Section: General Medicine

Original Research Article

SERIAL SEQUENTIAL ORGAN FAILURE ASSESSMENT SCORE AND SERUM LACTATE AS PREDICTORS OF MORTALITY IN ACUTE POISONING: A PROSPECTIVE OBSERVATIONAL STUDY

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Received : 05/05/2026
Received in revised form : 15/06/2026
Accepted : 01/07/2026

Keywords:
Organophosphate poisoning, Lactic acid, Organ dysfunction scores, Hospital mortality, Intensive care units.

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DOI: 10.47009/jamp.2026.8.4.77

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2026; 8 (4); 438-442

ABSTRACT

Background: This study aimed to assess whether serial measurements of the Sequential Organ Failure Assessment (SOFA) score and venous serum lactate, obtained at hospital admission, 24 hours, and 72 hours, could predict in-hospital death among patients presenting with acute poisoning. **Materials and Methods:** A prospective observational design was employed, recruiting 81 consecutive adults with acute poisoning who required admission to the intensive care unit of a tertiary teaching hospital. SOFA scores and venous serum lactate concentrations were documented at three time points: on arrival (hour 0), at 24 hours, and at 72 hours. Participants were categorised by final outcome (survival or death). Between-group differences in continuous variables were analysed with the independent-samples t-test and the Mann-Whitney U test; categorical data were compared using the chi-square or Fisher exact test, as applicable. The capacity of admission-day parameters to discriminate mortality was evaluated through receiver operating characteristic (ROC) curve analysis. **Results:** The study population had a mean age of 45.3 ± 16.4 years, with a male predominance of 61.7% (n = 50). Organophosphate compounds were responsible for 61 cases (75.3%), and the majority of ingestions were intentional (n = 69; 85.2%). Seven patients died in hospital, resulting in a mortality rate of 8.64%. At every time point, those who did not survive exhibited markedly higher SOFA scores and serum lactate values. On admission, mean SOFA scores were 11.00 ± 1.29 in non-survivors versus 3.69 ± 1.59 in survivors, while lactate concentrations were 5.97 ± 1.19 versus 2.82 ± 0.63 mmol/L (both $p < 0.001$). By 72 hours, these differences had widened further: SOFA 12.14 ± 1.68 versus 2.76 ± 1.55 and lactate 7.43 ± 1.29 versus 1.78 ± 0.38 mmol/L (both $p < 0.001$). Among survivors, lactate fell progressively, reaching a 34.0% reduction by 72 hours, whereas non-survivors demonstrated a persistent upward trajectory. Both admission SOFA score and admission lactate achieved high discriminatory accuracy for mortality on ROC analysis. Requirement for mechanical ventilation and a delay in presentation exceeding 6 hours were each independently linked to fatal outcome. **Conclusion:** Tracking SOFA scores and serum lactate serially offers straightforward, practical and accessible tools for risk stratification in acute poisoning. When either parameter fails to show improvement within the first 72 hours, this trajectory signals a high probability of death and warrants immediate intensification of management.

INTRODUCTION

Acute poisoning contributes substantially to avoidable morbidity and death across low- and middle-income countries. Within rural India, pesticide ingestion ranks among the most frequent indications for emergency attendance and critical care admission. Organophosphate compounds occupy a disproportionate share of these cases, driven by their low purchase cost and unrestricted access in farming communities.[1]

Timely and objective bedside risk assessment is central to appropriate triage, efficient allocation of limited intensive care resources, and meaningful

communication with families. Multiple organ dysfunction scoring tools have been explored in this context. Among them, the Sequential Organ Failure Assessment (SOFA) score, which grades the extent of failure across six distinct organ systems, has demonstrated utility in predicting death in poisoned patients managed in intensive care settings. Serum lactate, which reflects the adequacy of tissue oxygenation and serves as a surrogate marker for impaired aerobic metabolism, is technically straightforward, affordable, and amenable to repeated bedside measurement.[2]

The existing literature has largely evaluated these markers at a solitary time point, typically on hospital arrival. Yet acute poisoning follows a dynamic clinical trajectory in which events over the initial 48–72 hours often carry greater prognostic weight than any single admission measurement. Reliance on a single baseline assessment therefore risks underestimating the full prognostic signal embedded in serial trends. Therefore, this study evaluated to determine how well repeated measurements of SOFA score and serum lactate, obtained at admission, 24 hours, and 72 hours, predict in-hospital death in patients with acute poisoning admitted to a tertiary care intensive care unit.[3]

MATERIALS AND METHODS

Study design and setting: The investigation was carried out as a prospective observational study within the medical intensive care unit of a tertiary teaching hospital. Ethical clearance was obtained from the Institutional Ethics Committee prior to enrolment, and written informed consent was secured from every participant or, where the patient was incapacitated, from an accompanying immediate relative.

