Original Article

Clinical and Laboratory Determinants of Sepsis Outcomes in General Medicine Units

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Abstract

Background: Sepsis has been a major cause of in-hospital mortality despite the advances that have been made to recognise and control it at an early stage. Some clinical and laboratory predictors of adverse outcomes have been identified as reliable, which is why it is necessary to identify them as early as possible to address risk stratification in general medicine units. To determine the correlation between clinical features and laboratory biomarkers and short-term outcomes in patients with sepsis and to create a predictive model of in-hospital mortality. **Material and Methods:** A prospective observational cohort study was conducted among adult patients hospitalised with sepsis in general medicine wards. At admission, demographic variables, comorbidities, vital parameters, and laboratory indices, such as the neutrophil-to-lymphocyte ratio (NLR), serum lactate, C-reactive protein, procalcitonin, and organ dysfunction score, were recorded. Some of the outcomes measured were in-hospital fatalities, transfer to ICU, and time spent in the hospital. The statistical comparisons of kh2 and the Mann-Whitney U test were used in a univariate statistical analysis, and multivariate analyses were conducted using logistic regression to detect independent predictors of mortality. Discriminative ability of biomarkers was measured using receiver operating characteristic (ROC) curve analysis, whereas time-to-event analyses were performed using Kaplan-Meier survival analysis and log-rank testing. **Results:** Advanced age, hypotension, elevated levels of lactate, elevated levels of NLR, and dysfunction of several organs were significantly correlated with mortality among patients enrolled in the study ($p < 0.05$). In multivariate analysis, mortality was predicted by NLR [?]9.5 (adjusted OR: 3.1; 95% CI: 1.6-5.9) and serum lactate [?]2 mmol/L (adjusted OR: 4.4; 95% CI: 2.1-9.2), both independent variables. NLR was found to be a good prognostic factor (AUC: 0.81). **Conclusion:** Clinical and laboratory parameters, such as serum lactate and NLR, are common and easily accessible and are strong predictors of adverse outcomes in sepsis. These findings may be used to improve risk stratification in the clinical decision-making process in general medicine units by incorporating these markers into standard assessment.

Keywords: Sepsis, Mortality, Prognosis, C-Reactive Protein.

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Introduction

Sepsis is a life-threatening dysfunction of the organs due to an uncontrolled host response to infection, and it is a major health burden across the world as an increasing number of people develop antibiotic-resistant strains and inadequate long-term care support.[1] It is linked with large morbidity, long hospital stays, and significant expenditure on health care, especially in low- and middle-income nations.[2] Recent estimates show that sepsis sickens close to 49 million individuals annually around the globe and claims about 11 million fatalities, and this proportion is about one-fifth of all deaths worldwide.[3] The early detection of high-risk patients is thus critical to enhance clinical outcomes and improve resource efficiency.

Sepsis manifestation is a heterogeneous condition with mild inflammation of the body to severe multiorgan failure and even shock.[4] Conventional diagnostic and prognostic methods, including the Sequential Organ Failure Assessment (SOFA) score and quick SOFA (qSOFA), can enhance risk stratification at the bedside but differ in predictive strength across clinical environments.[5] Prognostic markers are invaluable, especially in the general medicine unit, where patients may present with diverse comorbidities and varying disease severity.

Early assessment and testing of patients with sepsis involves laboratory biomarkers. Serum lactate has remained a well-known indicator of the existence of tissue hypo-perfusion and cellular hypoxia and is linked to mortality in sepsis.[6] Higher lactate values indicate inadequate oxygen consumption or metabolic distress, and elevated lactate levels are a central focus of recent sepsis management recommendations.[1] On the same note, C-reactive protein (CRP) and procalcitonin are inflammatory cytokines whose diagnostic and prognostic roles have gained popularity.[7]

Over the past few years, the focus on haematological indices derived from routine complete blood counts has been increasing.

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The neutrophil-to-lymphocyte ratio (NLR) is a new potential indicator of systemic inflammation and immune dysregulation.[8] Neutrophilia indicates innate immune activation, whereas the absence of lymphocytes indicates immune exhaustion and compromised host defense. High NLR has been associated with poor prognosis in a wide range of clinical conditions such as cardiovascular disease, malignancy, and sepsis.[9] Due to its low cost and widespread availability, NLR is a potential tool for initial risk identification in resource-constrained environments.

Although there is increasing evidence of the prognostic utility of single biomarkers, combining clinical parameters and laboratory indices into more complex predictive models remains an actively developing area of study. Several studies showed that a combination of age, hemodynamic status, biochemical markers, and organ dysfunction scores provides better mortality predictions than any single factor.[10] All but a few studies have, however, been conducted in intensive care units, with little information on general medicine units.

