The neutrophil lymphocyte ratio may predict the discharge status in patients admitted to the emergency department

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Abstract

Objective: The neutrophil to lymphocyte ratio (NLR) has been investigated as an indicator of mortality and/or morbidity in many clinical pathologies. However, these studies have mostly been conducted for specific diseases. We investigated whether there is a relationship between the NLR and hospitalization or discharge decisions in the emergency department (ED).

Methods: We retrospectively reviewed the medical records of patients admitted to the ED. The NLR values of the patients were calculated, and their demographic characteristics (age and gender) and clinical outcomes were recorded.

Results: Of the 1970 patients, 1400 (71.1%) were discharged from the ED, and 570 (28.9%) were hospitalized. The patients who were discharged were younger and had lower NLR values, and this group had a lower female gender ratio (p<0.001, p<0.001, and p<0.001, respectively). The NLR threshold for discharge was 4.8, with a sensitivity of 70% and a specificity of 60%. Of the 570 hospitalized patients, 478 (83.9%) were discharged from the hospital and 92 (16.1%) died. Deceased patients were statistically significantly older with higher NLR values (p<0.001 and p=0.001, respectively). The threshold value of NLR for predicting mortality was calculated as 11.5, with a sensitivity of 45% and a specificity of 77%.

Conclusions: Our study reveals that the NLR is an important predictor of hospitalization and mortality in patients admitted to the ED regardless of diagnosis. ED physicians may consider to discharge patients with NLR values below 4.8 instead of spending additional time with advanced tests. In addition, clinicians should review the risk of mortality in patients with NLR values greater than 11.5 more thoroughly concerning mortality and should consider early aggressive treatment options.

Keywords: Complete Blood Cell Count, Emergency Department, Neutrophil Lymphocyte Ratio

Introduction

Determining the clinical course and the severity of patients in the emergency department (ED), where there are frequent and diverse patient admissions, is one of the most important topics in emergency medicine. The neutrophil to lymphocyte ratio (NLR) has been investigated as an indicator of mortality and/or morbidity in many clinical pathologies, especially sepsis, in recent years due to its easy and rapid applicability, low cost, and widespread use (1-5).

The increase in the number of white blood cells (WBCs) in the peripheral blood is a marker of systemic inflammation. The NLR is the ratio of neutrophils to lymphocytes, which comprise the majority of WBCs in the blood. During acute inflammation, the number of WBCs increases due to the number of neutrophils. There are publications showing that physiological stress suppresses the lymphocyte count in the blood (6). Therefore, the NLR has been accepted as a parameter to show the negative effects of both an increased

neutrophil count, which reflects acute inflammation, and decreased lymphocyte count, which reflects physiological stress. Numerous published studies have been conducted to determine whether the NLR has a prognostic or diagnostic value in clinical pathologies, such as acute abdominal events, cardiovascular system pathologies, ischemic events (e.g., acute ischemic stroke), pulmonary embolism, vascular events (e.g., aortic dissection), sepsis, and chronic obstructive pulmonary disease exacerbation. However, these studies have mostly been conducted for specific diseases (2,3). There is a lack of data in the literature on the relationship between the NLR and clinical outcomes regardless of the diagnosis from the ED evaluation.

In this study, we investigated whether there is a relationship between the NLR and the decision to admit or discharge patients in patients who presented to the ED.

Also, the predictive value of NLR for mortality in patients admitted to hospital was investigated in our study.

Material and Methods

This study was performed in accordance with the Declaration of Helsinki, and ethical approval was obtained from the Ethics Committee of Süleyman Demirel University Medical Faculty (2019/263). We retrospectively reviewed the medical records of patients admitted to the ED of Suleyman Demirel University Training and Research Hospital between October 1, 2017 to January 1, 2018. The data of patients who underwent a complete blood cell count (CBC) examination were obtained from the hospital data processing center. Patients with pregnancy, trauma, malignancy, immune deficiency, or drug use that could affect CBC parameters as well as patients who were under the age of 18 and whose medical records could not be reached were excluded. The NLR values of the patients included in the study were calculated, and the demographic characteristics (age and gender) and clinical outcomes were recorded.

The SPSS 25 program was used for statistical analysis. Since the quantitative data were not normally distributed, the Mann–Whitney U test was used in statistical comparisons, and the descriptive statistics are shown as the median (minimum-maximum). For categorical variables, a chi-square analysis was used in statistical comparisons, and descriptive statistics are shown as the frequency (%). The success of the NLR in predicting in-hospital mortality and patients' outcomes in the ED was evaluated by receiver operating characteristic (ROC) curve analysis. The sensitivity, specificity, positive predictive, and negative predictive values were calculated based on the threshold values obtained. When $p < 0.05$, the related result was considered statistically significant.

Results

A total of 9756 patients were admitted to the ED in the study period, and 4122 of these patients underwent a CBC examination. After investigation of the medical records, 2152 patients were excluded from the study according to the exclusion criteria, and a total of 1970 patients were included in the study (Figure 1). Of the patients included in the study, 1011 (51.3%) were male, and 959 (48.7%) were female. The median age was 50 years (18-97) in men, 58 years (18-96) in women, and 55 years (18-97) in total.

