DOI: 10.4274/anatoljmed.2025.63825
Anatol J Gen Med Res 2025;35(3):247-252

CLINICAL RESEARCH / KLİNİK ARAŞTIRMA

ANATOLIAN JOURNAL of GENERAL MEDICAL RESEARCH

Neutrophil/Lymphocyte Ratio as a Marker of Infections in Patients Hospitalized in the Oncology Palliative Care Service

Onkoloji Palyatif Bakım Servisi'nde Yatan Hastalarda Enfeksiyon Belirteci Olarak Nötrofil/Lenfosit Oranı

Muhammed Mustafa Uzan, Umut Gök Balcı, Tevfik Tanju Yılmazer

University of Health Sciences Türkiye, İzmir Tepecik Education and Research Hospital, Clinic of Family Medicine, İzmir, Türkiye

Cite as: Uzan MM, Gök Balcı U, Yılmazer TT. Neutrophil/lymphocyte ratio as a marker of infections in patients hospitalized in the oncology palliative care service. Anatol J Gen Med Res. 2025;35(3):247-252

Abstract

Objective: We aimed to evaluate the correlation of procalcitonin level with neutrophil to lymphocyte ratio (NLR) and to establish a cut-off value that can be used as an indicator parameter for oncological inpatient.

Methods: Study design is a cross sectional. The study was executed retrospectively on 640 patients with at least one oncological diagnosis. Demographic data, serum albumin, C-reactive protein (CRP), procalcitonin levels, and complete blood count data on the day of admission were attained.

Results: The average procalcitonin level was found to be 63.47% between 01/11/2021 and 30/01/2022 in the Clinic of Oncological Palliative Care, University of Health Sciences Türkiye, İzmir Tepecik Education and Research Hospital. The NLR cut-off value is 6.97 with sensitivity and specificity of 68% and 64%, respectively. There was a medium-level positive correlation between procalcitonin with leukocyte and neutrophil number (r=0.419).

Conclusion: The NLR parameter, which can be determined through complete blood count, can be used nearly as effectively as albumin or CRP for the detection of infection. This approach might prevent unnecessary antibiotic usage, thereby affecting the cost-effectiveness issue positively.

Keywords: Procalcitonin, family-medicine, oncology

Öz

Amaç: Amacımız prokalsitonin düzeyinin nötrofil/lenfosit oranı (NLR) ile ilişkisini değerlendirmek ve onkolojik yatan hastalar için gösterge parametresi olarak kullanılabilecek bir kesim değeri oluşturmaktır.

Yöntem: Çalışma tasarımı kesitsel bir çalışmadır. Çalışma, en az bir onkolojik tanısı olan 640 hasta üzerinde retrospektif olarak gerçekleştirildi. Yatış günündeki demografik veriler, serum albümin, C-reaktif protein (CRP), prokalsitonin düzeyleri ve tam kan sayımı verileri elde edildi.

Bulgular: Sağlık Bilimleri Üniversitesi, İzmir Tepecik Eğitim ve Araştırma Hastanesi, Onkolojik Palyatif Kliniği'nde 01/11/2021 ile 30/01/2022 tarihleri arasında ortalama prokalsitonin düzeyi %63,47 idi. NLR kesme değeri 6,97 olup duyarlılık ve özgüllük sırasıyla %68 ve %64'tür. Prokalsitonin ile lökosit ve nötrofil sayısı arasında orta düzeyde pozitif bir korelasyon vardı (r=0,419).

Address for Correspondence/Yazışma Adresi: Muhammed Mustafa Uzan, MD, University of Health Sciences Türkiye, İzmir Tepecik Education and Research Hospital, Clinic of Family Medicine, İzmir, Türkiye
E-mail: mustafauzan65@gmail.com
ORCID ID: orcid.org/0000-0002-2111-4520

Received/Geliş tarihi: 16.01.2025
Accepted/Kabul tarihi: 04.05.2025
Epub: 11.06.2025
Published date/Yayınlanma tarihi: 30.12.2025

Öz

Sonuç: Tam kan sayımı ile belirlenebilen NLR parametresi, enfeksiyon tespitinde en az albumin veya CRP kadar etkin olarak kullanılabilir. Böylece gereksiz antibiyotik kullanımının önüne geçilebilir ve maliyet-etkinlik konusu olumlu yönde etkilenebilir.