Participants: Adults aged 18 years or above presenting with a confirmed acute poisoning event were considered eligible for inclusion on a consecutive basis. Exclusion criteria comprised pre-existing chronic systemic disease known to independently impair organ function, current pregnancy, self-discharge against medical advice, and transfer out of the unit before the 72-hour observation window was complete. After applying these criteria, 81 participants were enrolled.

Data collection

Using a standardised case record form, the following information was collected for each participant: sociodemographic profile, nature of the offending agent, mechanism and route of exposure, interval from exposure to hospital arrival, and Glasgow Coma Scale score at the time of assessment. SOFA scoring and venous serum lactate estimation were performed at three pre-specified intervals: immediately on admission (hour 0), at 24 hours, and at 72 hours. Additional endpoints documented included the need for mechanical ventilatory support, length of intensive care unit stay, total duration of hospitalisation, and final disposition (discharged alive versus died in hospital).

Statistical analysis

All analyses were performed using commercially available statistical software. Normally distributed continuous data are presented as mean ± standard deviation; skewed data were summarised as medians with interquartile ranges. Categorical variables are reported as frequencies and proportions. Survivor and non-survivor groups were compared with respect to continuous variables using the independent-samples t-test (parametric) or the Mann-Whitney U test (non-parametric) as dictated by the distribution, and with respect to categorical variables using the chi-square test or Fisher exact test. The ability of the admission SOFA score and admission lactate to discriminate in-hospital death was quantified through area under the ROC curve analysis. Statistical significance was defined as a two-tailed p value of less than 0.05 throughout

RESULTS

Baseline characteristics

The enrolled cohort comprised 81 patients. Their mean age was 45.3 ± 16.4 years (range 18–74 years), with the 21–40-year age bracket being the most represented (34 patients, 42.0%). Males outnumbered females (50 versus 31; 61.7% versus 38.3%). A rural background was documented in 61.7% of participants. Regarding the type of toxic exposure, organophosphates were the most prevalent agent (61 patients, 75.3%), followed by carbamates (14 patients, 17.3%) and pyrethroids (6 patients, 7.4%). Intentional self-poisoning was reported in 69 cases (85.2%), while the remaining 12 (14.8%) were accidental; 72 patients (88.9%) had ingested the poison orally. A comprehensive overview of baseline demographic and clinical features is provided in [Table 1].

Table 1: Baseline demographic and clinical characteristics of the study population (N = 81)

Characteristic	Category	n (%)
Age group (years)	≤ 20	3 (3.7)
	21 - 40	34 (42.0)
	41 - 60	23 (28.4)
	> 60	21 (25.9)
Sex	Male	50 (61.7)
	Female	31 (38.3)
Residence	Rural	61 (75.3)
	Urban	20 (24.7)
Type of poison	Organophosphate	61 (75.3)

ISSN (O): 2687-5365; ISSN (P): 2753-6556

	Carbamate	14 (17.3)
	Pyrethroid	6 (7.4)
Mode of poisoning	Intentional	69 (85.2)
	Accidental	12 (14.8)
Route of exposure	Oral	72 (88.9)
	Inhalational	9 (11.1)
Time to presentation	≤ 2 hours	25 (30.9)
	> 2 - 6 hours	49 (60.5)
	> 6 hours	7 (8.6)
Mechanical ventilation	Required	21 (25.9)
	Not required	60 (74.1)
Outcome	Discharged	74 (91.4)
	Died	7 (8.6)

Values are presented as number (percentage). Mean age 45.3 ± 16.4 years (range 18 - 74 years).

Outcome

Of the 81 patients, 74 (91.36%) survived to hospital discharge while 7 (8.64%) died during the index admission. Mechanical ventilation was instituted in 21 patients (25.9%). The mean duration of intensive care unit stay was 6.7 ± 2.5 days, and mean overall hospitalisation lasted 11.0 ± 4.4 days.

