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Evaluation of Prognostic Scores in Adult Patients with Idiopathic Sudden Hearing Loss

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ABSTRACT

Objective: The pathophysiology of sudden hearing loss remains poorly understood. Research aimed at elucidating its etiology is crucial for the early diagnosis and treatment of patients. This study aimed to clarify the role of inflammation in the etiology of sudden hearing loss, which remains poorly understood, by analyzing the C-reactive protein-to-albumin ratio (CAR), systemic immune-inflammation index (SII), prognostic nutritional index (PNI), and neutrophil-to-lymphocyte ratio (NLR) values associated with inflammatory processes.

Materials and Methods: A chart review of patients with idiopathic sudden hearing loss admitted to the hospital between January 2019 and December 2020 was conducted. The study included 35 patients with this condition and 30 healthy individuals for comparison. The significance level was set at $p<0.05$.

Results: The mean age of the patient group was 48.26, while the mean age of the healthy group was 44.04. In the patient group, 15 were female, and 20 were male. Significant differences were observed in NLR, CAR, and SII values between the recovery and non-recovery idiopathic sudden sensorineural hearing loss (ISSHL) groups. The non-recovery group exhibited higher NLR (3.40±0.20), CAR (0.70±0.09), and SII (687.9±76.8) values (with p-values of 0.021, 0.026, and 0.038, respectively). In the ISSHL group, NLR exhibited approximately 87% sensitivity when above 3.41, while SII demonstrated approximately 69.6% sensitivity when exceeding 650.39. ($p=0.038$ and $p=0.037$, respectively).

Conclusion: The levels of NLR and SII index might help predict early outcomes in sudden hearing loss of unknown cause.

Keywords: Clinical markers, hearing loss, inflammation, inflammatory markers, prognosis.

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INTRODUCTION

Idiopathic sudden sensorineural hearing loss (ISSHL) without a clear cause is a significant concern in otological emergencies, affecting between 5 to 30 individuals per 100,000 annually.[1,2] ISSHL is defined as a sudden hearing loss of at least 30 decibels across three different frequencies in a hearing test, occurring within a period of three days.[3]

The exact causes and mechanisms of ISSHL remain unclear. Possible contributing factors include diabetes, high blood pressure, high cholesterol, infections, blood flow issues, blood disorders, metabolic imbalances, inner ear disorders, immune system dysfunctions, or even tumors.[4–7] The prognosis and response to treatment of ISSHL vary depending on the patient, suggesting a multifactorial etiology.[5] Different prognostic factors, such as the degree of hearing loss, vestibular assessment, age, presence of vertigo, and audiogram shape, influence outcomes.[8–11]

Chronic inflammations can lead to atherogenesis, microvascular damage, and inflammation of the vestibulocochlear nerve.[12] The purpose of using steroids in treating ISSHL is to suppress inflammation.[3] Recently, chronic inflammation has drawn attention in the pathophysiology of ISSHL.

Studies have examined the association between different blood cell levels—such as the platelet-to-lymphocyte ratio (PLR), neutrophil-to-lymphocyte ratio (NLR), and C-reactive protein to albumin ratio (CAR)—and outcomes in sudden hearing loss.[13,14] Additionally, certain blood test indicators, such as CAR, systemic inflammatory index (SII), and the prognostic nutritional index (PNI), have been observed to fluctuate in inflammatory diseases and tumors.[14–17] In a study by Öçal et al.,[14] the CAR value was significantly higher in ISSHL patients compared to healthy individuals. Similarly, a meta-analysis by Chen et al.[13] found that NLR values were significantly elevated in ISSHL patients.

The aim of this study was to explore the role of inflammation in the etiology of sudden hearing loss, which remains incompletely understood, by analyzing inflammation-related values: CAR, SSI, PNI, and NLR.

