RESEARCH ARTICLE
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Which Is the Best Inflammatory Index in Bell's Palsy?

Erkun Tuncer[1], Mehmet Erkan Kahraman[2], Fatih Yüksel[1], Sinan Kır[1]

[1]Konya City Hospital, Clinic of Otorhinolaryngology, Konya, Turkiye
[2]Gülhane Training and Research Hospital, Department of Otorhinolaryngology, Ankara, Turkiye

ORCID ID: E.T. 0000-0002-3336-2118; M.E.K. 0000-0003-4717-2929; F.Y. 0000-0003-3894-7948; S.K. 0000-0003-1875-9982

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ABSTRACT

Objective: This study aims to analyze previously suggested hematological markers in addition to the systemic inflammation response index (SIRI) and the aggregate index of systemic inflammation (AISI) in patients with Bell's palsy (BP) and to identify the most important hematologic inflammatory marker among them.
Material and Methods: The study consisted of 87 patients with BP who were between the ages of 18 and 65. Sixty-three healthy controls with similar age and sex distribution were assembled. A retrospective examination was done on the patient and control group files. House Brackmann grading system stage at the admission of patients with BP was recorded. Routine complete blood count values obtained from the patients at the time of admission and before the start of treatment were recorded. The systemic immune-inflammatory index (SII), the neutrophil-to-lymphocyte ratio (NLR), the platelet-to-lymphocyte ratio (PLR), the monocyte-to-lymphocyte ratio (MLR), SIRI, and AISI were all generated from these values.
Results: There were 39 (44.8%) men, 48 (55.2%) women in the BP group, and 34 (54.0%) men and 29 (46.0%) women in the control group. The patient group had substantially increased neutrophil, white blood cell, NLR, PLR, SII, SIRI, and AISI levels (P values: 0.001, 0.001, 0.001, 0.033, 0.001, 0.001, and 0.001, respectively). NLR, PLR, SII, SIRI, and AISI values were lower in Receiver Operating Characteristics curves (ROC) analysis than neutrophil the areas under the curves (AUC) values.
Conclusion: Neutrophil count was found to be more valuable than other inflammatory indexes in the diagnosis of BP.
Keywords: Bell's palsy, hematologic parameters, inflammatory indexes

INTRODUCTION

Rapid and unilateral peripheral paresis or paralysis of the seventh cranial nerve is defined as Bell's palsy (BP) (1). The incidence of the disease has been reported as 11-40/100,000 (2). The etiology of BP is unclear therefore, it is also called idiopathic facial paralysis. Bell's palsy's genesis has been linked to inflammation, viral infections, anatomical structure, ischemia, and cold sensitivity (1).

One of the routine tests performed during hospitalization is the CBC, which does not require any extra cost. Data from CBC are frequently used to evaluate infection and inflammation. Important biomarkers of systemic inflammation and immune response are leukocytes consisting of neutrophils, lymphocytes, eosinophils, and basophils (3). The ratio of these cell counts to each other gives neutrophil/lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), monocyte-to-lymphocyte ratio (MLR), Systemic immune-inflammatory index (SII), systemic inflammation response index (SIRI), and aggregate index of systemic inflammation (AISI). There are studies in which combined inflammation indexes are more valuable when compared to the evaluation of cell counts alone (4–6).

Complete blood count (CBC) values that demonstrate the importance of inflammatory events in the etiology of BP patients, as well as certain indicators generated from these data, have been extensively investigated in recent years (7,8). However, there are discrepancies between the data in these studies. In this study, we aimed to determine the most valuable hematological inflammatory index by analyzing hematological markers in patients with Bell's palsy.

MATERIAL AND METHODS

In a tertiary Konya City Hospital, this retrospective analysis was carried out between January 2015 and January 2020.

Corresponding Author: Erkun Tuncer **E-mail:** drerkun@hotmail.com
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The study consisted of 87 patients diagnosed with BP and 63 patients with age- and sex-matched healthy controls. Age, gender, comorbid disease, complete blood count values, and House Brackmann grading system (HB) stage at admission were recorded.