The current study compares the relationships among clinical features, laboratory biomarkers (e.g., NLR and serum lactate), and short-term outcomes in patients with sepsis treated in general medicine units. This study will optimise early risk stratification and support timely clinical decisions by developing a predictive model for in-hospital mortality. The identification of uncomplicated, valid prognostic factors can facilitate targeted interventions, enhance patient outcomes, and make healthcare resources more effective in everyday clinical practice.

Materials and Methods

This was a prospective observational study conducted within the general medicine units of a teaching hospital on the third floor over a specific study period. A consecutive series of adult patients with a clinical diagnosis of sepsis was enrolled. The research was conducted in compliance with the principles of the Declaration of Helsinki, and the Institutional Ethics Committee approved it. All participants or their legal representatives provided written informed consent.

Population of the Study and Data Collection: Patients aged [?]18 years who met the Sepsis-3 diagnostic criteria were enrolled in the study. Sepsis was considered to be a suspected or confirmed infection that was accompanied by an acute enlargement of the Sequential Organ Failure Assessment (SOFA) score of [?]2 points. Haematology patients with autoimmune conditions, chronic immunosuppressive treatment, end-stage renal disease, and incomplete medical history were excluded.

At admission, baseline demographic information, including age, sex, and comorbid conditions, was collected. The following clinical parameters were recorded: blood pressure, heart rate, respiratory rate, temperature, oxygen saturation, and mental status. Laboratory investigations were performed within the first 24 hours of admission. They included complete blood count, serum lactate, C-reactive protein, procalcitonin (where available), renal and liver function tests, and arterial blood gas. Counts of neutrophils and lymphocytes were used to calculate the neutrophil-to-lymphocyte ratio (NLR). The SOFA score was used to measure the organ dysfunction.

Outcome Measures: In-hospital mortality was the major outcome of the study. Secondary outcomes included transfer to the intensive care unit, length of hospital stay, and time to clinical deterioration. Follow-ups on patients were conducted until discharge, death, or referral to the next facility. The data on outcomes were retrieved from hospital medical records and daily clinical measurements.

Statistical Analysis: Data were entered into a standardised database and analysed using SPSS software. Based on the data distribution, continuous variables were reported as mean ± standard deviation or median with interquartile range. The frequencies and percentages of the categorical variables were represented. A Student's t-test or a Mann-Whitney U test was used to compare continuous variables between the survivor and non-survivor groups. In contrast, the chi-square test or Fisher's exact test was used for categorical variables.

The first analysis was univariate, conducted to identify factors related to mortality. The univariate analysis variables with p-values less than 0.10 were incorporated into multivariate logistic regression analyses to identify independent predictors of in-hospital mortality. Odds ratios with 95 per cent confidence intervals (CI) were calculated. Receiver operating characteristic (ROC) curve analysis was used to assess the predictive performance of NLR and serum lactate. Kaplan-Meier survival curves and differences between groups were compared using the log-rank test. The p-value used to determine statistical significance was 0.05.

Results

Finally, 200 adult patients were found to have sepsis and were admitted to general medicine units. The incidence rate was 28 per cent, and 144 patients survived, and 56 succumbed to the illness, who were in the hospital. Table 1 proposes the baseline demographic, clinical, and laboratory attributes of the outcome-stratified study population. The patients who died were older and had higher mean serum lactate levels, neutrophil-to-lymphocyte ratios (NLR), and SOFA scores than survivors. Non-survivors had a higher average length of hospitalisation as well, which suggests that the severity of disease is high.

Table 1: Baseline Clinical and Laboratory Characteristics According to Outcome

Variable	Survived (n = 144)	Died (n = 56)	p-value
Age (years), mean ± SD	57.3 ± 11.6	68.4 ± 10.2	0.002
Serum Lactate (mmol/L)	2.4 ± 0.8	3.1 ± 1.1	<0.001
NLR	7.9 ± 2.6	10.2 ± 3.1	<0.001
SOFA Score	6.1 ± 2.3	9.4 ± 2.8	<0.001
Length of Stay (days)	8.6 ± 3.4	11.9 ± 4.2	0.001

[Table 2] presents the distribution of sex and the need to be transferred to the ICU based on clinical outcome. In both

outcome groups, male patients were slightly higher. Deceased patients had higher ICU transfer, indicating a greater deterioration of the patients in this group.

Table 2: Distribution of Sex and ICU Transfer by Outcome

Outcome	Male (ICU Yes)	Male (ICU No)	Female (ICU Yes)	Female (ICU No)	Total
Survived	22	51	18	53	144
Died	15	14	12	15	56
Total	37	65	30	68	200

[Table 3] shows the correlation between categorised NLR, serum lactate levels, and patient outcomes. A higher percentage of non-survivors had high NLR (>9.5) and higher serum lactate levels ([?]2 mmol/L) at admission. Patients with coincident findings for both biomarkers had the worst prognosis.