Anahtar Kelimeler: Prokalsitonin, aile hekimliği, onkoloji

Introduction

Procalcitonin is an acute-phase protein that has been frequently used in recent years for the early diagnosis of bacterial infections, especially septicemia[1]. Procalcitonin comprises mainly the metabolization of thyroid hormone and secretion from adipose tissues and the lymphocytes.

Calcitonin is a peptide that is derived from a precursor protein. Serum levels start to rise within 24 hours during bacterial infections due to endotoxin production from parenchymal tissues. The level also rises post-operatively, after burns, heat stroke, and traumas[2]. Suggestive levels of septicemia are 2 ng/mL, and those of septic shock are 11.6 ng/mL. If the measurement is >5 ng/mL for patients who are known to be in shock status, the reason might be considered to result from an infection[3].

Procalcitonin might be accepted as an indication for the use of antibiotics in cases of bacteremia while waiting for the result of culture[4]. Laboratory parameters such as C-reactive protein (CRP), leucocyte, and neutrophil levels, can be evaluated jointly[5,6].

CRP is the prototype acute phase reactant of the pentraxin group. The serum levels might increase in 24 to 48 hours during inflammation or infection, and also decrease rapidly[7]. Normal levels of CRP are between 0.3 and 1.7 mg/L[8]. The increase in the serum level to 10 mg/dL is a sign of bacterial infection. The levels can also be increased in situations such as dental illnesses, hypertension, obesity, smoking, diabetes mellitus, exercise, cancer, chronic fatigue, senility, alcohol consumption, and depression[9]. The serum levels can be measured turbidometrically and nephelometrically[10].

Albumin, which constitutes 60% of plasma proteins, is a negative acute-phase protein. The serum and plasma levels decrease during infection, contrary to procalcitonin and CRP[11]. Its levels also decrease in situations like lasting starvation, liver dysfunction, and intestinal malabsorption. Albumin is responsible for providing plasma oncotic pressure. It can also be used to evaluate the nutritional status of individuals. Its normal serum levels are 3.5 to 5.0 g/dL[12,13].

Neutrophil to lymphocyte ratio (NLR) is one of the recently proposed parameters for early diagnosis of septicemia [5,14].

A complete blood count is a test that can be performed at almost any health facility, whereas a procalcitonin test cannot be implemented at every health institution due to its high cost.

The aim in this study was to evaluate the correlation of procalcitonin with NLR and also to establish a threshold level that can be used at early diagnosis during the courses of bacteremia and early phase septicemia. Additionally, the study aims to promote the NLR as an indicator parameter for inpatient clinics, especially for oncological ones where the risk for infection is increased.

Materials and Methods

Ethical approval was obtained from the Non-interventional Ethics Committee of University of Health Sciences of Türkiye, İzmir Tepecik Education and Research Hospital (decision no: 2021/10-28, date: 15.10.2021). The study retrospectively collected data on 640 patients treated at the care clinic in the hospital between November 2021 and January 2022. All the patients had at least one oncological diagnosis.

Demographic data, serum albumin, CRP, procalcitonin levels, and complete blood count data were obtained on the day of hospitalization. The cut-off levels of the biochemical and microbiological laboratories of the study center were procalcitonin: 0.06 ng/dL, albumin: 3.5 g/dL, white blood cell: 10.600/mm^3, neutrophil: 7.000/mm^3, CRP: 6.0 mg/L, platelet: 140.000/mm^3.

