SANAMED
2023; 18(2): 119–126
ISSN-1452-662X

DOI: 10.5937/sanamed0-44601
UDK: 616.857-08; 616.857-074:577.11
ID: 124066057
Original article

THE VALUE OF THE SYSTEMIC IMMUNE INFLAMMATION INDEX (SII) IN MIGRAINE PATIENTS TREATED WITH GREATER OCCIPITAL BLOCK TREATMENT

Sadri Sevil,[1] Ülfer Gözde,[2] Polat Burcu[3]

[1] Ministry of Health Bursa City Hospital, School of Medicine, Internal Medicine Department of Hematology, Bursa, Turkey
[2] Istanbul Medipol University, School of Medicine, Department of Biochemistry, Istanbul, Turkey
[3] Duzce University, Department of Neurology, Düzce, Turkey

Primljen/Received 21. 05. 2023. god. Prihvaćen/Accepted 13. 08. 2023. god.

Abstract: **Introduction:** Neuroinflammation plays a key role in various neurological conditions, including migraine. GON block has been used for both acute and preventive treatment in migraine sufferers. Exploring whether this localized nerve blocking therapy for migraines affects signs of systemic inflammation would be beneficial.

Materials and Methods: In this study, a total of 50 migraineurs (comprising high-frequency episodic and chronic migraine) and 60 healthy control volunteers of comparable ages and sexes were enrolled. The neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and SII levels in migraine patients, migraine sufferers, and healthy individuals are compared. This study examined hematological parameters and SII levels used as inflammatory markers in those diagnosed with migraine.

Results: It was determined that the mean platelet and PLR values of the case group's subjects were substantially lower than those of the patient group's subjects ($p < 0.05$). Biochemical characteristics of the cases were examined before and after treatment with greater occipital nerve (GON) block, revealing a statistically significant reduction in attack frequency, severity, and duration ($p < 0.001$). No significant differences were discovered when compared to post-treatment values ($p > 0.05$), even though the ratios were greater prior to GON block therapy in other measures.

Conclusion: These findings, in our opinion, are linked to the presence of a continuous inflammatory process even in the absence of episodes, supporting systemic inflammation in migraineurs. Thus, SII, an affordable and easily measurable marker in peripheral blood, may serve as a helpful predictive marker for migraine patients scheduled for GON block treatment. Further extensive research is needed to determine whether SII can be an independent prognostic factor in migraine patients.

Keywords: migraine, neuroinflammation, systemic immune inflammation index.

INTRODUCTION

The pathophysiology of migraine is believed to arise from a variety of causes. Neuroinflammation stands as a key mechanism in migraine, other neurological disorders, and their associated conditions. In fact, increasing research suggests that migraine, epilepsy, stroke, and COVID-19 infection might all be influenced by parenchymal neuroinflammation. The identification of neuroinflammation's crucial role in migraine has unveiled new insights into the disease's origins (1). Researchers reached the conclusion that the localized extracranial pathophysiology observed in chronic migraine sufferers (i.e., periosteal inflammation) should be considered as evidence that certain migraine attacks can initiate outside the head (2). Authors of a study similarly concluded that the localized extracranial pathophysiology seen in individuals with chronic migraines (i.e., periosteal inflammation) should be acknowledged as support for the notion that specific migraine attacks can commence beyond the skull.

Headache experts show a keen interest in migraine headache treatment. Both acute and preventative treatments encompass a wide array of medications with diverse mechanisms. While triptans, acetaminophen, and nonsteroidal anti-inflammatory drugs (NSAIDs)

are recommended by the American Headache Society and the American Academy of Neurology (2012) for managing acute attacks, acupuncture is suggested as a non-pharmacological approach alongside antiepileptics, antihypertensives, and antidepressants for prophylaxis (3, 4). The demand persists for a migraine treatment that is dependable, practical, affordable, and effective.

The dorsal rami of the C2 and C3 segments give rise to the greater occipital nerve (GON), which is composed solely of sensory fibers. It extends anteriorly to the vertex before becoming superficial on the inferolateral side of the occipital region. The convergence of sensory information from GON and the ophthalmic branch of the trigeminal nerve in the trigeminal nucleus caudalis is believed to contribute to the infrequent coexistence of occipital neuralgia and migraine headache symptoms (5). GON block is thought to alleviate pain and neuronal hyperexcitability by reducing afferent input to the trigeminal nucleus caudalis (6). Local anesthetic and corticosteroids are administered through a needle into the inferolateral aspect of the GON block in the occipital projection. Despite not being indicated in current guidelines for migraine headache management, the effectiveness of GON block treatment has been explored across varying degrees in studies (6, 7).

