

Arterial Lactate and NLR Value in Prognosis of Parquet Poisoning in Intensive Care Unit at Tertiary Care Hospital

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ABSTRACT

Background: Acute poisoning contributes to many the morbidity and mortality of critically ill patients. Prognostic assessment at an early stage can help identify the high-risk patients. We assessed the prognostic value of arterial lactate and NLR in acute poisoning.

Methods: A prospective observational study was performed in 90 patients suffering from acute poisoning who were admitted to the ICU of SCB Medical College and Hospital in the period from June 2023 to June 2025. Patients' serum arterial lactate and arterial blood gas parameters were obtained at the time of admission and NLR were calculated from the admission complete blood count. Follow-up was carried out until hospital discharge or death. Prediction accuracy of arterial lactate and NLR was analyzed by using ROC.

Results: Of the 90 patients, 68 (75.6%) survived to 28 days and 22 (24.4%) died. Mean arterial lactate was higher among non-survivors compared to survivors (6.7 ± 3.1 vs. 2.8 ± 1.4 mmol/L; $p < 0.001$). In the same way, NLR was higher among non-survivors compared to survivors (10.6 ± 5.7 vs. 4.9 ± 2.8 ; $p < 0.001$). The AUC for arterial lactate was 0.86 and for NLR was 0.82, the combined AUC was 0.90.

Conclusion: Higher admission arterial lactate and NLR were related to greater mortality in patients admitted with acute poisoning. The sum of these two indices may provide useful early prognostic information to assist with risk stratification of acute poisoning patients in the ICU.

Key-words: Acute poisoning, Arterial lactate, NLR, Prognosis, Mortality, Intensive care unit

INTRODUCTION

Acute poisoning is one of the major and ongoing problems in public health and clinical areas, in particular in third world countries where presentation is often late, early access to toxicological care is limited, and the patients often are suffering very serious systemic diseases. Patients who have been acutely poisoned may encounter many health issues affecting their respiratory, cardiovascular, renal, hepatic, neurological, and metabolic systems.

The prognosis often depends on the poison used, the dose, the time until presentation to the hospital, and individual patient differences. Identifying at a very early stage those people with poisoning who are at risk either of being admitted to an intensive care unit (ICU) or even dying will be very much needed to be able to monitor these patients accurately, provide interventions without delay, and distribute critical-care resources efficiently. In recent times, it has been increasingly recognized that some routinely available laboratory test results and inflammatory markers can work as promising prognostic tools for critically ill poisoned patients ^[1,2].

Arterial blood lactate is an important clinical marker commonly studied, which reflects tissue oxygen delivery-balance with its utilization as well as possible changes in cellular metabolism. Increased lactate level is usually a sign of inadequate perfusion, failure to utilize oxygen,

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overstimulation of beta-adrenergic receptors, mitochondrial malfunctioning, or other changes in metabolism due to severe poisoning. So, a high arterial lactate level at time of admission may be a harbinger of more significant physiological dysfunction and several researchers have explored this lactate marker in predicting unfavorable outcome for poisoned patients [2,3]. Many studies examining critical illness following poisoning have shown that abnormal values of arterial blood gases plus high lactate level are strongly connected to a worse prognosis for the patient, implying that measurement of lactate would help the doctors make timely prognostic decisions [4,5].

Predictive value of lactate levels has also been demonstrated in a group of patients with severe paraquat poisoning. Paraquat has proved to be one of the most dangerous weed killers leading to oxidative injury and progressive organ failure. The levels of lactate in blood when initially sampled are taken into account as the indicator of mortality risk in cases of acute paraquat poisoning, higher levels being generally more indicative of death [6,7]. On top of these measures, the level of clearance of lactate has been studied as another prognostic factor, suggesting that the patient ability that is reflected in the lactate normalization can provide more useful data than the starting level of lactate alone [6]. Early identification of severe systemic poisoning has also been pointed out by previous studies on paraquat poisoning as one among the factors that influence survival time after such incidents [8].

Besides metabolic biomarkers, systemic inflammatory markers could also offer valuable insights about disease severity and prognosis after poisoning. NLR, a single indicator derived from the ordinary count of differential leukocytes that represents the cross-talk between inflammatory activation and physiological stress that acute poisoning may induce not only the body's own systemic inflammatory responses but also other consequences like oxidative stress, tissue injury, and changes in leukocyte distribution. This way, NLR has been studied as a new possible marker for disease severity and has revealed a correlation to higher disease severity in critically ill patients. Results of a prospective observational study on acute poisoning showed that inflammatory markers and their related inflammation indicators at the moment of emergency department

were sufficient for predicting the likelihood of a patient to being admitted to ICU or even dying [1].