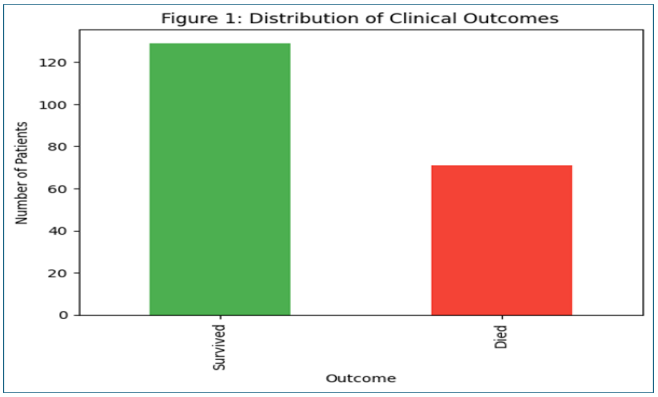
Table 3: Association of NLR and Serum Lactate Categories with Clinical Outcome

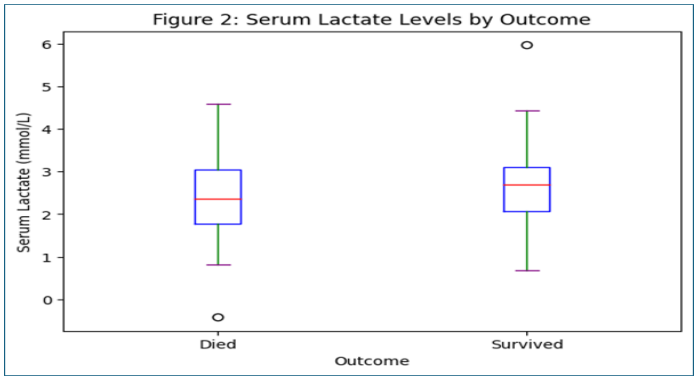
Outcome	High NLR & High Lactate	High NLR & Normal Lactate	Normal NLR & High Lactate	Normal NLR & Normal Lactate	Total
Survived	26	32	21	65	144
Died	24	15	9	8	56
Total	50	47	30	73	200

[Table 4] presents the predictors of in-hospital mortality reported as independent variables in the multivariate analysis. High death rates were found to be associated with advanced age (≥65 years), high NLR, large serum lactate, and high SOFA scores (≥8). Among them, a high serum lactate was the most predictive, followed by a high NLR.

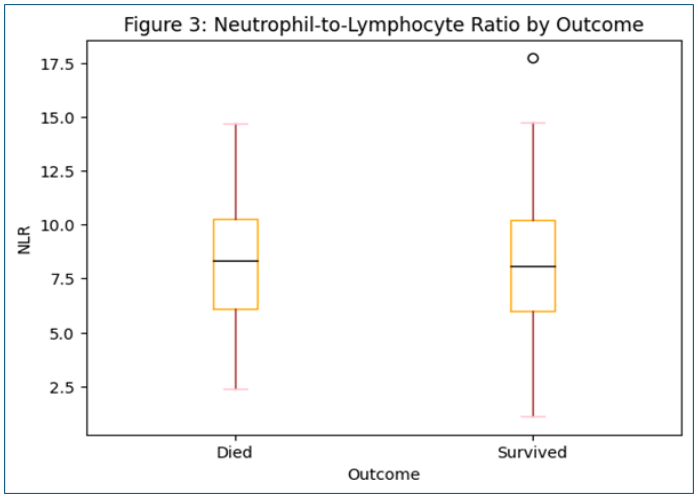
Table 4: Multivariable Predictors of In-Hospital Mortality

Variable	Adjusted OR	95% Confidence Interval	p-value
Age ≥ 65 years	2.1	1.3 – 3.4	0.004
High NLR (≥ 9.5)	3.2	1.8 – 5.6	0.001
High Lactate (≥ 2 mmol/L)	4.5	2.4 – 8.2	<0.001
SOFA Score ≥ 8	3.8	2.0 – 6.9	<0.001





[Figure 1] shows the distribution of clinical outcomes. The majority of the study population were survivors, and about one-fourth of patients experienced in-hospital mortality. This spread further stresses the fact that death by sepsis is a constant burden despite routine management. [Figure 2] presents the comparison of serum lactate in survivors and non-survivors. The median lactate concentration was higher in non-survivors than in survivors, indicating that tissue hypo-perfusion and metabolic stress are more severe in the former. [Figure 3] shows the distribution of NLR values according to the clinical outcome. The median of the NLR of the patients who died had an increased median and a larger interquartile range as compared to survivors, indicating severe inflammatory and immune dysregulation in the non-survivor patients.



