Original Article
Eurasian Journal of Critical Care

Prognostic Value of Blood Parameters in Patients Diagnosed With Ischemic And Hemorrhagic Cerebrovascular Events

Sema AYTEN[1]
[1]Istanbul Goztepe Medeniyet University, Prof. Dr. Suleyman Yalcin City Hospital, Istanbul, Turkey

Abstract

Background: Cerebrovascular events occur as a result of cerebral infarction (CI), intracerebral hemorrhage (ICH) or subarachnoid hemorrhage (SAH). Studies have shown that the inflammatory response that occurs exacerbates ischemic brain injury and neurological dysfunction. In our study, we aimed to see the correlation between the neutrophil-lymphocyte ratios (NLR) and the length of hospital stay in patients presenting with stroke symptoms.

Methods: Patients who were admitted to a hospital in the last six months and diagnosed with stroke were retrospectively analyzed. Blood samples taken at the time of admission of 116 patients with stroke diagnosed in the study were examined and NLR values were used in the study. Hospitalization times of the patients were recorded. The correlation of NLR values of the cases with the length of hospital stay was examined.

Result: Of the 116 patients included in the study, 100 had ischemic stroke and 16 had hemorrhagic stroke. Of the cases examined, 63 were male and 53 were female. The mean age was 71.6±11.6 years. We examined the correlation between the length of hospital stay and NLR values of the patients. We found that there was no statistically significant correlation between length of stay and NLR in ischemic stroke and hemorrhagic stroke patient groups.

Conclusion: In our study, we found that high NLR levels had no effect on mortality and morbidity. In addition to studies with similar results in the literature, there are also many studies showing that NLR level has a negative effect on mortality and morbidity.

Keywords: Stroke, neutrophil, lymphocyte, NLR

Introduction

Stroke is an acute focal injury to the central nervous system (CNS) caused by a vascular cause that includes cerebral infarction, intracerebral hemorrhage (ICH), and subarachnoid hemorrhage (SAH). This neurological problem is an important cause of mortality and morbidity worldwide (1). The World Health Organization's definition of stroke, which has been used since 1970, is "a condition that lasts longer than 24 hours or leads to death, without any cause other than vascular origin, in which clinical manifestations develop rapidly, resulting from a focal (or diffuse) disorder of cerebral function" (1). Due to methods such as modern brain imaging, which have become widespread in recent years, the World Health Organization's definition of stroke has begun to lose its validity. Because the 24-hour inclusion criterion is not only inaccurate but also misleading, permanent damage can occur much sooner than this period (1). The ischemic group constitutes 80-85% of stroke cases (2). However, mortality and morbidity in hemorrhagic stroke are much higher than in ischemic stroke (1). Although the risk of stroke is present in all age groups, its incidence is much higher in individuals over 65 years of age (2).

Inflammation has been shown to play a role in all processes of inflammatory response and acute ischemic stroke (AIS) and facilitates complications (3). There are many studies showing that the inflammatory response exacerbates ischemic brain injury and neurological dysfunction (3,4,5). In the study conducted by Brian et al., it was found that high white blood cell (WBC) and neutrophil counts in the early period (first 72 hours) in patients with AIS were associated with larger infarct areas observed on CT and MRI and increased stroke severity (6). In our study, we aimed to see whether there is a correlation between the neutrophil-lymphocyte ratios (NLR) in the blood samples taken at the time of admission and the length of hospital stay in patients presenting with stroke symptoms.

Materials And Methods

This study was prepared by retrospectively examining the patients who were admitted to the emergency department of

Corresponding Author: Sema Ayten **e-mail:** semayten@hotmail.com
Received: 27.12.2024 • **Revision:** 27.12.2024 • **Accepted:** 30.12.2024
DOI: 10.55994/ejcc.1608086

Cite this article as: Ayten S. Prognostic Value of Blood Parameters In Patients Diagnosed With Ischemic And Hemorrhagic Cerebrovascular Events. Eurasian Journal of Critical Care. 2024;6(3): 119-122

Istanbul Göztepe Prof. Dr. Süleyman Yalçın City Hospital between July 15, 2024 and December 15, 2024 as outpatients and/or with the 112 ambulance system. The cases in our study consisted of patients over 18 years of age with clinical findings and whose diagnosis was confirmed by emergency brain tomography, angio-phase brain tomography and diffusion magnetic resonance imaging. The results of the blood samples taken at the time of admission of the patients included in the study were examined and the Neutrophil and Lymphocyte counts in the complete blood count were taken into account. Patients were evaluated according to age, gender, NLR, diagnosis (ischemic or hemorrhagic stroke), length of hospital stay. Hospitalization times of the patients were recorded by one by.