The combined use of arterial lactate and NLR may provide a more comprehensive assessment of poisoning severity. While arterial lactate reflects metabolic and perfusion abnormalities, NLR provides information on systemic inflammatory and stress responses. Early assessment of both may help identify patients at higher risk. Blood lactate has also shown prognostic potential in other toxicological conditions, including phosphide poisoning, supporting its possible role as an early prognostic marker despite its non-specific nature [4].

But it is often difficult to prognosticate at presentation, despite advances in toxicological management and intensive care. Many of the clinical parameters routinely used in the assessment may be affected by the load and type of toxin, the period elapsed from toxin administration to presentation, preexisting disease and therapies administered before presentation. So, a simple, inexpensive and rapidly available parameter measured on admission may provide valuable prognostic information, mainly in less well-resourced settings. The utility of arterial lactate as a good predictor in the setting of poisoning and paraquat intoxication has previously been demonstrated [2,6,7], as well as inflammatory indices including the NLR, which appears to have promise as an indicator of both ICU admission and mortality [1].

Limited studies have evaluated the combined prognostic role of arterial lactate and neutrophil-to-lymphocyte ratio (NLR) in acute poisoning, particularly in Indian tertiary-care ICU settings. Assessment of these readily available parameters may improve early recognition of disease severity and help identify patients requiring closer monitoring and intensive treatment.

MATERIALS AND METHODS

Study Design and Setting- This prospective observational study was conducted in the ICU of SCB Medical College and Hospital from June 2023 to June 2025. It evaluated the prognostic role of arterial lactate and NLR in patients with acute poisoning requiring intensive care and their association with in-hospital clinical outcomes.

Study Population- A total of 90 patients who had poisoning and were admitted to the ICU during the study period took part in the research. The process of including patients lasted until all patients were enrolled one after

the other, and each patient had to meet a set of criteria to be included. Establishing a diagnosis of acute poisoning relied mainly on the history of the poisoning incident that fitted with the patient's clinical presentation, a relative's or an attendant's account, and any circumstantial or toxicological evidence that came to light during the diagnosis. At their first visit, the patients underwent assessments, and their course in the hospital was tracked to assess their final condition.

Inclusion Criteria- Adults of either sex with a clinically established diagnosis of acute poisoning who required ICU admission were included. Patients were eligible irrespective of the type of poison, provided that blood sampling and complete blood cell analysis could be performed.

Exclusion Criteria- Patients with incomplete clinical or laboratory records, significant prior intervention at another hospital, or conditions that could independently alter arterial lactate or leukocyte levels were excluded. Patients with chronic diseases or acute illnesses affecting interpretation of arterial lactate or NLR were also excluded. Patients or legally authorized representatives who did not provide consent were excluded.

Data Collection- For each enrolled patient, we used a structured data collection format to gather important demographics and clinical information. At admission, we recorded data about age sex type of poisoning, the estimated time since exposure, the route of exposure, presenting clinical symptoms and signs, vital parameters, and relevant past medical history. We also logged if mechanical ventilation or other life support was required during the ICU stay. Following that, until discharge from the hospital or death, we kept monitoring them regularly.

Assessment of Arterial Lactate and Arterial Blood Gas Parameters- An arterial blood sample was collected at ICU admission, preferably before major therapeutic interventions that could alter the measured values. Arterial blood gas analysis was performed using the hospital's standard blood gas analyzer. The initial arterial lactate level (mmol/L) was recorded. Where available, pH, PaO₂, PaCO₂, and bicarbonate levels were also documented. Initial arterial lactate was used as the

primary metabolic biomarker for assessing the risk of mortality.

Assessment of Neutrophil-to-Lymphocyte Ratio- At admission, venous blood was taken for performing complete blood count and differential leukocyte analysis. The absolute neutrophil and lymphocyte counts were obtained based on the first hematological investigation. NLR was obtained by dividing the absolute neutrophil count with the absolute lymphocyte count from the same blood sample. The admission NLR served as a basis for what comes next analysis on how NLR correlates with clinical outcome.

Clinical Monitoring and Outcome Assessment- Patients were managed according to their clinical condition, type of poisoning, and institutional ICU protocols. During ICU stay, vital signs, respiratory, cardiovascular, and neurological status, multi-organ dysfunction, and supportive therapy requirements were monitored. The primary outcome was in-hospital mortality. Patients who survived were classified as survivors, while those who died were classified as non-survivors. Other ICU outcomes, including mechanical ventilation requirement and length of ICU stay, were also recorded where applicable.

