The Journal of International Advanced Otology

J Int Adv Otol 2017; 13(2): 217–20 • DOI: 10.5152/iao.2017.3404

Original Article

Neutrophil–to–Lymphocyte and Platelet–to–Lymphocyte Ratios in Pediatric Patients with Idiopathic Sudden Hearing Loss

Suphi Bulğurcu, Bünyamin Dikilitaş, İlker Burak Arslan, İbrahim Çukurova

Clinic of Otorhinolaryngology, Başkale State Hospital, Van, Turkey (SB)
Clinic of Otorhinolaryngology, Tepecik Training and Research Hospital, İzmir, Turkey (BD, İBA, İÇ)

Cite this article as: Bulğurcu S, Dikilitaş B, Arslan İB, Çukurova İ. Neutrophil-to-Lymphocyte and Platelet-to- Lymphocyte Ratios in Pediatric Patients with Idiopathic Sudden Hearing Loss. J Int Adv Otol 2017; 13: 217-20.

OBJECTIVE: We investigated the significance of the neutrophil-to-lymphocyte and platelet-to-lymphocyte ratios, which have recently been used in adults for the prognosis of idiopathic sudden hearing loss (ISHL), in the prognosis of idiopathic sudden hearing loss in a pediatric population.

MATERIALS and METHODS: A total of 13 males and 8 females younger than19 years with idiopathic sudden hearing loss were retrospectively examined between January 2008 and August 2016.The control group consisted of 12 healthy males and 12 healthy females. Patients were divided into two groups: those who recovered after treatment and those who did not.

RESULTS: A statistical significance for the neutrophil-to-lymphocyte ratio was detected between the patient group and control group and between patients who recovered and those who did not ($p<0.05$). No statistical significance for the platelet-to-lymphocyte ratio was detected between the patient group and control group and between patients with recovery and those without recovery ($p>0.05$).

CONCLUSION: The neutrophil-to-lymphocyte ratio is an important marker for the prognosis of idiopathic sudden hearing loss in pediatric patients, similar to its use in adult patients.

KEYWORDS: Sensorineural hearing loss, pediatric, neutrophil-to-lymphocyte ratio

INTRODUCTION

Sudden hearing loss (SHL) is defined ashearing loss determined above 30 dB at three consecutive frequencies in 3 days. Its incidence varies between 5 and 20 per 100,000 in adult patients. However, its exact incidence is unknown in a pediatric population. Its etiology can be detected in only 10–15% of patients with SHL. These causes generally include cochlear artery perfusion problems and infectious and autoimmune causes. SHL with undetectable etiological factors is defined as idiopathic sudden hearing loss (ISHL) [1, 2]. Recently, it has been focused on chronic inflammation in patients with ISHL. Chronic inflammation causes microvascular injury and increases the risk of ischemia [3]. In studies on cardiovascular diseases, the neutrophil-to-lymphocyte ratio (NLR) was found to be an important prognostic factor [4]. Besides, the platelet-to-lymphocyte ratio (PLR) has been to be related to a poor prognosis in patients with peripheral arterial disease [5]. There are studies in the literature that show a relationship between SHL prognosis in adults and the NLR and PLR [6].

In this study, we investigated the relationship of the NLR and PLR in the prognosis of pediatric patients with ISHL by comparing the NLR and PLR in blood samples and pure-tone thresholds of pre- and post-treatment audiograms.

MATERIALS and METHODS

A total of 13 males and 8females younger than19 years with ISHL were retrospectively examined between January 2008 and August 2016 in our clinic. In all patients, hearing loss was followed up unilaterally. Besides, there was a control group consisting of 12 males and 12 females who did not have any problem and who had normal hearing functions.

