

## Neutrophil-to-lymphocyte ratio and red cell distribution width: potential inflammatory markers for sudden sensorineural hearing loss

Neutrophil-to-lymphocyte ratio and red cell distribution width in sudden sensorineural hearing loss

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### Abstract

**Aim:** In this study, we aimed to evaluate whether the neutrophil-to-lymphocyte (NLR) ratio and red cell distribution width (RDW) value, which are accepted as novel indicators of inflammation, can be indicators for the evaluation of inflammation in Sudden Sensorineural Hearing Loss (SSHL) disease or not. **Material and Method:** The patient group was diagnosed as SSHL in our clinic between January 2012 and September 2018. Control group was constituted from the participants who had normal audiometry findings. Hematologic parameters were recorded. NLR was calculated for the statistical analysis. **Results:** This study was carried out with 169 volunteers, between the age of 18 - 87 years. The mean age of the patients was  $49.4 \pm 15$  years. There was no difference between the groups in terms of age. RDW was found significantly higher in the study group than the control group. Also, we found that NLR was significantly higher in the patients with SSHL when compared to the control group. **Discussion:** The high level of NLR and RDW in this disease, which is thought to play a role in the etiology of many diseases, may be interpreted as a sign of inflammation on the basis of the disease. Considering the treatment for etiology, the importance of anti-inflammatory treatment is appreciated.

### Keywords

Sudden Sensorineural Hearing Loss; Neutrophil; Lymphocyte; Red Cell Distribution Width; Inflammation

DOI: 10.4328/JCAM.6077 Received: 06.11.2018 Accepted: 21.11.2018 Published Online: 21.11.2018 Printed: 01.03.2019 J Clin Anal Med 2019;10(2): 235-8  
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## Introduction

Sudden sensorineural hearing loss (SSHL) was defined in 1994 and is an otologic emergency with a hearing loss more than 30 dB in a pure voice audiogram (PTA) with at least three serial frequencies within 72 hours [1,2]. Only 10% to 15% of this clinic pathology is detected of its etiology, while 85% of this pathology is included in the idiopathic group [3]. The degree of hearing loss ranges from mild hearing loss to complete hearing loss [3]. Although the causes of sudden hearing loss still remain mysterious, the effect of chronic inflammation in the process has recently become prominent [4,5]. Laboratory values of white blood cell (WBC) and its subtypes are known as classical inflammatory markers, especially in cardiac diseases [6]. In addition, the neutrophil-lymphocyte ratio (NLR) was determined as an inflammatory marker in patients with cardiac and non-cardiac disease [7,8]. In some studies, it was shown that NLR is higher in patients with sudden hearing loss [9].

Red cell distribution width (RDW) is a routine test for blood hemogram analysis and provides information on the changes in circulating erythrocytes, and recent studies suggest that RDW is a potential marker of inflammation [10-11].

In our study, we aimed to evaluate whether the NLR and RDW value, which are indicators of inflammation, can be indicators for the evaluation of inflammation in SSHL disease or not.

## Material and Method

We conducted our study at the Otorhinolaryngology Department of Ankara Numune Training and Research Hospital. All investigations were performed in accordance with the Declaration of Helsinki. The patient group comprised those diagnosed as SSHL in our clinic between January 2012 and September 2018. Also, a control group was constituted from the participants who had normal audiometry findings. Individuals with a history of noise damage, middle ear hearing loss, and usage of ototoxic medications were excluded. Also, patients who were diagnosed with Meniere's disease or labyrinthitis, and patients who had exhibited serious medical health problems or neurological medical conditions were excluded from the study.

Pure tone audiometry was measured at 0.25, 0.5, 1, 2, 4, and 8 kHz to detect the hearing threshold at each given frequency, using an AC40 clinical audiometer (Interacoustics, Assens, Denmark) in a sound-isolated room standardized according to the manufacturer's instructions. Air-conduction thresholds between 0.25 and 8 kHz were measured using TDH-39 earphones and an MX41/AR cover. Bone-conduction thresholds between 0.5 and 4 kHz were measured using an Oticon 60273 vibrator. Pure tone average (PTA) was determined based on the air-conduction average threshold levels in each ear at 0.5, 1, 2, and 4 kHz. Tympanometric measurements were performed, after swallowing, on both ears of the participants by using an Impedance Audiometer AZ 7 (Interacoustics, Assens, Denmark).

In the hematology panel WBC, hemoglobin (Hg), neutrophil number, lymphocyte number, platelet number, and RDW were recorded. All the hematological examinations were performed in the same device (Sysmex XT-1800i), and those examinations were performed before the administration of the treatment in the patient group. Neutrophil-to-lymphocyte ratio was calculated for the statistical analysis.

## Statistical Analysis

Data analysis was performed with SPSS 21.0 (Statistical Package for Social Sciences; SPSS Inc., Chicago, IL). The normal distribution of considered variables was first evaluated using the Shapiro-Wilk test. Data were shown as mean  $\pm$  standard deviation for continuous variables, and a number of cases was used for categorical ones. The differences between the sudden sensorineural hearing loss and control groups in terms of age and audiologic measurements were compared with a t-test. To explore neutrophil-to-lymphocyte ratio in relation to the covariate factors (age and sex) measured in this study, data were submitted to a multivariate analysis of variance using the general linear model. The level of significance was set at 0.05.

## Results

This study was carried out with 169 volunteers, between the age of 18 - 87 years. The mean age of the patients was 49.4  $\pm$  15 years. There was no difference between the study group and the control group in terms of age ( $p=0.7$ ), whereas a gender difference was detected. ( $p=0.042$ ) (Table 1).