MATERIALS AND METHODS

This study is a retrospective case-control study. Patients aged 18 to 64 who visited the otolaryngology department between January 2019 and December 2020 and were diagnosed with sudden hearing loss were reviewed. Initially, 45 patients were identified, but 10 were excluded due to incomplete information. We also excluded individuals with other conditions that could affect blood tests, as well as those with heart problems, diabetes, brain issues, previous ear surgeries, or those who did not come to the hospital within three days of the onset of hearing loss. This resulted in a study group of 35 ISSHL patients who attended regular check-ups and a control group of 30 healthy individuals. Information on age, gender, hearing tests, and blood tests was obtained from hospital records. The study protocol was approved by the local ethics committee at our center (decree no: 26379996/14, date: 18/02/2021).

KEY MESSAGES

- Elevated Inflammatory Markers: Although the neutrophil-to-lymphocyte ratio (NLR), C-reactive protein-to-albumin ratio (CAR), and systemic immune-inflammatory index (SII) values were higher in the idiopathic sudden sensorineural hearing loss (ISSHL) group compared to controls, statistical significance was not achieved.
- Recovery Group Comparisons: Significant differences in NLR, CAR, and SII were observed between recovery and non-recovery subgroups in ISSHL patients, suggesting prognostic potential.
- Prognostic Indicators Conclusion: While NLR and SII may indicate ISSHL prognosis, CAR and prognostic nutritional index (PNI) show limited value, warranting further investigation with serial blood measurements.

Evaluation and Treatment

All patients received oral steroid treatment. Each participant with sudden hearing loss began with a high-dose steroid regimen, which was gradually tapered over a period of at least 10 days. The patients underwent audiologic tests upon arrival and again three months later. They were then divided into groups based on their hearing performance after treatment. A Siegel criteria system was applied, categorizing patients as follows: those with hearing restored to better than 25 decibels were classified as [1] complete recovery; those with an improvement of at least 15 decibels were classified as [2] partial recovery; those with slight improvement were classified as [3] slight recovery; and those without improvement were classified as [4] no improvement. Subsequently, the first two groups were designated as the recovery group, while groups three and four were designated as the non-recovery group. Thus, the patient population was divided into two subgroups according to treatment response.[18]

Laboratory Tests and Hematological Parameters

The NLR was calculated, and the CAR was determined based on serum levels of albumin and C-reactive-protein (CRP). The systemic immune-inflammation index was calculated using the formula: (Neutrophil count × Platelet count) / Lymphocyte count. The PNI was calculated using the formula (albumin × 10 + 0.005 × absolute lymphocyte count).

CAR, SII, PNI, CRP, and NLR values were examined in both the ISSHL group and the healthy group. Additionally, these values were analyzed to assess the ISSHL group's treatment response and to identify any correlations.

Table 1. Clinical characteristics and hematologic data of the groups

Variables	Patient group (n=35) (Mean±SD)	Control group (n=30) (Mean±SD)	p
Age, years	48.26±12.91	44.04±14.82	0.672
Gender, %			0.325
Female	15 (42.9)	14 (46.6)	–
Male	20 (57.1)	16 (53.3)	–
CRP, mg/L	2.45±0.74	2.36±0.29	0.553
Serum Albumin, g/dL	3.78±0.24	3.85±0.28	0.268
Neutrophil count, /mm^3	6742.3±1237.1	6356.9±1452.1	0.249
Lymphocyte count, /mm^3	2016.9±329.4	1958.3±441.1	0.540
Platelet count, ×1000/mm^3	195.9±31.0	197.2±35.5	0.870
NLR	3.29±0.21	3.18±0.32	0.115
CAR	0.64±0.10	0.61±0.07	0.190
SII	643.2±92.7	615.1±90.3	0.218
PNI	43.3±1.6	44.0±2.7	0.198

SD: Standard deviation; NLR: Neutrophil-to-lymphocyte ratio; CAR: C-reactive protein-to-albumin ratio; SII: Systemic Immune-Inflammation Index; PNI: Prognostic Nutritional Index.