Statistical Analysis

Data were analyzed with SPSS 26. Continuous variables were presented as mean and standard deviation, and categorical variables were presented as numbers and percentages. Continuous variables were tested for suitability for normal distribution. The Q-Q plot method and sample size were taken into consideration, and it was observed that they did not comply with the normal distribution assumption. Correlation between variables was investigated using the Spearman's rho

method. Independent group comparisons were made using Kruskal-Wallis and Mann-Whitney U tests, with a Bonferroni correction applied for multiple comparisons. Receiver operating characteristic (ROC) analysis was performed on variables that showed significant differences, and the most appropriate cut-off values were determined according to the Youden index. Binary variables were created for these values. Distribution differences of categorical independent variables were compared with the chi-square test, while the univariate odds ratio was calculated. Type 1 error was evaluated at an a level of 0.05 with a two-tailed test.

Results

The study was carried out with 640 patients; of these, 44.53% (n=285) were male. The percentage of individuals who were 65 years of age and over was 50.78% (n=325). The most prevalent oncological disease of the patients was breast cancer with 15.75% (n=97); the second most prevalent was stomach cancer with 7.03% (n=45).

The average procalcitonin level of the patients was 63.47 ng/mL. The averages for white blood cell number were 9.780/mm^3; for neutrophil number, they were 7.830/mm^3; and lymphocyte numbers, they were 1.130/mm^3 (Table 1).

There was a medium-level positive correlation between procalcitonin and white blood cells and neutrophil number (r=0.419), a medium-level positive correlation between procalcitonin and NLR (r=0.365) (Table 2).

According to the ROC analysis, the area under the curve used to determine a cut-off value for NLR was calculated to be 0.697. Therefore, the cut-off was determined as 6.00. This condition was recorded with an ideal sensitivity of 68% and a specificity of 64% (Figure 1).

Discussion

Increases in procalcitonin levels, may be mistakenly interpreted as a positive sign of infection. Sometimes, overuse of antibiotics can mask an infection despite low procalcitonin levels. Therefore, it may be wise to set a cut-off value. Eraldemir[1] has intercrossed procalcitonin levels at cut-off values 0.1, 1, 2, and 5 ng/mL in separate groups with NLR, and he identified cut-off values for NLR to be 4.71, 6.44, 7.65, and 8.24 in the respective order. When 4.71 was used as the cut-off value for NLR, he determined the sensitivity to be 58.16% and the specificity to be 78.76%. Önmez et al.[15] have studied patients with pancreatitis and specified that the highest correlation of NLR parameter with the severity of pancreatitis was 68% in the ROC analysis, with an area under the ROC curve of 0.687 (confidence interval: 0.570-0.804). Furthermore, the sensitivity of this value was determined to be 61% and the cut-off value has been confirmed to be 6.0451[15]. Another study reported that NLR with a cut-off value of 4.68 can significantly differentiate between normal and inflamed appendices[16]. Sayah et al.[17] have analyzed the potential fatality of coronavirus disease 2019. According to this, interleukin-6 has been shown to have a positive correlation with NLR where the cut-off value was 7.4, sensitivity was 96.3%, and specificity was 70.5%. Çil et al.[18] have specified NLR to be 7.21 in patients with pneumonia who had high procalcitonin levels. Our study revealed the NLR cut-off value to be 6.97 using ROC analysis, with sensitivity and specificity at 68% and 64% respectively. Therefore, we

Table 1. Procalcitonin, albumin, CRP and complete blood count parameters

	n	Mean	Standard deviation	Median	Minimum	Maximum
PCT	640	3.58	11.74	0.11	0.01	75
WBC	640	9.78	8.18	7.5	0.1	84.4
NEU	640	7.83	7.51	5.4	0	77.7
LYM	640	1.13	1.1	0.9	0	10.6
N/L	640	11.09	13.72	6.43	0	121.5
HGB	640	10.32	1.94	10.2	2.6	15.8
PLT	640	235.45	137.4	218	5	943
MPV	640	8.24	1.12	8.1	5.5	13.3
CRP	640	47.03	77.35	12.05	0.01	514.2
ALB	640	2.9	0.75	2.8	0.9	4.73