Prognostic Evaluation- The authors evaluated the prognostic importance of the first blood lactate level measured in artery and NLR as markers by looking at the difference in these numbers between the patients who survived or not. The way such parameters correlated with how badly the poisoning was and clinical outcomes was also analyzed by the research. Special effort was made to figure out if higher levels of lactate taken in and higher NLR had to do with mortality. They also evaluated what happens at a joint level of changes in arterial lactate and NLR to see whether by measuring metabolic disturbance in combination with systemic inflammatory activation one could get more useful information about outcome.

Statistical Analysis- Data were entered into a computerized database and analyzed using appropriate statistical methods. Continuous variables were summarized using measures of central tendency and dispersion, while categorical variables were expressed as frequencies and percentages. Survivor and non-survivor

groups were compared using appropriate tests. The associations of arterial lactate and NLR with mortality were assessed, and ROC curve analysis was performed to evaluate their prognostic performance using AUC, sensitivity, and specificity. A p-value <0.05 was considered statistically significant.

Ethical Considerations- This study was conducted in accordance with ethical principles for research involving human participants and was approved by the Institutional Ethics Committee of SCB Medical College and Hospital. Written informed consent was obtained from the patient or legally authorized representative where required. Patient confidentiality was maintained throughout data collection, analysis, and reporting, and the data were used solely for research purposes.

RESULTS

A total of 90 patients with acute poisoning admitted to the ICU were included in the study. Of these, 61 (67.8%) were males and 29 (32.2%) were females. The majority of patients were aged 21–40 years (48, 53.3%), followed by 41–60 years (25, 27.8%), >60 years (9, 10.0%), and ≤20 years (8, 8.9%). Overall, 68 patients (75.6%) survived, while 22 (24.4%) died during hospitalization. Mechanical ventilation was required in 39 (43.3%) patients and was more frequent among non-survivors than survivors (17/22 vs. 22/68) (Table 1).

Table 1; Demographic and Clinical Characteristics of the Study Population

Characteristic	Number (n=90)	Percentage (%)
Age group		
≤20 years	8	8.9
21–40 years	48	53.3
41–60 years	25	27.8
>60 years	9	10.0
Sex		
Male	61	67.8
Female	29	32.2
Clinical outcome		
Survivors	68	75.6
Non-survivors	22	24.4
Mechanical ventilation		
Required	39	43.3
Not required	51	56.7

Admission arterial lactate and NLR were significantly higher among non-survivors compared with survivors. Mean arterial lactate was 6.7 ± 3.1 mmol/L in non-survivors versus 2.8 ± 1.4 mmol/L in survivors ($p < 0.001$), while mean NLR was 10.6 ± 5.7 versus 4.9 ± 2.8 , respectively ($p < 0.001$). Non-survivors also had lower arterial pH and bicarbonate levels and higher PaCO₂ compared with survivors. The difference in ICU stay between the two groups was not statistically significant (Table 2).

Table 2: Comparison of Arterial Lactate, NLR and Selected Laboratory Parameters between Survivors and Non-survivors

Parameter	Survivors (n=68)	Non-survivors (n=22)	p-value
Arterial lactate (mmol/L)	2.8 ± 1.4	6.7 ± 3.1	<0.001
NLR	4.9 ± 2.8	10.6 ± 5.7	<0.001
Arterial pH	7.36 ± 0.08	7.22 ± 0.13	<0.001
PaCO ₂ (mmHg)	38.6 ± 9.4	44.8 ± 13.2	0.031
HCO ₃ ⁻ (mmol/L)	22.9 ± 4.5	18.1 ± 5.6	<0.001
ICU stay (days)	5.2 ± 3.6	4.1 ± 3.2	0.187

The distribution of arterial lactate and NLR values between survivors and non-survivors is illustrated in Fig. 1 and 2. Both parameters showed higher values among non-survivors.

