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NLR AS MORTALITY INDICATOR FOR SEPSIS AND SEPTIC SHOCK: A PROSPECTIVE STUDY

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ABSTRACT

Background: Sepsis and septic shock are major causes of morbidity and mortality in intensive care units. Early prognostic markers are essential for risk stratification. The neutrophil-lymphocyte ratio (NLR), derived from a routine complete blood count, is a simple and inexpensive marker of systemic inflammation.

Objectives: To assess the relationship between NLR and mortality in patients with sepsis and septic shock and to determine an NLR cut-off associated with unfavourable outcomes.

Methods: A prospective observational study was conducted among 170 patients admitted to the Medical and Respiratory Intensive Care Units at Basaveshwara Medical College and Hospital, Chitradurga, from August 2022 to February 2024. Admission NLR was calculated and patients were categorized into NLR <3 and NLR >3 groups. Clinical, biochemical, and outcome parameters were compared using Chi-square and independent-sample t-tests, with $p<0.05$ considered significant.

Results: Of 170 patients, 114 (67.1%) had NLR <3 and 56 (32.9%) had NLR >3. Significant differences were observed in ESR (32.8 vs 37.2, p=0.021), bilirubin (4.1 vs 2.5 mg/dL, p<0.001), creatinine (3.5 vs 2.2 mg/dL, p<0.001), mean arterial pressure (106.7 vs 86.7 mmHg, p<0.001), total leucocyte count, and 24-hour NLR (1.66 vs 5.0, p<0.001). Mortality was comparable between groups (12.3% vs 12.5%, p=0.967).

Conclusion: NLR correlated with several markers of organ dysfunction and disease severity but did not discriminate in-hospital mortality in this cohort. Larger multicentric studies with serial NLR measurements are warranted.

Keywords: *Neutrophil-lymphocyte ratio; sepsis; septic shock; mortality; prognosis; intensive care unit.*

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INTRODUCTION

Infections are associated with a wide range of physiological alterations, some of which necessitate prompt intervention in severe cases as they can be life-threatening and cause serious organ dysfunction. Sepsis is a highly prevalent and complex condition affecting both developed and developing nations, with an estimated global burden of over 30 million cases annually, potentially resulting in 6 million deaths [1].

Sepsis is associated with a cascade of organ and system failures; timely intervention is therefore essential to control disease progression and ensure appropriate recovery-directed care [2]. Current evidence indicates that sepsis is a public health concern affecting patients of all ages, with disproportionately higher morbidity and mortality among those requiring intensive care [3].

As per the Sepsis-3 definition, sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection, while septic shock represents a subset of sepsis characterised by profound circulatory, cellular, and metabolic abnormalities associated with a higher risk of mortality [4]. The reported incidence of severe sepsis in India is approximately 16.45%, with the global incidence projected to rise by 1.5% annually [5].

Early and accurate identification of patients at high risk of complications and death remains central to sepsis management. Several biomarkers-including total leucocyte count, C-reactive protein, and procalcitonin-have been evaluated for prognostication, but each carries limitations, particularly cost and availability [6]. Zahorec et al. first

proposed the neutrophil-to-lymphocyte ratio (NLR) as a simple additional marker of systemic inflammation and stress in critically ill patients [7]. NLR is calculated by dividing the absolute neutrophil count by the absolute lymphocyte count obtained from a routine differential blood count, and elevated values have been associated with unfavourable outcomes in sepsis [8]. The physiological rationale for NLR is the concurrent rise in neutrophils and fall in lymphocytes that occurs during systemic inflammation, reflecting altered apoptotic regulation compared with the non-inflammatory state [9]. Given the paucity of regional data on the utility of NLR in predicting mortality among sepsis and septic shock patients in this part of the country, the present study was undertaken to evaluate NLR as a prognostic marker in patients admitted with sepsis and septic shock.

AIM AND OBJECTIVES

Primary objective: To study the relationship of neutrophil-lymphocyte ratio with mortality in patients with sepsis and septic shock.

Secondary objective: To determine a cut-off value of neutrophil-lymphocyte ratio above which an unfavourable outcome is expected.