PCT: Procalcitonin, WBC: White blood cell, NEU: Neutrophil, LYM: Lymphocyte, N/L: Neutrophile to lymphocyte ratio, HGB: Hemoglobin, PLT: Platelet, MPV: Mean platelet volume, CRP: C-reactive protein, ALB: Albumin

Table 2. Procalcitonin and its correlation with other parameters

		PCT	NEU	LYM	NLR	CRP	ALB
PCT	Correlation coefficient	-	0.436**	-0.052	0.367%*	0.667**	-0.722**
	Sig. (2-tailed)		<0.001	0.186	<0.001	<0.001	<0.001
NEU	Correlation coefficient	0.436**	-	0.175**	0.620**	0.353**	0.404**
	Sig. (2-tailed)	<0.001		<0.001	<0.001	<0.001	<0.001
LYM	Correlation coefficient	0.052	0.175**	-	-0.598**	-0.093*	0.046
	Sig. (2-tailed)	0.186	<0.001		<0.001	0.019	0.244
NLR	Correlation coefficient	0.367**	0.620**	-0.598**	-	0.351**	-0.344**
	Sig. (2-tailed)	<0.001	<0.001	<0.001		<0.001	<0.001
CRP	Correlation coefficient	0.667**	0.353**	-0.093	0.351**	-	-0.662**
	Sig. (2-tailed)	<0.001	<0.001	0.019	<0.001		<0.001
ALB	Correlation coefficient	-0.722**	-0.404**	0.046	-0.344**	-0.662**	-
	Sig. (2-tailed)	<0.001	<0.001	0.244	<0.001	<0.001	

*: Correlation is significant at the 0.05 level (2-tailed), **: Correlation is significant at the 0.01 level (2-tailed), PCT: Procalcitonin, NEU: Neutrophil, LYM: Lymphocyte, N/L: Neutrophile to lymphocyte ratio, CRP: C-reactive protein, ALB: Albumin

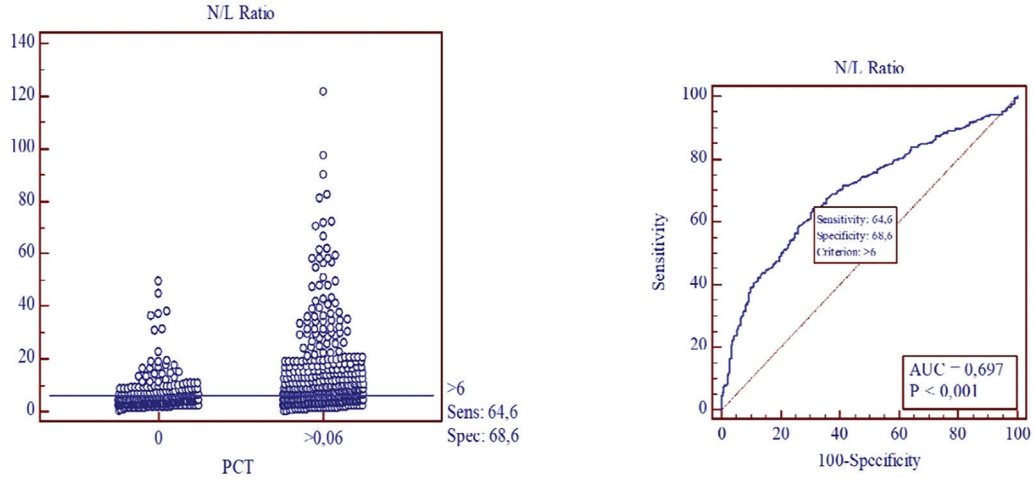

Figure 1. ROC curve cut-off value N/L ratio and associated criterion >6 for Youden index

ROC: Receiver operating characteristic, N/L: Neutrophile to lymphocyte ratio

consider these values to be self-consistent and to have high predictive value for septicemia.