Exclusion Criteria

Patients under the age of 18, patients diagnosed with Transient Ischemic Attack (TIA), patients with a history of brain surgery, patients with a diagnosis of brain tumor/mass, and patients with cerebral hemorrhage secondary to trauma were not included in the study.

Blood Sample Examination

The results of the complete blood count were evaluated from the venous blood taken by opening the peripheral vascular access during admission to the emergency department. In our hospital, blood samples taken in a calcium ethylenediaminetetra-acetic acid (EDTA) tube are routinely sent to the hospital laboratory. The data were obtained by collecting neutrophil and lymphocyte values measured in the complete blood count taken from peripheral blood using the hospital's digital recording systems. The NLR value was obtained by calculating the ratio of neutrophils to lymphocytes.

Statistical analysis methods

Descriptive statistics (mean + standard deviation, median (minimum-maximum)) values are given to define continuous variables. The conformity of continuous variables to normal distribution was examined by Shapiro Wilks test. 2 groups that did not conform to the independent normal distribution were examined with the continuous variable Mann Whitney u test. The relationship between categorical variables was investigated by Chi-Square (or Fisher Exact test / Yates Continuity Correction where appropriate). The correlation between 2 variables that do not conform to continuous, normal distribution was examined with the Spearman Rho Correlation coefficient. The statistical significance level was determined as 0.05. The analyses are available in MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013).

Results

Of the 116 patients included in the study, 100 had ischemic stroke and 16 had hemorrhagic stroke. When the incidence of diseases is examined, it is seen that this rate is reasonable (7). Of the cases examined, 63 were male and 53 were female. The mean age was 71.6±11.6 years. There was no statistically significant difference between hemorrhagic stroke and ischemic stroke groups in terms of age and gender (Table 1).

Table 1: Age and gender distribution of patients diagnosed with hemorrhagic and ischemic stroke

n(%)	Hemorrhagic Stroke n=16	Ischemic Stroke n=100	Whole group n=116	p
Gender				0,1291
Male	12(75)	51(51)	63(54,3)	
Female	4(25)	49(49)	53(45,7)	
Age				0,0672
Avg±SS	66.4±13.2	72.5±11.2	71.6±11.6	
Med(min-max)	65,50(47-93)	74(41-92)	73,5(41-93)	

1Yates Continuity Correction, 2Mann Whitney u test

Neutrophil and lymphocyte values were determined by examining the blood samples of the patients included in our study at the time of admission, and neutrophil/lymphocyte ratios (NLR) were calculated. As a result of the examination , there was no statistically significant difference between the Hemorrhagic SVO and Ischemic SVO groups in terms of Neutrophil, Lymphocyte and NLR values (Table 2).

To measure the effect of NLR value on patients' mortality and morbidity, we examined the correlation between the length of hospitalization and the NLR value. We found that there was no statistically significant correlation between length of stay and NLR in ischemic stroke and hemorrhagic stroke patient groups. When the whole patient group was evaluated, we showed that there was no weak and statistically significant correlation between length of stay and NLR (Table 3).

Table 2: Comparison of Neutrophil, Lymphocyte and NLR values in hemorrhagic and ischemic stroke groups

n(%)	Hemorrhagic Stroke n=16	Ischemic Stroke n=100	Whole group n=116	p
Neutrophil				0,527
Avg±SS	5.8±2.2	6.6±3.3	6.4±3.2	
Med(min-max)	5,1(2,6-10,1)	5,7(0,2-19,3)	5,5(0,2-19,3)	
Lymphocyte				0,174
Avg±SS	1.8±0.7	2.1±1.1	2.1±1.0	
Med(min-max)	1,6(1-4)	2(0,3-5,1)	2(0,3-5,1)	
NLR				0,608
Avg±SS	3.7±2.3	4.5±5	4.4±4.7	
Med(min-max)	3,1(1,5-10,1)	2,7(0,6-26,6)	2,8(0,6-26,6)	

Table 3: Investigation of length of stay and NLR value

	r*	p
Ischemic Stroke n=86	0,204	0,060
Hemorrhagic Stroke n=11	0,101	0,768
Whole group n=97	**0,214**	**0,035**

**Spearman Rho Correlation Coefficient*

Discussion

Many studies have shown that inflammatory parameters increase in thromboembolic diseases. There are several studies showing that leukocyte, neutrophil and lymphocyte counts play a role in peripheral inflammatory response and atherosclerotic processes (8,9). One of these parameters is NLR. Studies have shown that NLR is part of the inflammatory process and is elevated in thromboembolic events. In our study, we wanted to determine whether this rate had an effect on the length of hospital stay of the patients. However, in our study, NLR was found to be incorrelated with the length of hospital stay of the patients. In some studies, it has been shown that high NLR value is associated with poor prognosis in ischemic stroke patients (10).

