, 2000 Hz and 4000 Hz.

Within the scope of the study, age, gender, amount of hearing loss, hearing loss accompanied by vertiginous symptoms, hearing loss accompanied by tinnitus, FBC results, PIV and LMR were statistically examined between the groups.

Statistical analyses

IBM SPSS Version 29 was used for statistical analysis of the data. Data were checked for entry errors and data distribution. The independent samples *t*-test was used to

compare continuous variables, and Chi-square test was used to compare categorical variables. The correlation between the amount of hearing loss and blood values was examined with Pearson correlation analysis. The results for categorical variables are presented as number and percentage, while the results for continuous variables are presented as mean and standard deviation. A value of $P < 0.05$ was considered statistically significant.

RESULTS

The SSNHL group consisted of 156 patients and the control group consisted of 312 patients. Of the SSNHL group patients, 69 were women and 87 were men. Of patients in the control group, 138 were women and 174 were men ($P = 1.000$). While the average age of SSNHL group patients was 47.43 (± 14.34) years, the average age of patients in the control group was 45.53 (± 10.93) years ($P = 0.073$) [Table 1]. In the SSNHL group, hearing loss was in the right ear in 78 patients and in the left ear in 78 patients. Hearing loss was accompanied by tinnitus in 105 patients and vertiginous symptoms in 35. The average amount of hearing loss of patients in the SSNHL group was 47.84 (± 23.96) dB. The statistical analysis results for leukocytes, neutrophils, lymphocytes, monocytes, platelets, PIV and LMR between the control group and the SSNHL group are presented in Table 2. The results of statistical analysis according to tinnitus and vertiginous symptoms are presented in Tables 3 and 4. The results for the correlation analyses with the amount of hearing loss are presented in Table 5.

DISCUSSION

In our study, no relationship was detected between LMR and SSNHL. PIV was significantly higher in patients with SSNHL than in the control group. Due to the difference in the calculation of the two indices, neutrophil and platelet counts are the main variables in this relationship between SSNHL and PIV.

In their study examining patients with SSNHL regarding NLR and PLR, Seo *et al.*^[2] found that both indices were significantly higher in patients with SSNHL. Further analysis showed that only high NLR value was associated with poor prognosis in SSNHL. The results of the study by Koçak *et al.* are similar to the study by Seo *et al.* Moreover, in this study, neutrophils were significantly higher and lymphocytes were significantly lower in SSNHL patients. There was no difference with respect to platelets.^[3] In our study, neutrophil and platelet counts were significantly higher in SSNHL patients, while lymphocyte and monocyte counts were significantly lower. In the study by Soylu Özer about the relationship between SSNHL and NLR, the NLR

Table 1: Age and gender characteristics of the groups

	Age Mean \pm SD (Min-Max)	P
SSNHL (n=156)		
Female (n=69)	45.79 \pm 14.37 (18-70)	47.43 \pm 14.34
Male (n=87)	48.73 \pm 14.27 (18-77)	(18-77)
Control (n=312)		
Female (n=138)	44.93 \pm 10.90 (18-77)	45.53 \pm 10.93
Male (n=174)	46.00 \pm 10.97 (18-77)	(18-77)

*Independent samples *t*-test. SD: Standard Deviation, Min: Minimum, Max: Maximum

Table 2: Relationship of blood parameters between control and SSNHL groups

	Control (n=312)	SSNHL (n=156)	P*
Leukocytes	7.32 (± 1.86)	7.78 (± 2.54)	0.023
Neutrophils	4.21 (± 1.44)	5.10 (± 2.43)	<0.001
Lymphocytes	2.24 (± 0.63)	2.00 (± 0.74)	<0.001
Monocytes	0.58 (± 0.19)	0.53 (± 0.21)	0.006
Platelets	243.33 (± 58.66)	258.50 (± 69.83)	0.010
PIV	295.91 (± 227.40)	422.24 (± 469.60)	<0.001
LMR	4.12 (± 1.29)	4.13 (± 1.63)	0.455

*Independent samples *t*-test. PIV: Pan-immune-inflammation value, LMR: Lymphocyte-monocyte ratio

Table 3: Relationship between blood parameters and presence of tinnitus

	Tinnitus (+) (n=105)	Tinnitus (-) (n=51)	P*
Leukocytes	7.80 (± 2.82)	7.74 (± 1.83)	0.446
Neutrophils	5.20 (± 2.73)	4.89 (± 1.66)	0.228
Lymphocytes	1.94 (± 0.76)	2.14 (± 0.66)	0.058
Monocytes	0.52 (± 0.20)	0.54 (± 0.21)	0.287
Platelets	256.75 (± 69.88)	262.11 (± 70.30)	0.327
PIV	435.88 (± 487.66)	394.16 (± 433.32)	0.302
LMR	4.02 (± 1.61)	4.36 (± 1.68)	0.115