Corresponding Address: Suphi Bulğurcu E-mail: suphibulg@yahoo.com

Submitted: 18.12.2016 • **Revision Received:** 11.01.2017 • **Accepted:** 25.01.2017 • **Available Online Date**: 17.04.2017

The average age of the patients was 13.7±3.2 years, and the average age of those in the control group was 14.8±2.9 years. Inclusion criteria were as follows: starting of hearing loss within 72 hours; detection of pure-tone threshold over 30 dB hearing loss in three consecutive frequencies at audiogram; admission within 1 week after the initiation of the disease; not using steroid treatment before; not having acute inflammation, infection, ear surgery, trauma, and barotrauma in the last 4 weeks; not having cerebellopontine corner or congenital cochlear pathology; not using ototoxic medicine; and not having other major pathologies (such as diabetes mellitus).

Ethics committee approval was obtained, and the study was conducted in accordance with the Helsinki Declaration. Informed consent was obtained from the parents of the participants.

Audiometric examinations were performed in quiet rooms with an Interacoustics AC-40 clinical audiometer. Pure-tone averages (PTAs) in the audiogram before treatment and 1 month after treatment were classified according to Siegel criteria (Table 1) [7]. Then, patients were divided into two groups: those who recovered (complete+partial+mild) group and those who did not.

Blood samples were taken before the initiation of treatment. Hemogram was performed using peripheral venous blood samples obtained at admission. Blood samples were collected into tubes containing calcium ethylenediaminetetraacetic acid. These blood samples were tested using an automated blood cell counter (Beckman Coulter analyzer, CA, United States). The NLR and PLR were calculated as ratios between the absolute neutrophil and absolute lymphocyte counts and between the absolute platelet and absolute lymphocyte counts, respectively.

All patients started 1 miligram/kilogram prednisolone with decreasing doses for at least 2 weeks.

Statistical Analysis

Statistical analysis of data was performed using the SPSS® 20.0 software (SPSS Inc.; Chicago, IL, USA). For the evaluation of the relationship between the groups, Pearson's chi-square test and Fisher's exact test were used. Statistically, $p<0.05$ was considered as significant.

RESULTS

There was no statistically significant difference between the patient and control groups in terms of age and gender (p=0.572 and p=0.324, respectively). Those in the patient and control groups were divided into three groups according to their age: 0–5 years (group 1), 6–10 years (group 2), and 11–18 years (group 3). In the patient group, there was 1 patient in group 1, five in group 2, and 15 in group 3; in the control group, there were 2 individuals in group 1, 6 in group 2, and 14 in group 3. There was no statistically significant difference between the patient and control groups in terms of age (p=0.84).A statistical significance was detected between the patient and control groups in terms of the NLR ($p<0.05$), but there was no statistical significance in terms of the PLR ($p>0.05$) (Table 2).

The mean PTA of patients before treatment was 54.8±36.4 dB. One month after treatment, the mean PTA of patients who recovered was 18.5±12.2 dB and of those who did not recover was 59.4±30.6 dB.

In the first month after treatment, full (complete) recovery in 6 (28.5%) patients, partial recovery in 4 (19.4%), and mild recovery in 2 (9.52%) were observed in the audiograms. There was no recovery in 9 (42.85%) patients. There was no statistically significant difference in terms of age and gender between patients who recovered and those who did not (p=0.344 and p=0.181, respectively). A statistical significance was detected between patients who recovered and those who did not in terms of the NLR ($p<0.05$), but there was no statistical significance in terms of the PLR ($p>0.05$) (Table 3). The

Table 1. Siegel's criteria of hearing improvement

Group	Hearing recovery	Definition
I	Complete recovery	Patients having a final hearing level better than 25 dB regardless of the size of the gain
II	Partial recovery	Patients having a gain of more than 15 dB and having a final hearing level between 25 and 45 dB
III	Slight recovery	Patients having a gain of more than 15 dB and having a final hearing level poorer than 45 dB
IV	No improvement	Patients having a gain less of than 15 dB

Table 2. Comparisons of pediatric idiopathic sudden deafness with the control group

Variables	Patient group	Control group	p
Age (years) Mean±SD	13.7±3.2	14.8±2.9	0.572
Male	13	12	
Female	8	12	0.324
Neutrophil (10^3/U), Mean±SD	5.09±2.48	3.01±1.41	0.017
Lymphocyte (10^3/U), Mean±SD	1.79±0.35	2.12±0.87	0.039
Platelet (10^3/U), Mean±SD	247.12±53.23	262.11±41.18	0.071
NLR, Mean±SD	3.85±1.96	1.74±0.42	0.016
PLR, Mean±SD	158.21±47.42	141.62±58.79	0.089

NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; SD: standard deviation

Table 3. Comparisons of pediatric idiopathic sudden deafness with and without improvement

Variables	Patients who recovered	Patients who did not recover	p
Age (years) Mean±SD	12.9+2.4	14.2±2.7	0.344
Male	5	5	0.181
Female	7	4	
Neutrophil (103/U), Mean±SD	4.18±1.25	6.43±1.92	0.031
Lymphocyte (103/U), Mean±SD	2.19±0.66	1.42±0.52	0.037
Platelet (103/U), Mean±SD	258.6±57.58	251.84±41.54	0.851
NLR, Mean±SD	3.43±1.36	5.22±1.25	0.042
PLR, Mean±SD	151.41±77.64	163.26±34.14	0.063

NLR: neutrophil-to-lymphocyte ratio; PLR: platelet-to-lymphocyte ratio; SD: standard deviation

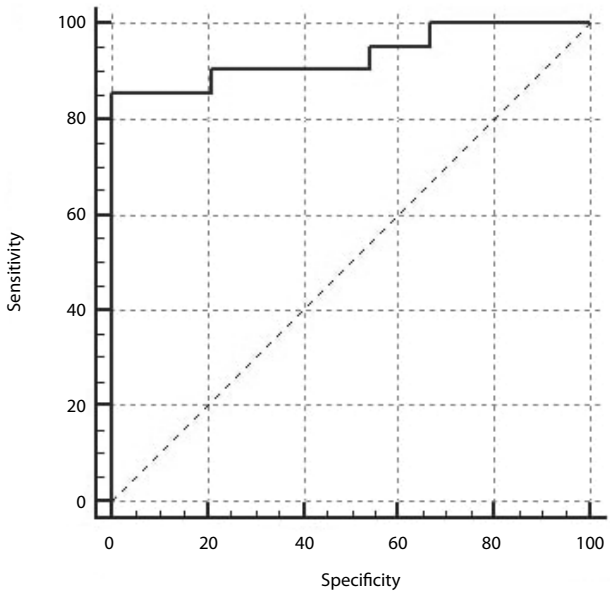

Figure 1. Receiver operating characteristic curves for the difference between the patient and control groups. Area under the receiver operating characteristics curve=0.933 (95% confidence interval).

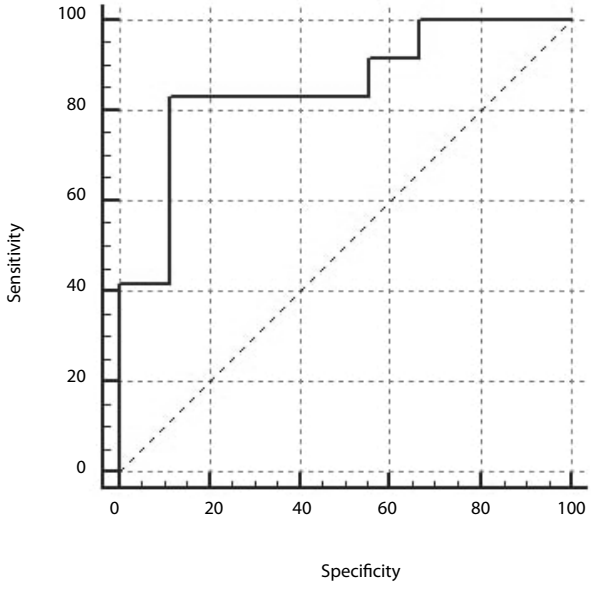

Figure 2. Receiver operating characteristic curves for the difference between patients who recovered and those who did not. Area under the receiver operating characteristics curve=0.852 (95% confidence interval).

sensitivity, specificity, and cut-off of NLRs between the patient and control groups were 84.71, 100, and 2.66, respectively (Figure 1). The sensitivity, specificity, and cut-off of NLRs between patients who recovered and those who did not were 83.33, 88.89, and 4.02, respectively (Figure 2).