MATERIALS AND METHODS

Study design and setting: A hospital-based prospective observational study was conducted among patients admitted to the MICU and RICU of Basaveshwara Medical College and Hospital, Chitradurga, over a period of 18 months (August 2022 to February 2024). Institutional ethics committee clearance was obtained prior to initiation of the study, and written informed consent was taken from all participants or their legal representatives.

Sample size: A total of 170 patients meeting the eligibility criteria constituted the study sample.

Inclusion criteria: Age >18 years; sepsis due to any cause; blood sampling within 24 hours of ICU admission; blood samples obtained prior to initiation of antibiotics.

Exclusion criteria: Prior antibiotic administration before blood sampling (up to one week before admission); immunosuppressive diseases such as HIV or malignancy; patients on immunosuppressive therapy; patients who developed secondary (nosocomial) sepsis during ICU stay.

Study procedure: All patients underwent a complete diagnostic workup including laboratory parameters, biochemistry, blood and urine cultures, chest radiography, coagulation profile, and other imaging as indicated. Sepsis was diagnosed as per Sepsis-3 criteria and qSOFA assessment. Venous blood was collected in EDTA tubes at admission; blood cultures were obtained prior to antibiotic administration and processed using a BACTEC incubator (5-day incubation unless earlier positivity). Complete blood counts were analysed using a Beckman Coulter LH 750 analyser. NLR was calculated by dividing the absolute neutrophil count by the absolute lymphocyte count; the normal reference range for neutrophils was taken as 39.9–73.9% and for lymphocytes as 18.8–50.8%, with a normal NLR cut-off between 0.78 and 3.53.[10] For analysis, patients were stratified into two groups: NLR <3 and NLR >3.

Statistical analysis: Data were entered into an Excel spreadsheet and analysed using SPSS version 20. Categorical variables were expressed as frequencies and percentages and compared using the Chi-square test. Continuous variables were expressed as mean ± standard deviation and compared using the independent-sample t-test. Receiver operating characteristic (ROC) curve analysis was used to assess predictive accuracy. A p-value <0.05 was considered statistically significant.

RESULTS

Of the 170 patients enrolled, 114 (67.1%) had an NLR <3 and 56 (32.9%) had an NLR >3. Baseline demographic, clinical, biochemical, and outcome parameters in the two groups are summarised below.

Demographic and behavioural characteristics

Age distribution showed that 31.6% of patients with NLR <3 were aged 61–70 years, while 30.4% of patients with NLR >3 were aged 41–50 years (χ^2=9.619, df=7, p=0.211, not significant). Sex distribution was comparable between groups (53.5% vs 53.6% male; χ^2=0.000, p=0.994). Smoking status (26.3% vs 42.1% smokers; χ^2=0.004, p=0.948) and alcohol consumption (18.4% vs 14.3%; χ^2=0.454, p=0.500) also showed no significant difference between groups showed in Table 01.

Table 01: Comparison of demographic and lifestyle characteristics between NLR groups

Parameter	NLR <3 n (%)	NLR >3 n (%)	p-value
Total patients	114 (100.0)	56 (100.0)	-
Male sex	61 (53.5)	30 (53.6)	0.994, NS
Smokers	30 (26.3)	15 (42.1)*	0.948, NS
Alcohol use	21 (18.4)	8 (14.3)	0.500, NS

**Percentage as reported among applicable subgroup in source data.*

Clinical and biochemical parameters

Mean CRP (21.5 ± 11.2 vs 19.8 ± 10.1, p=0.350) and HDL (23.6 ± 11.9 vs 23.5 ± 12.6, p=0.923) did not differ significantly between groups. Temperature (40.4% vs 30.4% febrile, p=0.205) and systolic blood pressure status (46.5% vs 42.9% hypotensive, p=0.655) were also comparable. ESR was significantly higher in the NLR >3 group (37.2 ± 8.7 vs 32.8 ± 12.4, p=0.021). GCS (12.8 ± 3.9 vs 12.2 ± 2.5, p=0.321) and prothrombin time (18.2 ± 4.3 vs 18.5 ± 4.1, p=0.646) were similar between groups ahowed in the table 02.