Central vestibular pathways and the inner ear are implicated in vascular and neurogenic inflammation, both as peripheral and central migraine triggers, as well as within central neural mechanisms. Peptide production from axon terminations of trigeminal ganglion cells triggers a sterile inflammatory response in the meningeal arteries (8, 9). According to specific findings, different pro-inflammatory components and cytokine levels are elevated in the peripheral blood of migraine patients. GON block has long been employed for treating and preventing migraines in patients. This study compares the hematological parameters of patients who received prophylactic GON block before and after treatment.

In clinical practice, the white blood cell count (WBC) is a common measure of inflammation. An increased "neutrophil-to-lymphocyte ratio" (NLR) may indicate inflammation and inflammation-related diseases even when WBC is within normal ranges (3). While it is widely recognized that hematologic disorders such as anemia and polycythemia are associated with headaches, there haven't been many studies examining the connections between headache features like frequency, severity, or duration and hematologic parameters.

Neutrophils play a key role in acute phase reactions that lead to inflammation, while lymphocytes are important participants in cellular and humoral processes. Due to its connection to inflammation, NLR, which is generated by neutrophils and lymphocytes in circulation, holds great significance. A complete blood count (CBC) can easily quantify the neutrophil/lymphocyte ratio (NLR) and platelet/lymphocyte ratio (PLR), two straightforward, accessible, and cost-effective markers of inflammatory response. NLR, PLR, and the systemic immunological inflammation index (SII) have gained popularity as indicators of oxidative stress and systemic inflammation (10). Serum NLR, PLR, and SII levels might be associated with migraine, particularly during attacks. By identifying hematologic and biochemical biomarkers in different migraine subtypes, it could be possible to link increased inflammation to various clinical manifestations and the severity of the condition. In comparison to individuals with migraine or other headache syndromes, patients with subarachnoid hemorrhage (SAH) had higher NLR levels, according to research by Eryiit et al. (11). Despite earlier research that examined NLR and PLR rates in cases of acute and chronic migraine (12, 13), there hasn't been a comprehensive investigation of SII in the literature.

The systemic immune-inflammation index (SII) is calculated using the total peripheral platelet count (P) and the neutrophil-to-lymphocyte ratio (N/L) (SII = P N/L ratio) (13). This index may serve as a prognostic indicator in various malignant diseases, as high SII has been associated with poor outcomes in cancer patients (14, 15, 16). Our aim is to assess the predictive value of SII in migraineurs undergoing GON block treatment. Based on hematological data, this study analyzes the concentrations of NLR, PLR, and SII, which serve as indicators of inflammation, in patients with high-frequency episodic and chronic migraine (during interictal periods), as well as in healthy individuals.

MATERIAL AND METHODS

Between May 1, 2021, and May 1, 2022, our institution received applications from 114 patients in accordance with the cross-sectional study design. This investigation included a total of 50 migraine sufferers and 64 healthy control volunteers with matched ages and sexes. The age and sex of the control group were matched. Rheumatoid arthritis, diabetes mellitus, inflammatory bowel disease, asthma, dermatitis, hepatitis, AIDS, and other inflammatory disorders were also excluded from the control group. Patients were recruited from an outpatient headache clinic. Exclusion criteria encompassed conditions other than regulated hypertension, medication overuse headache, chronic inflammatory processes, hematologic disorders, recent history of infectious disease, renal failure, hypoparathyroidism, ischemic heart disease, history of

corticosteroid use, alcohol consumption, or smoking. Thorough examinations of neurological systems were conducted for both the patient and control groups.