Descriptive statistics of the results from hematological measurements are given in Table 2. We found that WBC and neutrophil countings were significantly higher in the study group than in the control group ( $p=0.002$  and  $p=0.001$  respectively), whereas no difference was detected in lymphocyte countings ( $p=0.75$ ). Also, we found that RDW was significantly higher in the study group than in the control group ( $p=0.04$ ).

When the NLR was calculated, we found that this ratio was significantly higher in the patients with SSHL when compared to the control group ( $p=0.03$ ).

To explore NLR in relation to the co-variate factors (age and sex) measured in this study, data were submitted to a multivariate analysis of variance using the general linear model, and we found that age and gender did not have a significant effect on this ratio ( $p=0.9$  and  $p=0.3$  respectively).

Table 1. Descriptive statistics of the study groups

	Sudden sensorineural hearing loss (n=73)	Control group (n=96)	p-value
Age	48.4 $\pm$ 14	49.2 $\pm$ 17	0.7
Male / Female	47/26	46 / 50	0.042
Pure tone average (right ear)	42.7 $\pm$ 38.7	7.3 $\pm$ 3.8	<0.001
Pure tone average (left ear)	52 $\pm$ 33.8	7.2 $\pm$ 3.6	<0.001

Table 2. The results of hematologic measurements for the study groups

Hematologic measurements	Sudden sensorineural hearing loss	Control group	p-value
Hemoglobin	13.4 $\pm$ 1.7	13.5 $\pm$ 1.6	0.47
White blood cell	8.2 $\pm$ 2.4	7 $\pm$ 2.6	0.002
Neutrophil	5.2 $\pm$ 2.1	4.2 $\pm$ 1.6	0.001
Lymphocyte	2.2 $\pm$ 0.8	2.3 $\pm$ 1.9	0.75
Platelet	260 $\pm$ 75	265 $\pm$ 65	0.6
Red blood cell distribution width	13.6 $\pm$ 1	13.2 $\pm$ 1.2	0.04
Neutrophil to Lymphocyte ratio	2.6 $\pm$ 1.6	2.2 $\pm$ 1.2	0.03

## Discussion

The most important results we have obtained in this study are that the NLR and RDW values are detected to be statistically significant higher in the SSHL patient group than the control group.

SSSL is an otologic disease whose prevalence is increasing in the world [12]. There are many etiological factors associated with this disease. The most widely accepted is the deterioration of the cochlea perfusion, and inflammation also finds place among the etiological factors [5,13,14]. In our study, we planned to investigate the association of some markers of inflammation with SSSL.

One of the parameters we used in our study is the NLR value that obtained a number of neutrophils which is identified in the examination blood counts at the time the patient applied to the hospital with the number of lymphocytes. NLR is a valuable parameter used in clinical practice, even though it is known that neutrophil indicates the inflammation and lymphocyte may indicate general stress and nutritional status. This parameter is often used to demonstrate systemic inflammation [15]. NLR has been used as an indicator of inflammation in many cardiac and non-cardiac diseases. This parameter is monitored on some increasing characteristics such as some systemic lobular inflammation, cardiovascular diseases, gynecological and gastrointestinal cancers [16-18]. In the study by Ulu et al. [9], it was detected to be significantly higher in the SSSL patients than in the NLR control group. Again, in this study, patients with high NLR levels showed a decrease in response to treatment and were reported as poor prognostic factors. In our study, NLR was significantly higher than in the control group and it is strong evidence that inflammation plays a role in the etiology of the disease. In the study by Bahrami et al., the strong relationship between the emergence of SSSL and NLR in the meta-analysis was determined [19]. Therefore, this parameter is related to the emergence of the disease and it is important in a bad response to the treatment. However, in our study, the blood parameters of the patients were not evaluated after the treatment period. There might be an increase in the number of neutrophils and a decrease in the number of lymphocytes especially after the administration of steroidal agents that were used during the treatment, and which would lead to misleading deviations in the NLR ratio.

RDW is a quantitative parameter indicating the variability of circulating red blood cells. It is evaluated in the hemogram measurement as a routine [20]. Basically, although it has been used in the diagnosis and classification of disease such as iron deficiency anemia, thalassemia, the recent studies suggest that RDW is a potential marker of inflammation [10]. RDW was found to be a novel predictive indicator as an inflammatory marker, especially for cerebral and cardiovascular diseases [21-23].

In infectious events such as infection and autoimmune diseases, RDW appears as a biomarker with significant potential. In our study, RDW was found to be significantly higher than the control group. This situation may be evaluated so that inflammatory events have the role on the basis of SSSL as an indicator. This may be an important indicator of the need for inflammation suppressive treatment.

## Conclusion

SSSL is an important emergency situation of ear, nose and throat condition. The high level of NLR and RDW in this disease, which is thought to play a role in the etiology of many diseases, may be interpreted as a sign of inflammation on the basis of the disease. Considering the treatment for etiology, the importance of anti-inflammatory treatment is appreciated. This topic requires researches with a large patient population.

## Scientific Responsibility Statement

*The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.*

## Animal and human rights statement

*All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.*

## Funding: None

## Conflict of interest

*None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.*

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**How to cite this article:**

Dinc ASK, Cayonu M, Boynuegri S, Sahin MM, Eryilmaz A. Neutrophil-to-lymphocyte ratio and red cell distribution width: potential inflammatory markers for sudden sensorineural hearing loss. *J Clin Anal Med* 2019;10(2): 235-8.