Table 02: Comparison of clinical and laboratory parameters between NLR groups

Parameter (Mean ± SD)	NLR <3	NLR >3	p-value
CRP	21.5 ± 11.2	19.8 ± 10.1	0.350, NS
HDL (mg/dL)	23.6 ± 11.9	23.5 ± 12.6	0.923, NS
ESR	32.8 ± 12.4	37.2 ± 8.7	0.021, Sig
GCS	12.8 ± 3.9	12.2 ± 2.5	0.321, NS
Prothrombin time (sec)	18.2 ± 4.3	18.5 ± 4.1	0.646, NS

Organ dysfunction parameters

Serum bilirubin (4.1 ± 3.1 vs 2.5 ± 1.3 mg/dL, p<0.001), serum creatinine (3.5 ± 1.9 vs 2.2 ± 0.9 mg/dL, p<0.001), and mean arterial pressure (106.7 ± 24.0 vs 86.7 ± 20.7 mmHg, p<0.001) differed significantly between the NLR <3 and NLR >3 groups. PaO2/FiO2 ratio (2.0 ± 0.9 vs 2.2 ± 0.9, p=0.333) and urine output (1124.2 ± 340.8 vs 1217.5 ± 421.4 mL, p=0.946) showed no significant difference. SOFA scores at 24 hours (6.5 ± 4.0 vs 5.8 ± 3.8, p=0.258) and 48–72 hours (4.7 ± 4.5 vs 4.8 ± 4.1, p=0.946) were also comparable between groups showed in the table 03.

Table 03: Comparison of organ function and severity parameters between NLR groups

Parameter (Mean ± SD)	NLR <3	NLR >3	p-value
Serum bilirubin (mg/dL)	4.1 ± 3.1	2.5 ± 1.3	<0.001, Sig
Serum creatinine (mg/dL)	3.5 ± 1.9	2.2 ± 0.9	<0.001, Sig
Mean arterial pressure (mmHg)	106.7 ± 24.0	86.7 ± 20.7	<0.001, Sig
PaO2/FiO2 ratio	2.0 ± 0.9	2.2 ± 0.9	0.333, NS
Urine output (mL)	1124.2 ± 340.8	1217.5 ± 421.4	0.946, NS
SOFA score, 24 h	6.5 ± 4.0	5.8 ± 3.8	0.258, NS
SOFA score, 48-72 h	4.7 ± 4.5	4.8 ± 4.1	0.946, NS

Haematological trends

Total leucocyte count differed significantly between groups at admission (8569.4 ± 2755.6 vs 10138.4 ± 2597.5, p<0.001), 24 hours (7299.7 ± 1841.9 vs 10833.4 ± 1317.6, p<0.001), and 72 hours (6754.0 ± 2089.5 vs 7687.1 ± 1327.0, p=0.003). Neutrophil percentage at 24 hours (59.4 ± 7.2 vs 78.8 ± 6.7, p<0.001) and 72 hours (p<0.001), and lymphocyte percentage at 24 hours (37.3 ± 6.2 vs 17.7 ± 4.4, p<0.001) and 72 hours (34.4 ± 3.4 vs 28.7 ± 6.3, p<0.001) also differed significantly, though admission-day values did not. NLR at 24 hours was 1.66 ± 0.48 in the NLR <3 group versus 5.0 ± 2.6 in the NLR >3 group (p<0.001).

Table 04: Comparison of total leukocyte count and NLR at different time points

Parameter (Mean ± SD)	Timepoint	NLR <3	NLR >3	p-value
Total count	Admission	8569.4 ± 2755.6	10138.4 ± 2597.5	<0.001
Total count	24 hours	7299.7 ± 1841.9	10833.4 ± 1317.6	<0.001
Total count	72 hours	6754.0 ± 2089.5	7687.1 ± 1327.0	0.003
NLR	24 hours	1.66 ± 0.48	5.0 ± 2.6	<0.001

Outcome

All 170 patients were admitted to the intensive care unit. Mortality was 12.3% (14/114) in the NLR <3 group and 12.5% (7/56) in the NLR >3 group; this difference was not statistically significant (χ^2=0.002, df=1, p=0.967).