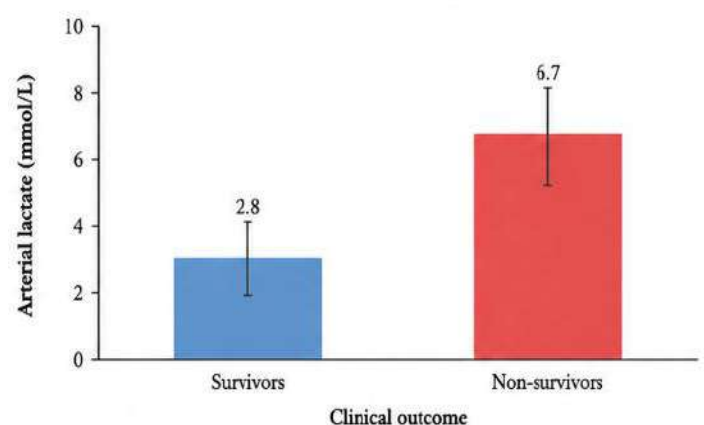


Fig. 1: Distribution of Arterial Lactate Levels among Survivors and Non-survivors

ROC curve analysis demonstrated good discriminatory performance of both biomarkers for in-hospital mortality. An arterial lactate cut-off of ≥ 4.0 mmol/L showed a sensitivity of 81.8%, specificity of 79.4%, and AUC of 0.86.

For NLR, a cut-off of ≥ 7.0 yielded a sensitivity of 77.3%, specificity of 75.0%, and AUC of 0.82. Combined assessment of arterial lactate and NLR demonstrated

improved discriminatory performance, with a sensitivity of 86.4%, specificity of 83.8%, and AUC of 0.90 (Table 3). The ROC analysis is presented in Fig. 3.

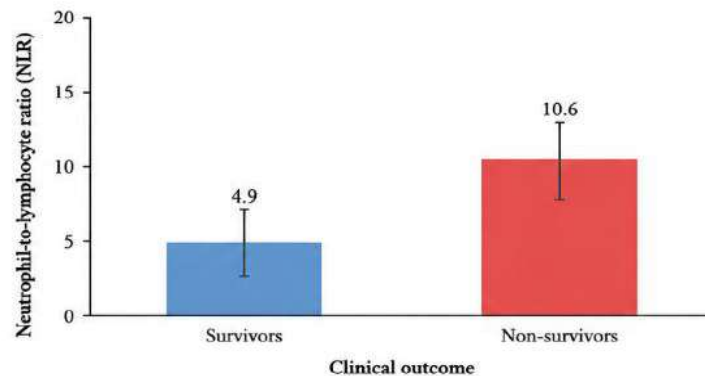


Fig. 2: Distribution of NLR among Survivors and Non-survivors

Table 3: Prognostic Performance of Arterial Lactate and NLR for In-hospital Mortality

Prognostic parameter	Illustrative cut-off	Sensitivity (%)	Specificity (%)	AUC
Arterial lactate	≥ 4.0 mmol/L	81.8	79.4	0.86
NLR	≥ 7.0	77.3	75.0	0.82
Arterial lactate + NLR	Combined assessment	86.4	83.8	0.90

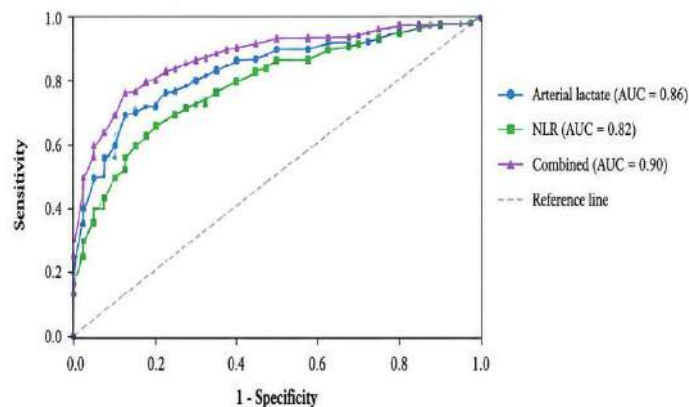


Fig. 3: ROC Analysis of Arterial Lactate and NLR for Prediction of In-hospital Mortality

This study of 90 critically ill patients with acute poisoning found that elevated admission arterial lactate and NLR were significantly associated with in-hospital mortality. When assessed together, these parameters showed better prognostic discrimination than either parameter alone. These findings support the potential utility of admission arterial lactate and NLR as early prognostic markers in critically ill patients with acute poisoning and warrant validation in larger prospective studies.

DISCUSSION

The present study evaluated the prognostic value of arterial lactate and NLR among 90 patients of acute poisoning who were admitted in to the intensive care unit. 22(24.4%) patients out of the total study group expired during their hospital stay. Both arterial lactate and NLR were elevated really among the non-survivors when compared to the survivors, because of this suggesting that increased metabolic and inflammatory abnormalities at admission can predict poor clinical outcome.