The lymphocyte number decreases while neutrophils increase during systemic inflammatory response and septicemia, thereby providing credibility for NLR increase in its medical implementation[19]. de Jager et al.[20] revealed that NLR increase is more valuable in the early diagnosis of bacteremia at the emergency service compared to neutrophil and leucocyte increase. Beyazit et al.[21] revealed that NLR is superior to leucocytes in conditions of bacteremia and septicemia. We identified a medium-level positive correlation between procalcitonin and NLR. Therefore, we can consider that the implementation of NLR instead of procalcitonin, at least for oncological patients, might prevent unnecessary antibiotic usage and positively affect cost-effectiveness. One must bear in mind that a complete blood count provides an advantage as it is both fast and low-cost.

Tekin et al.[22] revealed that in patients presenting with high fever, CRP levels increase significantly with bacterial infection compared to those with viral. Yıldız Celtek et al.[23] found CRP levels to be significantly higher in patients. Ljungström et al.[5] determined that single use of NLR or procalcitonin has similar diagnostic power; nevertheless, using NLR with CRP acts as a confirmatory factor.

Arikan et al.[24] reported that there was a significant difference between all groups in NLR and platelet to lymphocyte ratio values[25]. In a study conducted in Wuhan, it was determined that high values of NLR had high sensitivity and specificity in predicting mortality[26]. There are studies in the literature in which NLR is successful in predicting sepsis and mortality. In this sense, this finding supports our study by corroborating our hypothesis.

Study Limitation

The most important limitation of our study is in investigating the presence of clinical variability changes, and it being conducted in a single center. Therefore, studies with larger samples are needed.

Conclusion

Both the cost and unattainability of procalcitonin at some health institutions directs clinicians to use alternative infection markers. We consider that the NLR parameter, which can be determined through complete blood count, can be used nearly as effectively as procalcitonin for the detection of infection. Further studies are needed to conduct more multicenter research, especially those without infection variability.

Ethics

Ethics Committee Approval: Ethical approval was obtained from the Non-interventional Ethics Committee of University of Health Sciences of Türkiye, İzmir Tepecik Education and Research Hospital (decision no: 2021/10-28, date: 15.10.2021).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: M.M.U., Concept: M.M.U., U.G.B., Design: M.M.U., U.G.B., T.T.Y., Data Collection or Processing: M.M.U., Analysis or Interpretation: M.M.U., T.T.Y., Literature Search: M.M.U., Writing: M.M.U., U.G.B., T.T.Y.