DISCUSSION

This prospective observational study evaluated the neutrophil-lymphocyte ratio as a prognostic marker in 170 patients with sepsis and septic shock admitted to the MICU and RICU of a tertiary care hospital. Age and sex distribution were comparable between NLR groups, consistent with observations by Qiu et al. and Zhang et al., who similarly found no significant demographic clustering by NLR status [11, 12].

Smoking and alcohol use did not differ significantly between groups in this study. ESR was significantly higher in the NLR >3 group, suggesting a correlation between NLR and other markers of systemic inflammation, even though CRP itself did not differ significantly-a discordance also noted by Qiu et al., who reported comparable CRP levels between survivors and non-survivors despite differing inflammatory burden [11].

Serum bilirubin, serum creatinine, and mean arterial pressure differed significantly between groups, indicating that NLR correlates with markers of hepatic, renal, and haemodynamic dysfunction in this cohort. This is broadly consistent with prior literature linking elevated NLR to greater organ dysfunction, although the direction of some associations in this study (lower bilirubin and creatinine in the higher-NLR group) warrants cautious interpretation given the observational design and moderate sample size. Shi et al. reported comparable creatinine and PaO2/FiO2 trends between survivor and non-survivor groups in a similarly sized cohort of 173 septic patients [13].

SOFA scores at 24 hours and 48–72 hours did not differ significantly between NLR groups in this study, in contrast to some reports where combined NLR-SOFA models improved predictive performance for mortality [13]. Total leucocyte counts and NLR values themselves differed significantly across timepoints, as expected by definition of the grouping variable, confirming adequate group separation for the exposure of interest.

Importantly, in-hospital mortality did not differ significantly between the NLR <3 and NLR >3 groups (12.3% vs 12.5%, p=0.967) in this cohort. This finding parallels the results of Chebl et al., who also found that after adjusting for confounders, no independent association was seen between NLR and in-hospital mortality in sepsis, despite an identifiable optimal cut-off on ROC analysis [14]. Similarly, Ni et al. reported a paradoxically lower risk of in-hospital death with higher NLR in certain subgroups, and no significant association with 28-day mortality [15]. In contrast, Zhang et al. and Shi et al. reported significant independent associations between NLR (particularly serial or day-5 measurements) and mortality, suggesting that single admission-day NLR values may be less discriminative than serial trends combined with severity scores [12, 13].

Taken together, these findings suggest that while admission NLR correlates with several organ-dysfunction parameters in sepsis, its standalone value in discriminating in-hospital mortality may be limited, and serial measurements combined with established severity scores such as SOFA may offer superior prognostic performance.

LIMITATIONS

This study was conducted at a single centre using a convenience sampling method, which limits generalisability of the findings. The relatively modest sample size and the absence of serial NLR trends beyond 72 hours may have limited the ability to detect independent mortality associations. Larger, multicentric studies with serial biomarker measurement and multivariate adjustment for confounders are warranted.

CONCLUSION

The neutrophil-lymphocyte ratio is a simple, inexpensive, and readily available inflammatory marker that correlates with several indices of organ dysfunction-including ESR, serum bilirubin, serum creatinine, and mean arterial pressure-in patients with sepsis and septic shock. However, in this cohort, admission NLR alone did not significantly discriminate in-hospital mortality. NLR may hold greater value as part of a composite assessment alongside established severity scores such as SOFA, and further studies with serial measurements and larger sample sizes are needed to establish its independent prognostic utility in sepsis.

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AUTHOR CONTRIBUTION

All authors are contributed equally.