A total of 1400 (71.1%) patients were discharged from the ED, and 570 (28.9%) patients were hospitalized. When the patients were compared according to their ED outcomes, the patients who were discharged were younger, had lower NLR values, and had a higher female gender ratio ($p < 0.001$, $p < 0.001$, and $p < 0.001$, respectively) (Table 1). In the structured ROC curve analysis, the threshold value of NLR for discharge was 4.8, with a sensitivity of 70% and a specificity of 60% (Table 2) (Figure 2).

In our study, 478 (83.9%) of the 570 hospitalized patients were discharged from the hospital, and 92 (16.1%) of them died. When these patients were compared, the patients who died were statistically significantly older with higher NLR values ($p < 0.001$ and $p = 0.001$, respectively). No significant difference was found between the two groups in terms of the gender distribution ($p = 0.141$) (Table 1). In the ROC curve analysis of these patients, the threshold for predicting mortality was calculated as 11.5, with a sensitivity of 45% and a specificity of 77% (Table 2) (Figure 3).
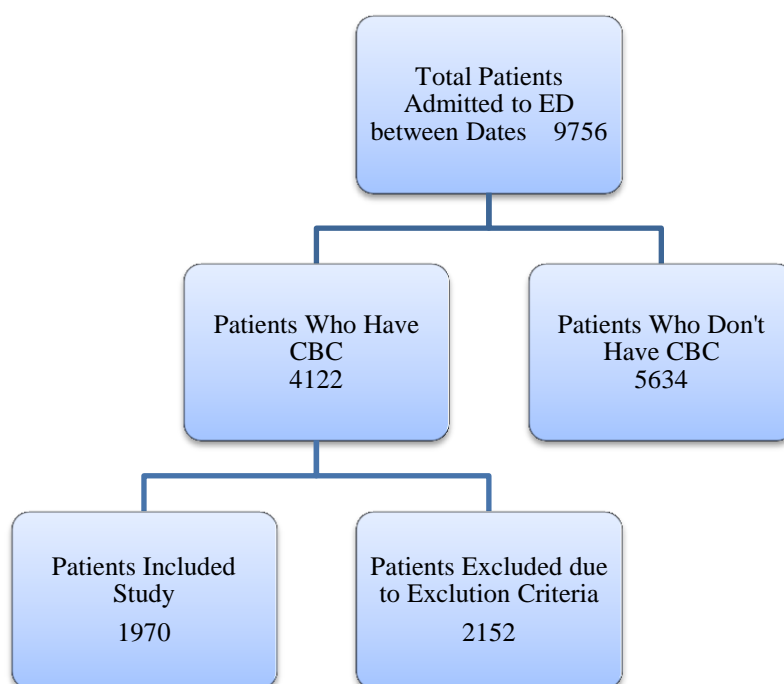
**Graphic 1.** Flow Chart of Study. ED: Emergency Department, CBC: Complete Blood Cell Count

Table 1. Comparison of Patients According to Emergency Room Outcome and Inhospital Mortality

	Gender (m/f)	Mean Age (year)	NLR
Discharged Paitents (n:1400)	666/734	49.2 ±20.2	5.2 ±6.6
Hospitalized Patients (n:570)	345/225	62.7 ±18.7	10.3 ±12.6
P value	**<0.001**	**<0.001**	**<0.001**
Patients Discharged From Hospital (n: 478)	283/195	60.8 ±18.7	9.3 ±11.5
Patients Died in Hospital (n: 92)	62/30	72.7 ±15.2	15.4 ±16.7
P value	0.141	**<0.001**	**0.001**

Table 2. Performance parameters of NLR as a Predictor of Discharge from ED and Inhospital Mortality

	Discharged from ED NLR<4.8) (95% CI)	Inhospital Mortality (NLR>11.5) (95% CI)
Sensitivity	70 (67.52-72.39)	45.65 (35.22-56.37)
Specificity	60.88 (56.74-64.91)	77.41 (73.39-81.08)
Positive predictive value	81.46 (79.15-83.62)	28 (20.98-35.91)
Negative predictive value	45.24 (41.68-48.84)	88.1 (84.61-91.03)
Positive likelihood ratio	1.79 (1.61-1.99)	2 (1.53-2.60)
Negative likelihood ratio	0.49 (0.44-0.55)	0.7 (0.58-0.85)
Receiver operating characteristic curve area	0.68 (0.65-0.71)	0.61 (0.54-0.68)
P value	**<0.001**	**0.001**