The study included individuals with BP diagnosed between the ages of 18 and 65. People with a history of infection, trauma, neurological or otological comorbidity, ototoxic drug use during the previous 10 days, and cerebral pathology on magnetic resonance imaging were eliminated from the research. In addition, those with inflammatory diseases such as autoimmune disease, diabetes mellitus, inflammatory bowel disease, dermatitis, and hepatitis were also excluded from the control group.

Blood samples were routinely taken from the patients at the time of admission and before starting the treatment. The samples were analyzed in the laboratory of our hospital. Complete blood count values from blood samples were recorded. From these values, NLR (neutrophil/lymphocyte), PLR (platelet/lymphocyte), MLR (monocyte/lymphocyte), SII (neutrophil×platelet/lymphocyte), SIRI (neutrophil×monocyte/lymphocyte) and AISI (neutrophil×platelet× monocyte/lymphocyte) were calculated.

The Ethics Committee of Necmettin Erbakan University has agreed to our study (Date: 04.02.2022, No: 2022/3630). Since this study was made from records, patient consent was not obtained. The study was carried out in conformity with the international ethical standards of the Declaration of Helsinki.

Statistical analysis

The statistical evaluations were carried out using SPSS edition 22 (IBM SPSS, Chicago, USA). The participants' ages and genders were compared using descriptive statistics. The Mann-Whitney U test and Student's t-test were used to compare numerical variables. The chi-square test was used to compare categorical variables. Through the use of Receiver Operating Characteristics curves (ROC) analysis, the areas under the curves (AUC) of hematological inflammatory markers were calculated. Youden Index was used for optimal cut-off values. By using Spearman correlation analysis, the association between the HB stage and hematological markers was examined. P values under 0.05 were accepted as significant.

RESULTS

In the BP group, 48 (55.2%) of the 87 patients were female, and 39 (44.8%) of them were male. In the control group, 34 (54.0%) of the 63 patients were male, and 29 (46.0%) were female. The patient group's median age was 53.0 (16) years, while the control group's was 55.0 (11.0). Age and gender did not significantly differ between the patient and control groups (P values of 0.269 and 0.935, respectively) (Table 1).

The patient group's values for neutrophils, WBC, SII, SIRI, AISI, NLR, and PLR were discovered to be significantly higher than those of the control group. It was observed that the patient group's lymphocyte levels were significantly lower than those of the control group (P value: 0.032). The patient group and the control group did not significantly differ in their platelet, monocyte, or MLR values (Table 1).

Table 1: The distribution of demographic data, hematologic parameters and inflammatory markers of both groups

	Bell's palsy (n=87)	Control group (n=63)	P value
Gender, n (%)			
Male	39 (44.8)	34 (54.0)	0.269
Female	48 (55.2)	29 (46.0)	
Age (year)	53.0 (16)	55.0 (11.0)	0.935
White blood cell ($10^3/mm^3$)	10.21 (4.92)	7.59 (2.62)	**<0.001**
Neutrophil ($10^3/mm^3$)	6.53 (4.06)	4.01 (1.65)	**<0.001**
Platelet ($10^3/mm^3$)	278.18±67.97	269.86±52.67	0.418
Lymphocyte ($10^3/mm^3$)	2.21 (1.46)	2.63 (1.30)	**0.032**
Monocyte	0.58±0.31	0.59±0.16	0.904
NLR	2.74 (2.91)	1.64 (0.78)	**<0.001**
PLR	116.08 (74.97)	105.20 (48.50)	**0.033**
MLR	0.23 (0.14)	0.21 (0.10)	0.720
SII	765.99 (819.41)	403.54 (240.32)	**<0.001**
SIRI	1.39 (1.48)	0.85 (0.51)	**<0.001**
AISI	411.36 (434.29)	222.51 (170.46)	**<0.001**

NLR: neutrophil-to-lymphocyte ratio, PLR: platelet-to-lymphocyte ratio, MLR: monocyte-to-lymphocyte ratio, SII: Systemic Immune-Inflammation Index, SIRI: Systemic Inflammation Response Index, AISI: Aggregate Index of Systemic Inflammation. Parameters were expressed as n (%), median (Interquartile Range) and mean ±standard deviation.