Hematological parameters (neutrophil, lymphocyte, platelet, NLR, PLR, SII), demographic information, family history, chronic diseases, visual analog scale (VAS) scores, number of migraine attacks, attack duration, and hematological parameters were obtained from medical records before and after GON block treatment (15 days before and 15 days after the intervention). The ICHD-3 diagnostic criteria were employed for migraine diagnosis and categorization. All study calculations were based on patients' complete blood counts (CBCs). The initial CBC findings for each patient determined each value by dividing the total number of neutrophils by the total number of lymphocytes. For this purpose, regular electronic CBC equipment (XN-CBC, Sysmex, Bornbarch 1, 22848 Norderstedt, Germany) was used. Blood samples (2 cc) were collected in EDTA tubes and gently inverted 6-7 times for mixing. Samples were stored in the refrigerator (2-8 °C); delays in transferring blood to the tube could result in clotting and inaccurate results.

Diagnosis was made through clinical evaluation by a neurologist and blood tests were requested. A hematology specialist was consulted for hematological evaluation. Anamnesis and medications were used to exclude potential causes of systemic inflammation. While CRP was not examined to exclude participants with underlying inflammatory conditions that could affect study results, healthy subjects were included in the screening for exclusion criteria. No research in the literature exploring the relationship between migraine and SII was located. Therefore, the purpose of this study was to uncover any potential diagnostic correlations between migraine and a novel index called SII. The study focused on the hematological parameters and SII levels used as inflammatory markers in diagnosed migraine patients.

Statistics

Parametric tests were applied without conducting the normality test, as they are compatible with the Central Limit Theorem**.** The data's conformity to the normal distribution was assessed using the Shapiro-Wilk test. Student's t-test was utilized to compare normally distributed features between the patient and control groups, and the comparison of pre-and post-treatment measurements was conducted using the Paired t-test. Chi-square test statistics were employed to assess relationships between categorical variables. The relationships between quantitative variables were examined using the Pearson correlation coefficient. Descriptive statistics provide mean ± standard deviation for numerical variables and number and percentage values for categorical variables. Statistical analyses were carried out using the SPSS (Statistical Package for the Social Sciences, SPSS Inc., Chicago, IL, USA) version 24.0 software, with a significance level of $P < 0.05$ considered as statistically significant.

RESULTS

In our investigation, it was found that the case and control groups' subject populations' gender distribution and mean ages were comparable ($p > 0.05$). While 84% were female patients, 16% were male patients; 93.8% of female patients were included in the control group. The mean age of the patients was 36.58 ± 9.67, and the mean age of the control group was 34.23 ± 9.35 ($p > 0.05$).

The average number of migraines per patient was 13.56 ± 8.10 years (Table 1). The findings of compar-

Table 1. *Evaluation of socio-demographic and clinical characteristics according to migraine status*

	Patient (n = 50)	Control (n = 64)	Total (n = 114)	p
Female n (%) Male n (%)	42 (84) 8 (16)	60 (93.8) 4 (6.3)	102 (89.5) 12 (10.5)	0.092
Age (mean ± sd)	36.58 ± 9.67	34.23 ± 9.35	35.26 ± 9.52	0.193
Migraine duration (mean ± sd)	13.56 ± 8.10			

Table 2. *Comparison of pretreatment biochemical parameters between groups*

Parameters	Patient mean ± sd	Control mean ± sd	p
WBC	7.44 ± 1.75	7.11 ± 1.73	0.323
MPV	9.64 ± 1.85	9.92 ± 0.94	0.319
NLR	2.26 ± 1.41	2.29 ± 1.25	0.915
PLR	154.18 ± 53.97	126.64 ± 46.61	**0.005**
SII	761.88 ± 1539.28	650.61 ± 350.11	0.576

P value obtained from Student t test sd: standard deviation

ing the pre-treatment biochemical parameters between the patient and control groups are shown in Table 2. It was determined that the subjects in the patient group's mean platelet and PLR values were considerably greater than those of the patients in the control group ($p < 0.05$). The patient and control groups were found to share other parameters ($p > 0.05$). Pre-treatment values refer to the parameters checked just before the GON block.

The findings of comparing the biochemical parameters of the subjects before and after the GON block treatment are shown in Table 3. This led to the observation that the decrease in attack frequency, severity, and length was statistically significant ($p < 0.001$). No significant differences were discovered when compared to post-treatment values ($p > 0.05$), despite the fact that the ratios were greater prior to GON block therapy in other measures.