CI: Confidence Interval, NLR: Neutrophil to Lymphocyte Ratio, ED: Emergency Department
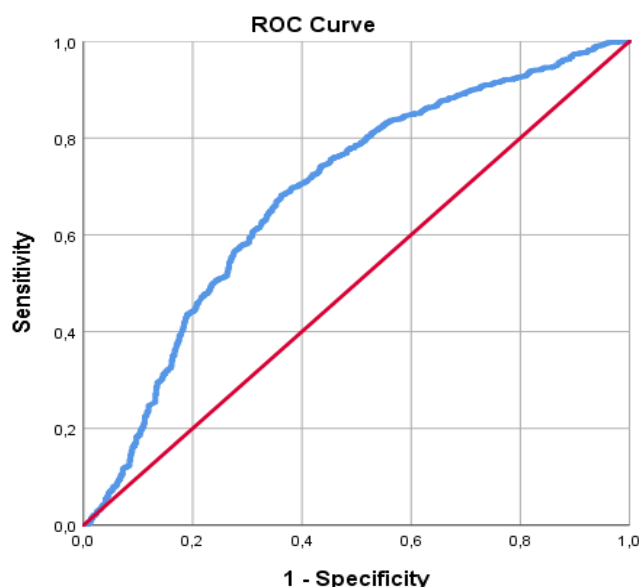
Figure 2. Receiver Operating Characteristic Curve of NLR to Predict Discharge from ED.
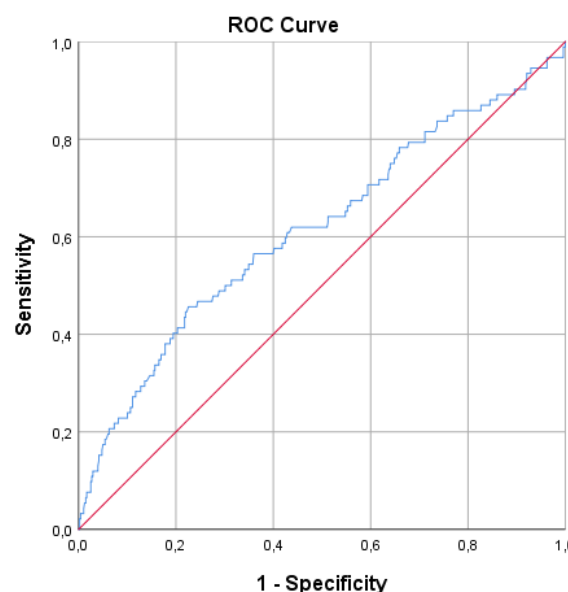
Figure 3. Receiver Operating Characteristic Curve of NLR to Predict Inhospital Mortality.

Discussion

Our study reveals that the NLR is an important predictor of hospitalization and mortality in patients admitted to the ED regardless of diagnosis. As a result of technological developments, the overall lifespan has increased, and chronic diseases have become more common. In parallel, the number of patients being admitted to EDs worldwide is reportedly increasing daily (7).

With this increase, patients' lengths of stay in the ED is prolonged, and treatment processes are negatively affected. In this case, emergency physicians must evaluate patients and make the decision to admit or discharge patients quickly. Several risk scoring scales have been developed to enable the rapid assessment of patients (8).

However, remarkably few of these scoring systems use laboratory data. In addition, the effects of laboratory data on clinical evaluation have been questioned in many studies (9,10). There are no published studies considering the ability of NLR to predict patient discharge in the ED. Our study reveals that patients with NLR values less than 4.8 can be safely discharged from the ED. This value, in addition to other scoring methods or vital signs, will be much more sensitive than alternative measures in predicting discharge and will shorten the patient evaluation process in the ED, thus contributing to the overall functioning of the ED. In our study, an NLR value greater than 11.5 significantly predicted mortality in hospitalized patients. Many published studies support the use of the NLR in predicting mortality. In a wide-scale cohort by Proctor et al., an increase in the neutrophil count and a decrease in the lymphocyte count, along with many laboratory values, significantly predicted all-cause mortality (11). Although the sensitivity and specificity of the NLR was not evaluated in their study, the results showed that NLR significantly predicted mortality. Akıllı et al. stated that an NLR greater than 11.9 was an independent risk factor for mortality in patients admitted to the ED and was an indicator of critical illness according to the systemic inflammatory response syndrome criteria (12). Although there was a methodological difference between our study and this study, the findings support each other.

Age is generally used as a parameter to predict mortality rather than patient severity in the ED (8). In our study, the mean age of patients who died was significantly higher than the mean age of patients who were discharged, supporting these mortality predicting scores (Table 1). In addition, the mean age of patients who were hospitalized was over 60 years, and the mean age of patients who were discharged was below 60 years. Significant difference was observed between the two groups (Table 1). Considering these findings, it would be appropriate to add age as a parameter to the scoring systems to estimate the severity of the status of patients in the ED. The most important limiting factors of our study were its retrospective single-center design. A risk score based on the vital signs and physical examination findings of the patients included in the study could not be performed because of the retrospective nature of the study. More comprehensive prospective studies on this topic are required to provide further findings.

Conclusion

The NLR promises hope to clinicians as an easily accessible, fast, and inexpensive parameter that can provide information in the distinction and risk classification of critical patients. Our study showed that the NLR can be a critical guide for emergency physicians in patient evaluation. Emergency physicians may consider to discharge of patients with NLR values less than 4.8 instead of spending additional time with advanced tests. Thus, patients' lengths of stay in the ED can be significantly reduced. In addition, clinicians should review the risk of mortality in patients with NLR values greater than 11.5 more thoroughly and should consider early aggressive treatment options.

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