In ROC analysis, the AUC of neutrophils was higher than that of the NLR, PLR, SII, SIRI, and AISI (Figure 1). For neutrophil, NLR, PLR, SII, SIRI, and AISI, the optimal cut-off values determined by the maximum Youden index were 5.17, 2.41, 144.14, 631.87, 1.10, and 340.18, respectively. The cut-off value of neutrophil was calculated as 5.17 x 10^3/mm^3 with rates of 77.0% sensitivity and 85.7% specificity in the diagnosis of BP (Table 2). WBC, lymphocyte, neutrophil, NLR, PLR, SII, SIRI, and AISI values were not found to significantly correlate with the HB stage (r = 0.460, 0.417, 0.990, 0.796, 0.761, 0.864, 0.845, and 0.761 respectively, and p > 0.05 for all).

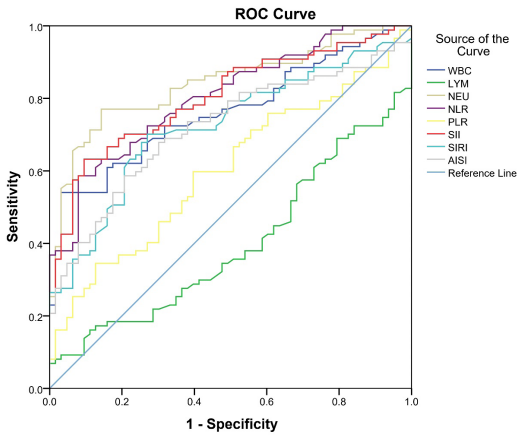

Figure 1: The graph of the ROC analysis

found between the HB stage and WBC, neutrophil, lymphocyte, NLR, SII, SIRI, and AISI. To our knowledge, this is the first study on SIRI and AISI in patients with BP.

PLR and NLR have reportedly been linked to poor prognosis in cardiovascular diseases, peripheral vascular diseases, head and neck cancers, and gynecological and gastrointestinal malignancies (9–11). In addition, it has been shown that there is a relationship between the prognosis of sudden sensorineural hearing loss and NLR. This suggests that the etiology of sudden sensorineural hearing loss is due to inflammatory events (12,13). In studies conducted on patients with BP, it was reported that neutrophils and NLR were significantly higher than controls (7,14–16). In addition, studies are reporting that there is no significant difference between lymphocyte counts, platelet counts, and PLR values of BP patients and controls (14,15). In our study, neutrophil, WBC, NLR, and PLR values were found to be significantly higher and lymphocyte levels were found to be significantly lower in the BP group. In addition, it was determined that there was no significant difference in platelet, monocytes, and MLR values between BP and control groups.

There are conflicting findings in the literature about the association between hematological inflammatory indices and the severity of BP. Atan et al. found no statistically significant relationship between the degree of facial paralysis and NLR and PLR (14). Bucak et al. showed that NLR levels were higher

Table 2: ROC analysis results of patients with Bell's Palsy

				95 % CI			
	Value	AUC	P	Lover	Upper	Sensitivity (%)	Specificity (%)
WBC (10^3/mm^3)	9.98	0.763	<0.001	.688	.838	54.0	96.8
Neutrophil (10^3/mm^3)	5.17	0.842	<0.001	.779	.905	77.0	85.7
Lymphocyte (10^3/mm^3)	2.49	0.397	0.032	.307	.487	37.9	41.3
NLR	2.41	0.805	<0.001	.737	.873	58.6	92.1
PLR	144.14	0.602	0.033	.512	.692	34.5	87.3
SII	631.87	0.802	<0.001	.733	.872	63.2	90.5
SIRI	1.10	0.723	<0.001	.642	.804	70.1	73.0
AISI	340.18	0.718	<0.001	.637	.800	58.6	79.4

NLR: neutrophil-to-lymphocyte ratio, PLR: platelet-to-lymphocyte ratio, SII: Systemic Immune-Inflammation Index, SIRI: Systemic Inflammation Response Index, AISI: Aggregate Index of Systemic Inflammation, AUC: area under the curve, CI: confidence interval, ROC: receiver operator characteristic. Receiver operator curve evaluating NLR, PLR, SII, SIRI and AISI for BP. AUC > 0.600 and p < 0.05 were accepted as significant.