Table 4 provides an evaluation of the patients' relationships after treatment. The connection between the cases' SII value and neutrophil values was found to be moderately significant ($r = 0.536$; $P = 0.001$). SII values also rise as a result of the rise in neutrophil values. Between the cases' SII values and their lymphocyte values, there was a weakly significant negative association ($r = -0.489$; $P = 0.001$) discovered. A drop in SII values is brought on by an increase in lymphocyte values.

The connection between the cases' SII values and platelet values was found to be moderately significant

Table 3. *Comparison of biochemical parameters pre/post-treatment in cases*

	Pre-treatment	Post-treatment	p
	mean ± sd	mean ± sd	
WBC	7.44 ± 1.75	7.21 ± 1.5	0.309
MPV	9.64 ± 1.85	9.66 ± 1.97	0.832
NLR	2,27 ± 1,42	1.94 ± 0.83	0.121
PLR	126.64 ± 46.61	118.38 ± 47.93	0.252
SII	761.88 ± 1539.28	506.32 ± 237.9	0.239
attack frequency	11.62 ± 8.8	2.78 ± 3.2	**< 0.001**
Vas	8.36 ± 1.48	4.98 ± 2.46	**< 0.001**
attack duration	37.3 ± 24.35	14.98 ± 22.58	**< 0.001**

P value obtained from paired t-test.

Table 4. *The relationship of post-treatment biochemical parameters in cases*

		WBC	neutrophil	lympho-cyte	Platelet	MPV	NLR	PLR	SII	Attack frequency	Attack severity	Attack duration	MigPatient Duration
Age	r	-0.053	-0.155	0.117	0.042	-0.035	-0.052	-0.031	-0.073	-0.012	0.175	0.113	0.512
	p	0.715	0.282	0.420	0.770	0.809	0.722	0.832	0.616	0.936	0.223	0.435	0.001
WBC	r	1	0.857	0.607	0.238	0.086	0.081	-,283	0.200	-0.223	-,333	-0.226	-,386
	p		0.001	0.001	0.096	0.553	0.578	0.047	0.164	0.119	0.018	0.114	0.006
neutrophil	r		1	0.171	0.149	0.091	0.492	-0.006	0.536	-0.220	-,288	-0.190	-,303
	p			0.236	0.300	0.531	0.001	0.968	0.001	0.125	0.043	0.187	0.032
lymphocyte	r			1	0.243	-0.097	-0.643	-0.609	-0.489	-0.109	-0.122	-0.206	-0.232
	p				0.089	0.504	0.001	0.001	0.001	0.453	0.399	0.150	0.105
Platelet	r				1	-0.162	-0.061	0.458	0.429	0.047	0.213	0.270	0.006
	p					0.262	0.676	0.001	0.002	0.746	0.137	0.058	0.969
MPV	r					1	0.124	-0.014	0.039	-,650	-,478	-,323	-0.162
	p						0.391	0.922	0.788	0.001	0.001	0.022	0.261
NLR	r						1	0.623	0.850	-0.144	-0.130	-0.009	-0.050
	p							0.001	0.001	0.319	0.366	0.949	0.728
PLR	r							1	0.793	0.061	0.201	-.340	0.132
	p								0.001	0.673	0.163	0.016	0.361
SII	r								1	-0.107	0.003	0.178	-0.034
	p									0.460	0.982	0.217	0.813
attack frequency	r									1	-.422	-.430	0.090
	p										0.002	0.002	0.534
attack severity	r										1	-.441	-.328
	p											0.001	0.020
attack duration	r												0.185
	p												0.198

r: Pearson correlation coefficient (n=50)

($r = 0.458$; $P = 0.001$). An increase in SII values is anticipated as platelet values rise.

DISCUSSION

Previous research has indicated that individuals suffering from migraines often exhibit elevated levels of platelet activation and interactions between platelets and leukocytes. This interaction is believed to contribute to the inflammatory vascular process underlying migraines, facilitating the spread of infection and inflammation (17, 18). Our study also supports this notion, revealing significantly higher levels of platelets and platelet-to-lymphocyte ratio (PLR) in individuals with migraines compared to the control group. Notably, mean platelet volume (MPV) serves as a highly accurate predictor of platelet activation and has shown promise as a predictive and therapeutic measure for conditions involving thrombosis and inflammation (19). Recent research has even explored its potential in gauging prothrombotic and proinflammatory potentials (19). Similarly, Çelikbilek et al (20) found elevated platelet values in individuals with migraines compared to the control group, with no significant difference in MPV values. Our study similarly detected no significant difference in MPV values, despite notable variation in platelet counts between the pre-treatment migraine patient group and the control group. Additionally, like the findings from Bas et al (21), we observed no statistically significant difference in either platelet count or MPV between adult migraine and control groups. Comparing platelet levels among female migraine sufferers and controls, Peatfield et al. (22) discovered slightly higher levels in females, though the difference was not statistically significant. The MPV values were slightly elevated in the migraine group compared to the control group.