Statistical Analysis

Statistical data were analyzed using SPSS, version 26.0. The Shapiro-Wilk test was used to assess whether the data were normally distributed. If the data were normally distributed, they were presented as mean±standard deviation; otherwise, they were presented as median (range). The Student's t-test was used for paired group comparisons. A receiver operating characteristic (ROC) curve was applied to assess how well the NLR, CAR, SII, and PNI values predicted outcomes in sudden hearing loss. Sensitivity and specificity for these values were calculated, and the optimal cut-off value for predicting outcomes in sudden hearing loss was identified. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The total study population consisted of 65 participants, with 35 in the patient group and 30 healthy individuals in the control group. Hematological laboratory data between the ISSHL patient group and the control group are presented in Table 1. When comparing gender and age between the two groups with matched criteria, no statistically significant differences were observed (p>0.05). Comparing the patient and control groups regarding NLR, CAR, and SII values, these metrics were elevated in the patient group compared to the control group. Specifically, the NLR values were 3.29±0.21 in the ISSHL group and 3.18±0.32 in the control group; CAR values were 0.64±0.10 in the ISSHL group and 0.61±0.07 in the control group; and SII values were 615.1±90.3 in the ISSHL group and 643.2±92.7 in the control group. However, no statistical differences were observed. The PNI exhibited a lower level in the patient group; however, intriguingly, there was no statistically significant difference between the patient and control groups regarding PNI values (p>0.05) (Table 1). When comparing recovery and non-recovery groups, the NLR, CAR, and SII values (3.23±0.19 vs. 3.40±0.20, 0.61±0.10 vs. 0.70±0.09, and 687.9±76.8 vs. 619.9±93.2, respectively) differed significantly between these two subgroups (p=0.021, p=0.026, and p=0.038, respectively) (Table 2).

The sensitivity and specificity of inflammatory indices were evaluated using ROC analysis. When the NLR value was set at 3.41 as the cut-off point, it demonstrated a sensitivity of 87% and a specificity of 59.3%. When the SII value of 650.39 was used as the cut-off, a sensitivity of 69.6% and a specificity of 66.7% were obtained (p=0.038, p=0.037, respectively) (Table 3, Fig. 1).

DISCUSSION

ISSHL is an otolaryngologic emergency of unknown etiology. Therefore, it is crucial to predict the prognosis. Since inflammation is involved in the pathogenesis of sudden hearing loss, steroids are the preferred treatment. Measuring blood markers associated with inflammation can facilitate the management of this process. This is the first study to examine NLR, CAR, PNI, and SII as inflammation markers in sudden hearing loss.

Table 2. Comparison of systemic inflammatory indices

Variables	Recovery group (n=23) (Mean±SD)	Non-recovery group (n=12) (Mean±SD)	p
NLR	3.23±0.19	3.40±0.20	0.021
CAR	0.61±0.10	0.70±0.09	0.026
SII	619.9±93.2	687.9±76.8	0.038
PNI	43.4±1.5	43.1±1.9	0.586

SD: Standard deviation; NLR: Neutrophil-to-lymphocyte ratio; CAR: C-reactive protein-to-albumin ratio; SII: Systemic Immune-Inflammation Index; PNI: Prognostic Nutritional Index.

Table 3. Sensitivity and specificity of systemic inflammation indices for patients with idiopathic sudden sensorineural hearing loss (ISSHL)

	Cut-off	AUC	SE	p	95% CI		Sensitivity	Specificity
					Lower	Upper		
NLR	3.41	0.717	0.095	0.038	0.530	0.904	87.0%	59.3%
CAR	0.69	0.690	0.091	0.068	0.512	0.868	65.2%	50.0%
SII	650.39	0.717	0.086	0.037	0.549	0.885	69.6%	66.7%
PNI	43.62	0.438	0.108	0.555	0.226	0.658	52.2%	50.0%

AUC: Area under the curve; SE: Standard error; CI: Confidence interval; NLR: Neutrophil-to-lymphocyte ratio; CAR: C-reactive protein-to-albumin ratio; SII: Systemic Immune-Inflammation Index; PNI: Prognostic Nutritional Index.