Neutrophils are the main subgroup of white blood cells that are able to respond earliest after a stroke and show an active inflammatory response (11). In a study, it was shown that a high neutrophil count was associated with more severe stroke in a blood sample taken at the time of admission to the hospital (12,13). In particular, it has been reported that the number of neutrophils at first admission is directly proportional to the severity of ischemic injury and causes poor neurological prognosis. In animal experiments, it has been determined that the decrease in neutrophils improves the clinical course (14). Inflammatory cells in the blood are known to strongly contribute to secondary brain injury following intracranial hemorrhage (ICH) (7).

The relationship between NLR and neurological deterioration was investigated in a retrospective cohort study, and patients whose condition worsened in the first week were found to have higher white blood cells, higher neutrophil counts, lower lymphocyte counts, and higher NLR than others (7,15). In the study conducted by Wang et al. with 224 patients diagnosed with stroke, the NLR value measured in the morning after hospital admission was significantly higher in deceased patients than in survivors (16), and similar results were obtained in another study conducted with stroke patients (17). In the study conducted by Tokgoz et al., the NLR values measured when the deceased patients were admitted to the hospital were found to be significantly higher than the surviving patient group (18). However, there are also studies showing that NLR has no effect on mortality. In the study conducted by Yılmaz et al., WBC, neutrophil count and N/L ratio were found to be quite high in the patient group, but it was determined that these values had no effect on survival and disease-free survival (19). In the study conducted by Arıkan et al., NLR value was found to be significantly lower in encephalitis patients than in meningitis patients, but there was no significant difference in NLR parameters between surviving and deceased patients (20). Recently, NLR has been proposed as an independent predictor of the severity and mortality of acute coronary syndrome and not only in ischemic strokes (11,21). It has been determined that there is a higher level of NLR in thrombus-related acute myocardial infarction than in non-thrombus (21). NLR is a low-cost, non-invasive test and has been shown in many studies to be used in combination with other markers to evaluate clinical outcome in patients with AIS (11,12).

Conclusion

We now know that neutrophils play an important role in the early inflammatory process. The role of the inflammatory process in cases of acute ischemic and acute hemorrhagic stroke has been proven in many studies. Although there are many studies in the literature showing that high neutrophil and low lymphocyte values have a negative effect on mortality and morbidity, there are also studies that have not been shown to have an effect as in our study. It is still controversial whether NLR can be used as a marker to determine the clinical course in stroke patients. Although its low cost increases its usability, it is still not clear whether it can be used in treatment follow-up.

References

1. Sacco, R. L., Kasner, S. E., Broderick, J. P., Caplan, L. R., Connors, J. J., Culebras, A., ... & Vinters, H. V. (2013). An updated definition of stroke for the 21st century: a statement for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke*, *44*(7), 2064-2089.
2. Allen, C. L., & Bayraktutan, U. (2009). Oxidative stress and its role in the pathogenesis of ischaemic stroke. *International journal of stroke*, *4*(6), 461-470.
3. Chamorro, A., & Hallenbeck, J. (2006). The harms and benefits of inflammatory and immune responses in vascular disease. *Stroke*, *37*(2), 291-293.
4. Xue, J., Huang, W., Chen, X., Li, Q., Cai, Z., Yu, T., & Shao, B. (2017). Neutrophil-to-lymphocyte ratio is a prognostic marker in acute ischemic stroke. *Journal of Stroke and Cerebrovascular Diseases*, *26*(3), 650-657.
5. Rodrigues, S. F., & Granger, D. N. (2014). Leukocyte-mediated tissue injury in ischemic stroke. *Current medicinal chemistry*, *21*(19), 2130-2137.
6. Buck, B. H., Liebeskind, D. S., Saver, J. L., Bang, O. Y., Yun, S. W., Starkman, S., ... & Ovbiagele, B. (2008). Early neutrophilia is associated with volume of ischemic tissue in acute stroke. *Stroke*, *39*(2), 355-360.