Elevated neutrophil-to-lymphocyte ratio (NLR) values have been shown to independently predict the risk of cardiovascular diseases, cancer, and stroke (23,24). Karabulut et al's 2016 study (13) found higher NLR values during migraine episodes in 92 migraine patients compared to 67 healthy controls. Saricam et al (25) observed significantly elevated values for C-reactive protein (CRP), platelet-to-lymphocyte ratio (PLR), and neutrophil-to-monocyte ratio (NMR) in migraine without aura, and an even greater NMR in migraine with aura, compared to the control group. Our study found no statistically significant differences compared to the control group. Importantly, Eryiğit et al (11) demonstrated higher NLR levels in patients with subarachnoid hemorrhage compared to those with migraines or other headache types. The authors concluded that these findings suggest systemic inflammation in migraine sufferers, indicating the presence of a persistent inflammatory process even between migraine attacks. Inan et al's study in 2015 (26) revealed a statistically significant decrease in headache severity, duration, and monthly frequency in 84 patients treated with greater occipital nerve (GON) block therapy, which was deemed a safe and effective treatment. Other observational studies also indicate the potential benefits of GON block therapy in reducing migraine attack frequency, duration, and severity (27, 28). In our study, the reduction in the number of attacks, visual analog scale (VAS) scores, and attack duration post-GON block treatment was statistically significant, confirming the efficacy of this treatment. Despite the small number of patients in our prospective investigation, other inflammatory markers exhibited higher values without a statistically significant difference. Notably, high levels of the systemic immune-inflammation index (SII), combining inflammatory cells (neutrophils and platelets) and thrombotic factors (platelets), have been linked to recurrence and mortality in pancreatic cancer and gastroesophageal adenocarcinoma (29, 30). A connection has also been established between high SII levels and postoperative adverse cardiovascular events in individuals with coronary heart disease (31). While research has explored neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR) in various headache types (12), our study found a higher albeit not statistically significant rate of SII in migraine patients, both before and after GON treatment, compared to control patients. This suggests a potential link between neuroinflammation development and migraines.

Our study has several notable limitations, including its retrospective nature and the lack of comparison with other migraine subgroups. Additionally, we didn't explore the association between these biomarkers and migraine intensity or their impact on quality of life. Further research with larger patient groups is warranted to examine inflammatory parameters across all migraine subgroups. We believe our findings support the concept of systemic inflammation in migraines and its association with a persistent inflammatory process, even in the absence of episodes. To understand the detailed pathophysiological components of migraines, comprehensive and controlled investigations are essential.

CONCLUSION

These findings, in our opinion, are related to the occurrence of a continuous inflammatory process even in the absence of episodes and support systemic inflammation in migraineurs. SII is a cheap and simple

to assess marker in peripheral blood, and it may be a helpful prediction marker for migraine patients who are scheduled for GON treatment even though our results are not conclusively significant. SII may be a standalone prognostic factor in migraine patients. Our findings demonstrate the clinical significance of inflammatory markers in migraine sufferers. More extensive clinical research is required to define the function of SII in patients receiving GON block therapy and to enhance our understanding of it.

Conflict of Interests: The authors declare no conflicts of interest related to this article.

Acknowledgments

The authors would like to express their gratitude to Elif Ertaş from the Department of Biostatistics, Mersin University, for her support in this research.

Funding: The study was financially supported by the researchers and authors themselves.

Ethics approval

The present study was approved by the Ethics Committee of Istanbul Medipol University of Medical Sciences, Istanbul, Turkey.

Author contribution

Idea/Concept: Sevil Sadri contributed to the conception and design of the research. Design: Sevil Sadri contributed to the design of the research. Data Collection/Processing: Gözde Ülfer contributed to the interpretation of the data. Analysis/Interpretation: Sevil Sadri contributed to the acquisition and analysis of the data. Literature Review and Drafting/Writing: Sevil Sadri and Burcu Polat drafted the manuscript.