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

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

References

1. Eraldemir FC. Neutrophil/lymphocyte ratio instead of procalcitonin: is it an option? Türk Klinik Biyokimya Derg. 2018;16:11-6.
2. Lee H. Procalcitonin as a biomarker of infectious diseases. Korean J Intern Med. 2013;28:285-91.
3. Mitaka C. Clinical laboratory differentiation of infectious versus non-infectious systemic inflammatory response syndrome. Clin Chim Acta. 2005;351:17-29.
4. Günal Ö, Barut HS. Sepsis and procalcitonin. CMJ. 2009;31:502-12.
5. Ljungström L, Pernestig AK, Jacobsson G, Andersson R, Usener B, Tilevik D. Diagnostic accuracy of procalcitonin, neutrophil-lymphocyte count ratio, C-reactive protein, and lactate in patients with suspected bacterial sepsis. PLoS One. 2017;20:7.
6. Kim SY, Jeong TD, Lee W, Chun S, Min WK. Procalcitonin in the assessment of bacteremia in emergency department patients: results of a large retrospective study. Ann Clin Biochem. 2015;52:654-9.
7. Pepys MB. C-reactive protein fifty years on. Lancet. 1981;1:1653-7.
8. Baumann H, Gauldie J. The acute phase response. Immunol Today. 1994;15:74-80.
9. Hacimustafaoglu M. Acute phase reactants (erythrocyte sedimentation rate, CRP). J Pediatr Inf. 2017;11:53-5.
10. Büyükberber N, Sevinç A. İnfeksiyon ve kanserde C-reaktif protein. Arşiv. 2003;12:149.
11. Batırel A, Gençer S, Özer S. Enfeksiyon göstergesi olarak akut faz reaktanları: C-reaktif protein (CRP) ve serum amiloid A (SAA). KEAH. 2003;14:220-4.
12. Ceron JJ, Eckersall PD, Martinez-Subiela S. Acute phase proteins in dogs and cats: current knowledge and future perspectives. Vet Clin Pathol. 2005;34:85-99.
13. Georgieva TM, Andonova MJ, Slavov EP, Dzhelebov PV, Zapryanova DS, Georgiev IP. Blood serum protein profiles and lysozyme activity in dogs during experimental infection with staphylococcus intermedius. Revue Méd Vét. 2011;162:580-5.
14. Can E, Hamilcikan S, Can C. The value of neutrophil to lymphocyte ratio and platelet to lymphocyte ratio for detecting early-onset neonatal sepsis. J Pediatr Hematol Oncol. 2018;40:229-32.
15. Önmez A, Bilir E , Torun S. The relationship between acute pancreatitis severity of platelet lymphocyte ratio, neutrophil lymphocyte ratio, erythrocyte distribution width and mean platelet volume. Konuralp Medical Journal. 2019;11:24-9.
16. Kahramanca S, Ozgehan G, Seker D, et al. Neutrophil-to-lymphocyte ratio as a predictor of acute appendicitis. Ulus Travma Acil Cerrahi Derg. 2014;20:19-22.
17. Sayah W, Berkane I, Guermache I, et al. Interleukin-6, procalcitonin and neutrophil-to-lymphocyte ratio: potential immune-inflammatory parameters to identify severe and fatal forms of COVID-19. Cytokine. 2021;141:155428.
18. Çil E, Karadeniz G, Yenigün S, Çoraplı G. Evaluation of the relationships between procalcitonin and neutrophil/lymphocyte ratio and platelet/lymphocyte ratio in patients with pneumonia. Eur Rev Med Pharmacol Sci. 2022;26:3200-5.

19. Zahorec R. Ratio of neutrophil to lymphocyte counts--rapid and simple parameter of systemic inflammation and stress in critically ill. Bratisl Lek Listy. 2001;102:5-14.
20. de Jager CP, van Wijk PT, Mathoera RB, de Jongh-Leuvenink J, van der Poll T, Wever PC. Lymphocytopenia and neutrophil-lymphocyte count ratio predict bacteremia better than conventional infection markers in an emergency care unit. Crit Care. 2010;14:R192.
21. Beyazit Y, Sayilir A, Torun S, et al. Mean platelet volume as an indicator of disease severity in patients with acute pancreatitis. Clin Res Hepatol Gastroenterol. 2012;36:162-8.
22. Tekin M, Çalışkan M, Kayak D, Konca Ç. Is the C-reactive protein a reliable marker for the diagnosis of bacterial infection? ADYÜ Sağlık Bilimleri Derg. 2017;3:475-86.
23. Yıldız Celtek N, Ünlü U, Karaaslan E, Demir O. Can neutrophil lymphocyte ratio be an evaluation criterion for hospitalization in children with fever? Pediatr Pract Res. 2020;8:75-8.
24. Arikan MG, Akgul M, Akdeniz E, Iskan G, Arda E. The value of hematological inflammatory parameters in the differential diagnosis of testicular torsion and epididymorchitis. Am J Clin Exp Urol. 2021;9:96-100.
25. Yığman M, Ekenci BY, Durak HM, Sanci A. Predictive value of hematologic parameters in the differential diagnosis of testicular torsion and epididymo-orchitis. Androl Bul. 2024;26:167-72.
26. Wang X, Li X, Shang Y, et al. Ratios of neutrophil-to-lymphocyte and platelet-to-lymphocyte predict all-cause mortality in inpatients with coronavirus disease 2019 (COVID-19): a retrospective cohort study in a single medical centre. Epidemiol Infect. 2020;148:e211.