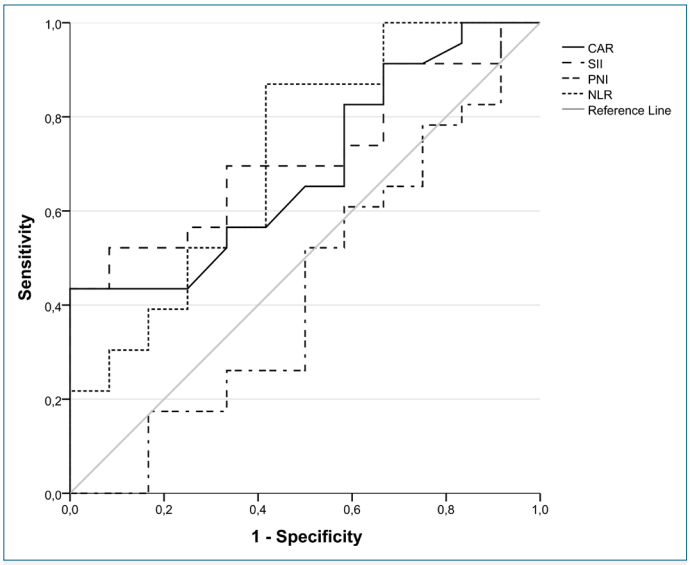

Figure 1. The receiver operating characteristic (ROC) curve.

While neutrophil, lymphocyte, monocyte, and white blood cell counts have been linked to inflammation in ISSHL patients, these markers were found to be elevated in ISSHL patients in a study utilizing NLR and PLR as formulas.[19] According to our study findings, although the NLR value was higher in the study group compared to the control group, the difference was not statistically significant. However, in the comparison between the recovery and non-recovery groups, a notable and statistically significant difference was observed. Specifically, the non-recovery group showed a high and significant disparity, with p-values of 0.155 and 0.021, respectively.

CRP and albumin, known as acute-phase reactants, have long been used in various cancers, facial paralysis, and other inflammatory conditions and have been studied extensively to determine prognosis.[20–23] In this study, CAR values were higher in the group with sudden hearing loss than in the control group; however, this difference was not statistically significant. Among patients who received treatment for ISSHL, there was a notable distinction between those who recovered and those who did not. Specifically, the recovery group had a lower CAR value compared to the non-recovery group, and this difference was statistically significant.

Although the SII has been previously studied in cancer patients, no studies have evaluated it in ISSHL.[15,16,24] The SII value, calculated using platelet, lymphocyte, and neutrophil counts, was found to be lower in both the control group and the

recovery group. The SII value showed a significant difference in the recovery group, suggesting that greater inflammation may negatively impact recovery prognosis.

The PNI has been used as a prognostic marker in head and neck cancers, often indicating lower levels in cancer patients.[25,26] In this study, PNI values were higher in both the control group and the recovering patient group with sudden hearing loss, although no significant difference was observed between them.

To determine recovery status in ISSHL, ROC analysis was performed using NLR, CAR, SII, and PNI values (Table 3). In this cross-sectional study, inflammatory markers such as SII and NLR were found to be useful in predicting the prognosis of ISSHL. However, PNI and CAR scores for ISSHL patients may not sufficiently represent the prognosis.

Limitations

The results of our study were evaluated using only the initial blood data taken at the patient's admission. Serial blood measurements would provide a more reliable assessment in determining prognosis.

CONCLUSION

While prognostic values in ISSHL have been extensively investigated, no universally accepted predictor has been established. Although NLR and SII values are not specific to ISSHL, they can be useful in predicting early prognosis.

Ethics Committee Approval: The Yıldırım Beyazıt University Clinical Research Ethics Committee granted approval for this study (date: 18.02.2021, number: 26379996/14).

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