Sažetak

VREDNOST INDEKSA SISTEMSKOG IMUNOG INFLAMATORNOG ODGOVORA (SII) KOD PACIJENATA SA MIGRENOM TRETIRANIH TERAPIJOM VEĆEG OKCIPITALNOG BLOKA

Sadri Sevil,[1] Ülfer Gözde,[2] Polat Burcu[3]

[1] Ministarstvo zdravlja, Gradska bolnica Bursa, Medicinski fakultet, Interno odeljenje, Služba za hematologiju, Bursa, Turska
[2] Univerzitet Medipol u Istanbulu, Medicinski fakultet, Departman za biohemiju, Istanbul, Turska
[3] Univerzitet Duzce, Departman za neurologiju, Düzce, Turska

Uvod: Neuroinflamacija ima ključnu ulogu u različitim neurološkim stanjima, uključujući i migrenu. Blokada većeg okcipitalnog nerva (GON) se koristi kako za akutno, tako i za preventivno lečenje osoba koje boluju od migrene. Istraživanje da li ova lokalna terapija blokadom nerva utiče na znakove sistemskog zapaljenja moglo bi biti korisno.

Materijali i metode: U studiju je uključeno ukupno 50 osoba koje boluju od migrene (uključujući osobe sa visokofrekventnom epizodnom i hroničnom migrenom) i 60 zdravih kontrolnih volontera istog uzrasta i pola. Upoređivani su odnos neutrofila i limfocita (NLR), odnos trombocita i limfocita (PLR) i nivoi SII kod osoba koje boluju od migrene i zdravih pojedinaca. Ova studija je analizirala hematološke parametre i nivoe SII koji se koriste kao inflamatorni markeri kod osoba sa dijagnostikovanom migrenom.

Rezultati: Utvrđeno je da su prosečne vrednosti trombocita i PLR vrednosti kod ispitanika slučajne grupe znatno niže od vrednosti kod ispitanika grupe pacijenata ($p < 0.05$). Biohemijske karakteristike slučajeva su ispitane pre i posle tretmana većom blokadom okcipitalnog nerva (GON), što je otkrilo statistički značajno smanjenje u učestalosti napada, ozbiljnosti i trajanju ($p < 0.001$). Nisu otkrivene značajne razlike u poređenju sa vrednostima nakon tretmana ($p > 0.05$), iako su odnosi bili veći pre primene terapije GON blokadom kod drugih mera.

Zaključak: Naša mišljenja su da su ovi rezultati povezani sa prisustvom kontinuiranog inflamatornog procesa čak i u odsustvu epizoda, podržavajući sistemsku inflamaciju kod osoba sa migrenom. Stoga, SII, pristupačan i lako merljiv marker u perifernoj krvi, može poslužiti kao koristan prediktivni marker za pacijente sa migrenom koji su zakazani za tretman blokadom većeg okcipitalnog nerva (GON). Dalja opsežna istraživanja su neophodna kako bi se utvrdilo da li SII može biti nezavisan prognostički faktor kod pacijenata sa migrenom.

Ključne reči: migrena, neuroinflamacija, sistemski indeks imunog zapaljenja.

REFERENCES

1. Kursun O, Yemisci M, van den Maagdenberg AM-JM, Karatas H. Migraine and neuroinflammation: the inflammasome perspective. J Headache Pain. 2021; 22(1): 55. doi: 10.1186/s10194-021-01271-1.

2. Perry CJ, Blake P, Buettner C, Papavassiliou E, Schain AJ, Bhasin MK, et al. Upregulation of inflammatory gene transcripts in periosteum of chronic migraineurs: Implications for extracranial origin of headache. Ann Neurol. 2016; 79(6): 1000-13. doi: 10.1002/ana.24665.

3. Rudiger A, Burckhardt OA, Harpes P, Müller SA, Follath F. The relative lymphocyte count on hospital admission is a risk factor for long-term mortality in patients with acute heart failure. Am J Emerg Med. 2006; 24(4): 451-4. doi: 10.1016/j.ajem.2005.10.010.