The mean arterial lactate concentration was 6.7 ± 3.1 mmol/L in non-survivors compared to 2.8 ± 1.4 mmol/L in survivors ($p < 0.001$). This may be an indication that a raised lactate on admission is reflective of a significant physiological derangement in patients with severe poisoning. A number of recent studies of patients with acute paraquat poisoning have shown that arterial or serum lactate has prognostic importance [9-12]. A higher serum or arterial lactate concentration has been connected to worse outcome. This is in keeping with the findings of the current study.

Elevation in lactate levels in the critically ill may be secondary to regional tissue hypoperfusion, deranged cellular metabolism, or impaired utilization of oxygen. Changes in lactate, on top of the initial lactate value, may also provide valuable prognostic information. Yang *et al.* illustrated the importance of arterial lactate changes for prognostic assessment in septic shock, implying that serial lactate levels may in fact be a result of treatments as well as ongoing progression of metabolic derangement [10]. While the current study evaluated initial arterial lactate levels, serial values may in fact be useful in determining prognosis in the setting of acute poisoning.

The current study showed that there was also a highly statistically significant elevated NLR among non-survivor compared to survivor (10.6 ± 5.7 vs. 4.9 ± 2.8 ; $p < 0.001$). An NLR of about 7.0 had a sensitivity of 77.3% and specificity of 75.0% for mortality prediction in our present study. The elevated NLR amongst non-survivors may be reflective of a greater systemic inflammatory and stress response in patients with severe poisoning, as alterations in commonly measured haematological parameters have also been shown to have prognostic significance in acute paraquat poisoning [11].

ROC analysis revealed that arterial lactate had an AUC of 0.86, while NLR had an AUC of 0.82. And, both parameters were found to have good discriminatory power for identifying patients who are at greater risk of death. The combination of arterial lactate and NLR had an AUC of 0.90, indicating that metabolic and inflammatory parameters may have a complementary role in risk stratification; this should be examined in greater detail in larger studies to determine clinically relevant cut-offs.

The relationships between various other clinical and physiological parameters and outcome in acute

poisoning have been previously investigated. QTc prolongation has been identified as a predictor of outcome in acute paraquat poisoning [13]. In addition, a number of emergency-department severity scoring systems have been evaluated for prognostic prediction, illustrating the importance of combining clinical observations with objective severity indicators [14]. Findings by Du and Mou have also demonstrated prognostic utility for alternate methods of severity assessment in acute paraquat poisoning [15]. These investigations outline the importance of assessing a range of parameters in prognostication in acute poisoning, rather than relying on a single prognostic indicator.

The clinical relevance of the present results is that arterial lactate and NLR are both easily available. Arterial lactate can be obtained rapidly from an ABG, and NLR can be calculated using a standard CBC. Their availability at the time of ICU admission may assist in identification of patients who need increased observation and support. This should be interpreted by considering the type of ingested substance, time elapsed since poisoning, hemodynamic parameters and evidence of end-organ damage, as well as other established markers of severity. The present study has some limitations. First of all, the relatively small sample size and single-centre study, is a weakness of this study. The heterogeneity of acute poisoning might have also affected the values of lactate and NLR. Second of all, only admission values have been analyzed in the present paper, while serial measurements of the parameters have not been done. Larger prospective studies with serial measurements of the biomarkers and a multivariable analysis are needed to establish whether arterial lactate and NLR are independent predictors of mortality.

Basically, our current study showed that elevated admission arterial lactate and NLR on admission was tied to increase in-hospital mortality in acutely poisoned patients admitted to the ICU. The findings of our study suggest that these two readily available parameters may offer the additional information to early prognosis and risk stratification in critically ill poisoned patients.

CONCLUSIONS

In our study, admission arterial lactate and NLR were significantly associated with in-hospital mortality among ACPS patients admitted to the ICU. Non-survivors had

higher arterial lactate and NLR levels than survivors, suggesting greater metabolic and systemic inflammatory disturbance at presentation. ROC analysis demonstrated useful prognostic discrimination for both parameters, while their combined assessment showed better discriminatory value than either parameter alone. Both arterial lactate and NLR are inexpensive and readily available from routine blood investigations. Their measurement at ICU admission may provide early prognostic information and help identify patients at higher risk of poor outcomes. However, these parameters should be interpreted alongside clinical signs, symptoms, and other established indicators of poisoning severity. Large prospective multicentre studies with serial measurements are required to validate these associations and establish clinically acceptable cut-off values.

CONTRIBUTION OF AUTHORS

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