DISCUSSION

There is limited information in the literature about SHL in a pediatric population. Besides, its incidence is not exactly known because of the difficulties in performing an audiological evaluation in infants and young children. In a study, 3.5% of pediatric patients with SHL were reported to be younger than 14 years. Besides, there is not too much information available about its etiology. It is thought to be caused by reasons such as cochlear perfusion defects and infectious, immunological, and inflammatory causes [8, 9]. Some studies are particularly focused on the relationship between chronic inflammation and cochlear injury, and they found that inflammatory markers are related to ISHL prognosis [10]. High levels of neutrophils can cause endothelial damage; they lead to the impairment of microcirculation and play an important role in the production of cytokines in the inflammatory process. Besides, apoptosis of lymphocytes occurs during inflammation and causes reduction in the number of lymphocytes. Likewise, high levels of platelets can cause vascular occlusion and perfusion problems [6, 11]. NLRs and PLRs are defined as novel potential markers in oncologic, cardiac, cerebrovascular, and renal diseases; Alzheimer's disease; and many inflammatory diseases such as ulcerative colitis, and they are detected to be as valuable as expensive markers such as interleukin (IL)-6, IL-8, IL-1b, and tumor necrosis factor-alpha [12]. The increase in the NLR has been shown to be associated with elevated levels of inflammation [13]. Masuda et al. [14] and Ulu et al. [10] have shown that the NLR was statistically higher in adult patients who were diagnosed with ISHLthan in those in a healthy group. Besides, the NLR was statistically higher in patients who did not recover than in those who recovered.

An increased PLR is associated with critical limb ischemia and vascular diseases such as atherosclerosis [15]. Durmuş et al. [12] and Seo et al. [6] observed that the PLR was significantly higher in adult patients with ISHL than in those in the healthy group. Likewise, the PLR in patients who did not recover was statistically higher than that in those who recovered.

Lee et al. [9] found that that the NLR was statistically higher in pediatric patients with SHL than in those in the healthy group. PLRs were also higher in pediatric patients with SHL than in the healthy group, but they were not statistically significant. No comparison was conducted between patients who recovered and those who did not.

In this study, we investigated the NLR and PLR in 21 pediatric patients with ISHL. The NLR in the healthy pediatric population was lower than that in a pediatric population with ISHL, andthis difference was statistically significant. It was higher in patients who did not recover than in those who recovered 1 month after treatment, and this difference was statistically significant. On the other hand, the PLR was lower in the control group than in the group, but this difference was not statistically significant. In patients who recovered, the PLR was significantly lower than that in patients who did not recover, but this difference was also not statistically significant. The results of our study are similar to those obtained by Lee et al. [9]. The statistical significance of the PLR in adult patients with ISHL compared to pediatric patients with ISHL may be related to age-dependent changes in the PLR and inadequate elevation of PLR value in pediatric patients with ISHL [16].

In the present study, we detected that an increase in NLR can be used as a cheap and an easily detectable prognostic marker in a pediatric population with ISHL, similar to its use in adult patients. Besides, the relationship between the NLR and recovery supports the chronic inflammation theory in ISHL etiology. The relationship observed between ISHL prognosis and the PLR in adult patients was not detected

in pediatric patients with ISHL. As ISHL is a rare disease in pediatric patients, the importance of NLR should be supported with further studies.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Tepecik Training and Research Hospital, İzmir (No:2016-31/19).

Informed Consent: Written informed consent was obtained from the parents of the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - S.B.; Design - İ.B.A.,İ.Ç.; Supervision - İ.Ç.; Resources - B.D.; Materials - B.D.; Data Collection and/or Processing - İ.B.A.; Analysis and/or Interpretation - İ.B.A.; Search - S.B., B.D.; Writing Manuscript - S.B.; Critical Review - İ.Ç.

Conflict of Interest: No conflict of interest was declared by the authors.

Financial Disclosure: The authors declared that this study has received no financial support.

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