4. Holland S, Silberstein SD, Freitag F, Dodick DW, Argoff C, Ashman E; Quality Standards Subcommittee of the American Academy of Neurology and the American Headache Society. Evidence-based guideline update: NSAIDs and other complementary treatments for episodic migraine prevention in adults: report of the Quality Standards Subcommittee of the American Academy of Neurology and the American Headache Society. Neurology. 2012; 78(17): 1346-53. doi: 10.1212/WNL.0b013e3182535d0c.

5. Reed KL, Black SB, Banta CJ 2nd, Will KR. Combined occipital and supraorbital neurostimulation for the treatment of chronic migraine headaches: initial experience. Cephalalgia. 2010; 30(3): 260-71. doi: 10.1111/j.1468-2982.2009.01996.x.

6. Ashkenazi A, Levin M. Greater occipital nerve block for migraine and other headaches: is it useful? Curr Pain Headache Rep. 2007; 11(3): 231-5. doi: 10.1007/s11916-007-0195-3.

7. Afridi SK, Shields KG, Bhola R, Goadsby PJ. Greater occipital nerve injection in primary headache syndromes--prolonged effects from a single injection. Pain. 2006; 122(1-2): 126-9. doi: 10.1016/j.pain.2006.01.016.

8. Kemper RH, Meijler WJ, Korf J, Ter Horst GJ. Migraine and function of the immune system: a meta-analysis of clinical literature published between 1966 and 1999. Cephalalgia. 2001; 21(5): 549-57. doi: 10.1046/j.1468-2982.2001.00196.x.

9. Lénárt N, Brough D, Dénes Á. Inflammasomes link vascular disease with neuroinflammation and brain disorders. J Cereb Blood Flow Metab. 2016; 36(10): 1668-85. doi: 10.1177/0271678X16662043.

10. Yazar HO, Yazar T, Aygün A, Kaygisiz Ş, Kirbaş D. Evaluation of simple inflammatory blood parameters in patients with migraine. Ir J Med Sci. 2020; 189(2): 677-83. doi: 10.1007/s11845-019-02136-y.

11. Eryigit U, Altunayoglu Cakmak V, Sahin A, Tatli O, Pasli S, Gazioglu G, et al. The diagnostic value of the neutrophil-lymphocyte ratio in distinguishing between subarachnoid hemorrhage and migraine. Am J Emerg Med. 2017; 35(9): 1276-80. doi: 10.1016/j.ajem.2017.03.063.

12. Poyrazoğlu HG, Öztürk AB. Predictive value of laboratory parameters in childhood migraine. Acta Neurol Belg. 2020; 120(4): 907-14. doi: 10.1007/s13760-019-01106-6.

13. Karabulut KU, Egercioglu TU, Uyar M, Ucar Y. The change of neutrophils/lymphocytes ratio in migraine attacks: A case-controlled study. Ann Med Surg (Lond). 2016; 10: 52-6. doi: 10.1016/j.amsu.2016.07.023.

14. Hu B, Yang XR, Xu Y, Sun YF, Sun C, Guo W, et al. Systemic immune-inflammation index predicts prognosis of patients after curative resection for hepatocellular carcinoma. Clin Cancer Res. 2014; 20(23): 6212-22. doi: 10.1158/1078-0432.CCR-14-0442.

15. Yang R, Chang Q, Meng X, Gao N, Wang W. Prognostic value of Systemic immune-inflammation index in cancer: A meta-analysis. J Cancer. 2018; 9(18): 3295-302. doi: 10.7150/jca.25691.

16. Zhong JH, Huang DH, Chen ZY. Prognostic role of systemic immune-inflammation index in solid tumors: a systematic review and meta-analysis. Oncotarget. 2017; 8(43): 75381-8. doi: 10.18632/oncotarget.18856.

17. Zeller JA, Lindner V, Frahm K, Baron R, Deuschl G. Platelet activation and platelet-leucocyte interaction in patients with migraine. Subtype differences and influence of triptans. Cephalalgia. 2005; 25(7): 536-41. doi: 10.1111/j.1468-2982.2005.00916.x.

18. Freedman JE, Loscalzo J. Platelet-monocyte aggregates: bridging thrombosis and inflammation. Circulation. 2002; 105(18): 2130-2. doi: 10.1161/01.cir.0000017140.26466.f5.