*Independent samples *t*-test. PIV: Pan-immune-inflammation value, LMR: Lymphocyte-monocyte ratio

Table 4: Relationship between blood parameters and presence of vertiginous symptoms

	Vertiginous Symptoms (+) (n=35)	Vertiginous Symptoms (-) (n=121)	P*
Leukocytes	8.00 (± 2.79)	7.72 (± 2.47)	0.285
Neutrophils	5.37 (± 2.81)	5.02 (± 2.32)	0.231
Lymphocytes	2.00 (± 1.01)	2.01 (± 0.64)	0.465
Monocytes	0.48 (± 0.20)	0.54 (± 0.21)	0.054
Platelets	266.54 (± 79.23)	256.18 (± 67.06)	0.221
PIV	398.76 (± 381.49)	429.03 (± 493.35)	0.369
LMR	4.39 (± 1.71)	4.06 (± 1.61)	0.150

*Independent samples *t*-test. PIV: Pan-immune-inflammation value, LMR: Lymphocyte-monocyte ratio

value was significantly higher in SSNHL patients. In comparisons made according to the severity of hearing loss, NLR was higher in the patient group with severe

Table 5: Correlation analysis between blood parameters and amount of hearing loss

	Amount of Hearing Loss	
	Pearson Correlation Coefficient (<i>r</i>)	<i>P</i> *
Leukocytes	0.108	0.178
Neutrophils	0.168	0.036
Lymphocytes	-0.148	0.066
Monocytes	-0.123	0.128
Platelets	0.035	0.665
PIV	0.072	0.374
LMR	0.017	0.835

*Pearson correlation analysis. PIV: Pan-immune-inflammation value, LMR: Lymphocyte-monocyte ratio

hearing loss.^[9] In another study by Ulu *et al.*, NLR was found to be higher in SSNHL patients and was associated with poor prognosis.^[10] In another study by Ulu *et al.*, which aimed to compare SII with NLR and PLR in SSNHL patients, SII and NLR were significantly higher in SSNHL patients.^[4] Since there is no previous study examining the relationship between PIV and SSNHL, a direct comparison cannot be made. However, in the above-mentioned studies, the relationships detected between PIV and the indices expected to give parallel results support our results. At the same time, the relationships found in these studies for high NLR, poor prognosis and advanced hearing loss also support the significant positive correlation between neutrophils and the amount of hearing loss in our study. In many studies, a high amount of hearing loss was found to be a poor prognostic factor in SSNHL.^[11,12]

Classically, lymphocyte count is expected to increase in viral infections. However, both in studies based on other indices where lymphocyte is the denominator, and in our study the results are exactly the opposite. Lymphocyte counts were significantly lower in SSNHL patients in our study. According to these results, the viral infection hypothesis does not have a direct effect on the development of SSNHL. In the studies by Seo *et al.* and Soylu Özer, high NLR values were considered with respect to atherosclerosis-based mechanisms.^[2,9] Just as an inflammatory response may occur following ischaemic events, changes that lead to ischaemia may also occur following chronic inflammation.^[13,14] The aim of the inflammatory response secondary to ischaemia is to eliminate hypoxia. For this purpose, there is a decrease in lymphocyte counts while there is an increase in neutrophil and monocyte counts in circulation.^[14] The results in our study are parallel to these expected changes. Both other studies in the literature and the results in our study may indicate the possible role of vascular disorders, that is ischaemia-based mechanisms,

in the development of SSNHL. In addition to hearing loss due to impaired cochlear nutrition after ischaemic events, the distribution of inflammatory cells in peripheral circulation may also change as a result of these ischaemic events. The fact that relationships between ischaemia-related genes and ischaemic diseases and SSNHL were identified in the current literature indirectly supports our conclusion about the role of ischaemia in SSNHL.^[15,16]

The main limitations of our study are its retrospective design, the limited number of patients included and the inability to include biochemical parameters related to inflammation. The strength of our study is that it is the first to address PIV and LMR indices in SSNHL patients.

In conclusion, the aetiopathogenesis of SSNHL remains unclear. In our study, PIV was significantly higher in SSNHL patients. A statistically significant relationship was detected between high neutrophil count and the amount of hearing loss. The results of our study can be evaluated on the basis of the inflammation-ischaemia relationship in the aetiopathogenesis of SSNHL. Our results need to be supported by further studies.

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Conflicts of interest

There are no conflicts of interest.

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