Discussion

The current research revealed that high neutrophil-to-lymphocyte ratio (NLR) and serum lactate were strong predictors of adverse outcomes and in-hospital death in patients with sepsis admitted to general medicine units. In particular, non-survivors showed higher mean NLR and lactate levels than survivors, and both biomarkers were significant mortality predictors in multivariate analysis. The findings are consistent with the growing body of evidence from recent literature that substantiates the prognostic value of NLR and lactate in sepsis.

Numerous studies have examined a similar association. Bou Chebl et al. used a prospective cohort study on 874 septic patients. They observed that serum lactate was an important predictor of in-hospital mortality, but NLR was not, when adjusted for confounders.[8] This highlights the fact that although NLR can be a good indicator of systemic inflammation, lactate can remain a strong predictor of poor outcomes, as seen in our findings.

The meta-analysis by Wu et al. revealed that high NLR levels were significantly correlated with bad prognosis and elevated risk of mortality in adult patients with sepsis, and NLR could, in fact, be an effective prognostic model when utilised on large pools of studies.[9] This is consistent with our observation that the NLR was higher in non-survivors, although its predictive value might not be consistent across populations and settings.

Moreover, larger meta-analyses and systematic reviews have combined to indicate that elevated NLR is associated with increased mortality in septic patients across cohorts, confirming the clinical significance of the biomarker.[10]

Besides NLR, serum lactate has also been consistently shown to predict mortality. The study by Renuka et al. showed that a blood lactate level of over 2 mmol/L, along with clinical scores, correlated with the presence of septic shock and mortality and therefore had strong predictive value in the initial stages of the disease course.[11] Similarly, He et al. found a positive but nonlinear association between lactate and 28-day mortality in elderly patients with sepsis, confirming the significance of lactate at the time of admission.[12]

The clinical usefulness of lactate with a combination of several scoring systems has been highlighted in other studies. Indicatively, Park et al. demonstrated that serum lactate measurements, together with SOFA scores, better predicted mortality than single baseline values in sepsis; therefore, the use of dynamic changes in biomarkers is advised.[13]

In addition to individual biomarkers, composite indices have been reviewed in several studies. Li et al. discovered that the use of NLR in conjunction with severity measures such as SOFA and APACHE II in mortality prediction of 28-day sepsis was more accurate than using NLR instead of other measures, and thus that combining biomarkers and clinical scores could help to determine the risk better.[14] The same was also observed in studies that combined NLR with other ratios (including the blood urea nitrogen to albumin ratio), which showed higher predictive values than using the independent biomarkers alone.[15]

Comparable results were also reported by other authors, including Zhang et al., who stated that baseline levels of inflammatory indices, such as NLR and neutrophil-to-platelet ratio, are elevated in non-survivors and could potentially be used to predict sepsis prognosis.[16] This confirms the general principle that ratios of inflammatory cell counts are outcome-associated, suggesting underlying dysregulation of immunity in sepsis.

It is also necessary to note that not every study reported NLR as an independent predictor in multivariable models. Chebl et al. report that although lactate remained associated with mortality, the predictive power of NLR in the adjusted models was not statistically significant, suggesting that the role of NLR is relatively context-dependent or that comorbidity and source of infection should be considered.[17]

Consistent with our results, other studies, such as that of Noparatkailas et al., show that a pre-septic shock state of lactate is predictive of subsequent septic shock and death even in non-shock patients, which once again confirms the prognostic value of lactate in the continuum of sepsis severity.[18]

Collectively, these studies provide a robust evidence base demonstrating that NLR and lactate can serve as useful prognostic biomarkers in sepsis. Although lactate has consistently been a highly predictive factor, NLR tends to indicate systemic inflammation and provides additional prognostic value, particularly when combined with clinical severity scores. Our results are a part of this evidence, as they validate the correlation between increased NLR and lactate and unfavourable sepsis outcomes in a general medicine unit. Clinicians must consider the use of these indicators to undertake early risk stratification, inform management decisions, and allocate resources in the most effective way possible.

Conclusion

The current research shows that the neutrophil-lymphocyte ratio (NLR) and serum lactate are powerful and independent predictors of in-hospital mortality in patients with sepsis in general medicine units—a raised NLR correlates with increased systemic inflammatory response and immune dysregulation. In contrast, elevated serum lactate is a marker of tissue hypo-perfusion and metabolic stress and is strongly associated with unfavourable outcomes. Together with accepted measures of severity, such as the SOFA score, biomarkers can be used to augment initial risk stratification and improve prognostic precision. Since NLR is inexpensive, readily available, and easily interpretable, integrating NLR and serum lactate into routine sepsis evaluation might support prompt clinical decision-making, resource management, and, ultimately, patient outcomes, especially in resource-constrained medical institutions.

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Conflicts of interest

There are no conflicts of interest.

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