DISCUSSION

Bell's palsy is thought to be brought on by edema and inflammation of the facial nerves. In recent years, many publications have reported that inflammatory markers obtained from peripheral blood count are associated with prognosis and severity in patients with BP. In our study, patients with BP had significantly increased NLR, SII, SIRI, and AISI levels. We think that this is due to the number of neutrophils in the formulas of markers such as NLR, SII, SIRI, and AISI. Contrary to expectations, no correlation was

in patients with BP who did not fully recover than in those with complete recovery (15). In another study, it was reported that the NLR value increased with the severity of BP. This study demonstrated that the NLR values of patients with permanent facial motor impairment were considerably greater than those of the control group (16). Similarly, Ozler and Gunak. also found a positive correlation between NLR and HB stage (17). In this study, there was no difference in neutrophil, platelet, eosinophil, monocyte, and PLR values according to the BP stage. There was no significant correlation between the HB

stage and the WBC, lymphocyte, neutrophil, NLR, or PLR values discovered in our study. (r = 0.460, 0.417, 0.990, 0.796, and 0.761 respectively, and p > 0.05 for all). In ROC analysis, the AUC value of neutrophil count was higher than that of NLR and PLR values (AUC: 0.842, 0.805, and 0.602 respectively), and neutrophil count was found to be more valuable than NLR and PLR in the diagnosis of BP.

Another index that is considered to have prognostic value is SII. It has been reported that high SII can be used to predict the prognosis of the disease in breast cancers, gynecological cancers, gastrointestinal malignancies, lung cancer, and prostate cancer (18,19). Kinar et al. found that neutrophil count, SII, and NLR values were high in patients with BP (8). In the ROC analysis, they reported that the AUC value of SII was higher than that of the NLR (0.731 and 0.728, respectively), and SII was more valuable than NLR in the diagnosis of BP. In our study, patients with BP had higher SII values than the control group [765.99 (819.41) and 403.54 (240.32) respectively, and P<0.001]. The AUC value of NLR was found to be higher than that of SII in ROC analysis (0.805 and 0.802, respectively).

In acute diseases and malignancies, AISI and SIRI have been reported to be better prognostic indices than NLR (20,21). Wei et al. reported that SIRI is an indicator of poor prognosis in cancers (22). According to the authors, SIRI could be used as a useful marker in cancer therapy. A study of patients with idiopathic pulmonary fibrosis found that AISI was significantly associated with mortality (23). In contrast, Erre et al. reported that SIRI and AISI were not significantly associated with Rheumatoid Arthritis activity, but with systemic inflammation (24). According to this study, NLR was the index that outperformed SIRI and AISI. In our study, SIRI and AISI were found to be significantly higher in the patient group. However, in our study, the AUC of the neutrophil count, NLR, and SII were higher than SIRI and AISI according to ROC analysis (AUC: 0.842, 0.805, 0.802, 0.723, and 0.718, respectively).

The most important limitations of our study are its retrospective nature and lack of prognostic evaluation. The combined inflammation index calculated using multiple blood cell populations is expected to better reflect the inflammatory status and predict prognosis than a single hematological marker. Contrary to predictions, the neutrophil count's AUC was higher than that of the other hematological inflammatory indices. In our investigation, the data collected from BD patients before therapy showed no statistically significant difference in platelet or monocyte values between the patient and control groups. As a result, it was established that AISI and SIRI did not function properly (P values: 0.418 and 0.904, respectively). We think that prognostic studies with a large patient population, including post-treatment data on SIRI and AISI, should be performed.

CONCLUSION

The neutrophil count was found to be more valuable than other hematological indexes in the diagnosis of BP. Inflammatory indexes were not correlated with the BP stage.

Ethics Committee Approval: This study was approved by The Ethics Committee of Necmettin Erbakan University (Date: 04.02.2022, No: 2022/3630).

Informed Consent: Written informed consent was obtained.

Peer Review: Externally peer-reviewed.

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Conflict of Interest: The authors have no conflict of interest to declare.

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Informed Consent: Patient consent was not obtained because this study was conducted from the records.

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