7. Lattanzi, S., Brigo, F., Trinka, E., Cagnetti, C., Di Napoli, M., & Silvestrini, M. (2019). Neutrophil-to-lymphocyte ratio in acute cerebral hemorrhage: a system review. *Translational stroke research*, *10*, 137-145.

8. Nasr, N., Ruidavets, J. B., Arnal, J. F., Sie, P., & Larrue, V. (2009). Association of neutrophil count with microembolization in patients with symptomatic carotid artery stenosis. *Atherosclerosis*, *207*(2), 519-523.

9. Desertler, B. S. (2005). Leukocytosis and ischemic vascular disease morbidity and mortality: is it time to intervene?. *Arteriosclerosis, thrombosis, and vascular biology*, *25*(4), 658-670.

10. Küçük, E., Kocayiğit, İ., Günel, C., & Regular, H. (2016). Neutrophil-to-lymphocyte ratio in occlusive vascular diseases: the literature review of the past 10 years. *World journal of emergency medicine*, *7*(3), 165.

11. Li, W., Hou, M., Ding, Z., Liu, X., Shao, Y., & Li, X. (2021). Prognostic value of neutrophil-to-lymphocyte ratio in stroke: a systematic review and meta-analysis. *Frontiers in Neurology*, *12*, 686983.

12. Zhang, J., Ren, Q., Song, Y., He, M., Zeng, Y., Liu, Z., & Xu, J. (2017). Prognostic role of neutrophil–lymphocyte ratio in patients with acute ischemic stroke. *Medicine*, *96*(45), e8624.

13. Kim, J., Song, T. J., Park, J. H., Lee, H. S., Nam, C. M., Nam, H. S., ... & Heo, J. H. (2012). Different prognostic value of white blood cell subtypes in patients with acute cerebral infarction. *Atherosclerosis*, *222*(2), 464-467.

14. Tokgöz, S., Keskin, S., Kayrak, M., Seyithanoğlu, A., & Oğmegül, A. (2014). Is neutrophil/lymphocyte ratio predict to short-term mortality in acute cerebral infarct independently from infarct volume?. *Journal of Stroke and Cerebrovascular Diseases*, *23*(8), 2163-2168.

15. Lattanzi, S., Cagnetti, C., Provinciali, L., & Silvestrini, M. (2017). Neutrophil-to-lymphocyte ratio and neurological deterioration following acute cerebral hemorrhage. *Oncotarget*, *8*(34), 57489.

16. Wang, F., Hu, S., Ding, Y., Ju, X., Wang, L., Lu, Q., & Wu, X. (2016). Neutrophil-to-lymphocyte ratio and 30-day mortality in patients with acute intracerebral hemorrhage. *Journal of Stroke and Cerebrovascular Diseases*, *25*(1), 182-187.

17. Gökhan, S., Özhasenekler, A., Durgun, H. M., Akil, E., Üstündağ, M., & Orak, M. (2013). Neutrophil lymphocyte ratios in stroke subtypes and transient ischemic attack. *Age (mean±SD; y), 67*, 11-13.

18. Tokgoz, S., Kayrak, M., Akpinar, Z., Seyithanoğlu, A., Güney, F., & Walker, B. (2013). Neutrophil lymphocyte ratio as a predictor of stroke. *Journal of Stroke and Cerebrovascular Diseases*, *22*(7), 1169-1174.

19. Yilmaz, E., Bayram Kaçar, A., Bozpolat, A., Harmsiz, G., Gorkem, B. S., Karakukcu, M., ... & Unal, E. (2018). The relationship between hematological parameters and prognosis of children with acute ischemic stroke. *Child's Nervous System*, *34*, 655-661.

20. Arıkan, C., Çınaroğlu, O. S., Efgan, M. G., Kanter, E., & Bora, E. S. (2023). A new adjunct in the differentiation of encephalitis and meningitis after negative cerebrospinal fluid culture: systemic inflammatory immune index. *The European Research Journal*, *9*(5), 1129-1134.

21. Bhat, T., Teli, S., Rijal, J., Bhat, H., Raza, M., Khoueiry, G., ... & Costantino, T. (2013). Neutrophil to lymphocyte ratio and cardiovascular diseases: a review. *Expert review of cardiovascular therapy*, *11*(1), 55-59.