19. Gasparyan AY, Ayvazyan L, Mikhailidis DP, Kitas GD. Mean platelet volume: a link between thrombosis and inflammation? Curr Pharm Des. 2011; 17(1): 47-58. doi: 10.2174/138161211795049804.

20. Celikbilek A, Zararsiz G, Atalay T, Tanik N. Red cell distribution width in migraine. Int J Lab Hematol. 2013; 35(6): 620-8. doi: 10.1111/ijlh.12100.

21. Bas FY, Demirci S, Arslan B .The relationship between headache features and haematological parameters in migraine patients. Euras J Fam Med. 2015; 4(2): 53–6.

22.. Peatfield RC, Gawel MJ, Guthrie DL, Pearson TC, Glover V, Littlewood J, et al. Platelet size: no correlation with migraine or monoamine oxidase activity. J Neurol Neurosurg Psychiatry, 1982; 45(9): 826–9.

23. Auezova R, Ryskeldiev N, Doskaliyev A, Kuanyshev Y, Zhetpisbaev B, Aldiyarova N et al. Association of preoperative levels of selected blood inflammatory markers with prognosis in gliomas. Onco Targets Ther. 2016; 9: 6111-7. doi: 10.2147/OTT.S113606.

24. Köklü E, Yüksel İÖ, Arslan Ş, Bayar N, Çağırcı G, Gencer ES, et al. Is Elevated Neutrophil-to-Lymphocyte Ratio a Predictor of stroke in patients with intermediate carotid artery stenosis? J Stroke Cerebrovasc Dis. 2016; 25(3): 578-84. doi: 10.1016/j.jstrokecerebrovasdis.2015.10.031.

25. Sarıcam G. Relationship between migraine headache and hematological parameters. Acta Neurol Belg. 2021; 121(4): 899-905. doi: 10.1007/s13760-020-01362-x.

26. Inan LE, Inan N, Karadaş Ö, Gül HL, Erdemoğlu AK, Türkel Y, et al. Greater occipital nerve blockade for the treatment of chronic migraine: a randomized, multicenter, double-blind, and placebo-controlled study. Acta Neurol Scand. 2015; 132(4): 270-7. doi: 10.1111/ane.12393.

27. Weibelt S, Andress-Rothrock D, King W, Rothrock J. Suboccipital nerve blocks for suppression of chronic migraine: safety, efficacy, and predictors of outcome. Headache. 2010; 50(6): 1041-4. doi: 10.1111/j.1526-4610.2010.01687.x.

28. Palamar D, Uluduz D, Saip S, Erden G, Unalan H, Akarirmak U. Ultrasound-guided greater occipital nerve block: an efficient technique in chronic refractory migraine without aura? Pain Physician. 2015; 18(2): 153-62.

29. Aziz MH, Sideras K, Aziz NA, Mauff K, Haen R, Roos D, et al. The Systemic-immune-inflammation Index independently predicts survival and recurrence in resectable pancreatic cancer and its prognostic value depends on bilirubin levels: a retrospective multicenter cohort study. Ann Surg. 2019; 270(1): 139-146. doi: 10.1097/SLA.0000000000002660.

30. Jomrich G, Paireder M, Kristo I, Baierl A, Ilhan-Mutlu A, Preusser M, et al. High Systemic Immune-Inflammation Index is an adverse prognostic factor for patients with gastroesophageal adenocarcinoma. Ann Surg. 2021; 273(3): 532-41. doi: 10.1097/SLA.0000000000003370.

31. Yang YL, Wu CH, Hsu PF, Chen SC, Huang SS, Chan WL, et al. Systemic immune-inflammation index (SII) predicted clinical outcome in patients with coronary artery disease. Eur J Clin Invest. 2020; 50(5): e13230. doi: 10.1111/eci.13230.

Correspondence to/Autor za korespondenciju
Sevil Sadri
Department of Haematology, Bursa City Hospital, Nilüfer/Bursa, Turkey
E-mail contact: sevilsadri@hotmail.com
Phone contact: +905369730394

***How to cite this article**:* Sadri S, Ülfer G, Polat B. The value of the Systemic Immune Inflammation Index (SII) in migraine patients treated with greater occipital block treatment. Sanamed. 2023; 18(2): 119-126. Doi: 10.5937/sanamed0-44601.