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CONFLICT OF INTREST

Authors are declared that no conflict of interest

REFERENCES

1. Fleischmann C, Scherag A, Adhikari NKJ, Hartog CS, Tsaganos T, Schlattmann P, et al. Assessment of global incidence and mortality of hospital-treated sepsis: current estimates and limitations. Am J Respir Crit Care Med. 2016;193(3):259-272. doi:10.1164/rccm.201504-0781OC.
2. Hotchkiss RS, Moldawer LL, Opal SM, Reinhart K, Turnbull IR, Vincent JL. Sepsis and septic shock. Nat Rev Dis Primers. 2016;2:16045. doi:10.1038/nrdp.2016.45.
3. Evans L, Rhodes A, Alhazzani W, Antonelli M, Coopersmith CM, French C, et al. Surviving sepsis campaign: international guidelines for management of sepsis and septic shock 2021. Intensive Care Med. 2021;47(11):1181-1247. doi:10.1007/s00134-021-06506-y.
4. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, et al. The third international consensus definitions for sepsis and septic shock (Sepsis-3). JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287.
5. Chatterjee S, Bhattacharya M, Todi SK. Epidemiology of adult-population sepsis in India: a single center 5 year experience. Indian J Crit Care Med. 2017;21(9):573-577. doi:10.4103/ijccm.IJCCM_240_17.
6. Jarczak D, Kluge S, Nierhaus A. Sepsis-pathophysiology and therapeutic concepts. Front Med (Lausanne). 2021;8:628302. doi:10.3389/fmed.2021.628302.
7. 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(1):5-14.
8. 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;12(7). doi:10.1371/journal.pone.0181704.
9. Joshi VD, Kalvakolanu DV, Cross AS. Simultaneous activation of apoptosis and inflammation in pathogenesis of septic shock: a hypothesis. FEBS Lett. 2003;555(2):180-184. doi:10.1016/S0014-5793(03)01271-7.
10. de Jager CP, Wever PC, Gemen EF, Kusters R, van Gageldonk-Lafeber AB, van der Poll T, et al. The neutrophil-lymphocyte count ratio in patients with community-acquired pneumonia. PLoS One. 2012;7(10). doi:10.1371/journal.pone.0046561.
11. Qiu X, Wang Q, Zhang Y, Zhao Q, Jiang Z, Zhou L. Prognostic value of neutrophils-to-lymphocytes ratio and platelets-to-lymphocytes ratio in sepsis patients with lymphopenia. Biomark Insights. 2024;19:11772719231223156. doi:10.1177/11772719231223156.
12. Zhang Y, Peng W, Zheng X. The prognostic value of the combined neutrophil-to-lymphocyte ratio (NLR) and neutrophil-to-platelet ratio (NPR) in sepsis. Sci Rep. 2024;14:15075. doi:10.1038/s41598-024-64469-8.
13. Shi Y, Yang C, Chen L, Cheng M, Xie W. Predictive value of neutrophil-to-lymphocyte and platelet ratio in in-hospital mortality in septic patients. Heliyon. 2022;8(11). doi:10.1016/j.heliyon.2022.e11498.
14. Chebl RB, Assaf M, Kattouf N, Haidar S, Khamis M, Abdeldaem K, et al. The association between the neutrophil to lymphocyte ratio and in-hospital mortality among sepsis patients: a prospective study. Medicine (Baltimore). 2022;101(30). doi:10.1097/MD.0000000000029343.
15. Ni J, Wang H, Li Y, Shu Y, Liu Y. Neutrophil to lymphocyte ratio (NLR) as a prognostic marker for in-hospital mortality of patients with sepsis: a secondary analysis based on a single-center, retrospective, cohort study. Medicine (Baltimore). 2019;98(46). doi:10.1097/MD.0000000000018029.
16. Martins EC, Silveira LDF, Viegas K, Beck AD, Fioravantti Júnior G, Cremonese RV, et al. Neutrophil-lymphocyte ratio in the early diagnosis of sepsis in an intensive care unit: a case-control study. Rev Bras Ter Intensiva. 2019;31(1):64-70. doi:10.5935/0103-507X.20190010.
17. Gameiro J, Fonseca JA, Jorge S, Gouveia J, Lopes JA. Neutrophil, lymphocyte and platelet ratio as a predictor of mortality in septic-acute kidney injury patients. Nefrologia (Engl Ed). 2020;40(4):461-468. doi:10.1016/j.nefro.2019.11.006.