SOFA score and serum lactate by outcome

Across all three assessment time points, patients who died consistently displayed substantially higher SOFA scores and serum lactate concentrations than those who survived. On admission, non-survivors recorded a mean SOFA score of 11.00 ± 1.29 compared with 3.69 ± 1.59 in survivors; corresponding lactate values were 5.97 ± 1.19 versus 2.82 ± 0.63 mmol/L (both $p < 0.001$). These inter-group gaps became more pronounced as follow-up extended: at 72 hours, SOFA scores were 12.14 ± 1.68 in non-survivors versus 2.76 ± 1.55 in survivors, and lactate values were 7.43 ± 1.29 versus 1.78 ± 0.38 mmol/L (both $p < 0.001$). Serial numerical data are tabulated in [Table 2]; the temporal trajectories for each group are depicted graphically in [Figure 2].

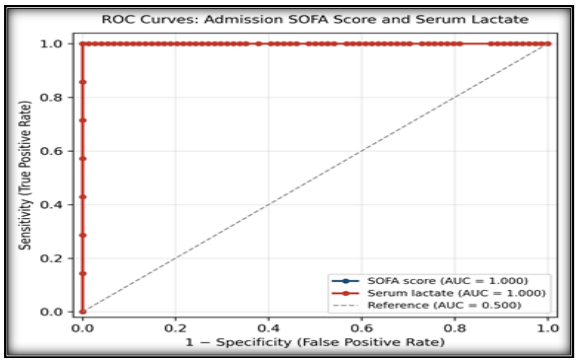

Figure 1: Receiver operating characteristic (ROC) curves for admission SOFA score and admission serum lactate in predicting in-hospital mortality.

ROC analysis based on 81 patients (7 deaths). Both admission parameters showed excellent discrimination between survivors and non-survivors in the study cohort.

In the survivor group, lactate declined in a stepwise fashion, registering mean reductions of 29.5% by 24 hours and 34.0% by 72 hours relative to admission values. Non-survivors, by contrast, showed no such clearance; their lactate continued to climb throughout the observation period. A comparable pattern of divergence was evident in the SOFA score trajectories, which trended downward in survivors while continuing to rise in those who ultimately died.

Discriminatory performance

ROC curve analysis confirmed that both the admission SOFA score and admission serum lactate demonstrated strong discriminatory performance for in-hospital mortality within this cohort. [Figure 1] Notably, the distributions of admission SOFA scores in survivors and non-survivors showed no overlap; an identical finding held for admission lactate. This complete separation of values between outcome groups underscores the exceptional predictive accuracy achievable with these readily available parameters in the study population.

Other factors associated with mortality

Requirement for invasive mechanical ventilation emerged as the factor most strongly associated with fatal outcome: all seven deaths occurred within the subgroup of 21 ventilated patients, and no fatality was observed among the 60 patients who did not require ventilatory support ($p < 0.001$). A delay in seeking medical attention was similarly prognostic; every recorded death occurred in patients who arrived more than 6 hours after the poisoning event ($p < 0.001$). Ventilated patients carried significantly higher admission SOFA scores (6.43 ± 3.52 versus 3.58 ± 1.66; $p = 0.002$) and admission lactate concentrations (4.16 ± 1.54 versus 2.72 ± 0.61 mmol/L; $p < 0.001$) than their non-ventilated counterparts. The intent behind poisoning (deliberate versus accidental) did not significantly influence clinical outcome ($p = 0.59$).

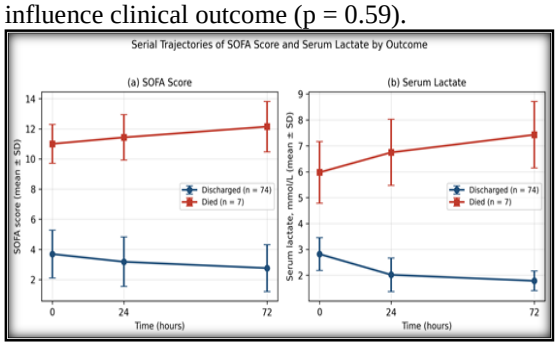

Figure 2: Serial trajectories of (a) SOFA score and (b) serum lactate at admission, 24 hours and 72 hours, by outcome group.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Data points represent group mean values; error bars represent one standard deviation. Survivors showed progressive improvement in both parameters, whereas non-survivors showed a rising trend.

Table 2: Serial SOFA score and serum lactate by outcome group

Parameter	Discharged (n = 74)	Died (n = 7)	p value
SOFA score, admission	3.69 ± 1.59	11.00 ± 1.29	< 0.001
SOFA score, 24 hours	3.18 ± 1.64	11.43 ± 1.51	< 0.001
SOFA score, 72 hours	2.76 ± 1.55	12.14 ± 1.68	< 0.001
Serum lactate, admission (mmol/L)	2.82 ± 0.63	5.97 ± 1.19	< 0.001
Serum lactate, 24 hours (mmol/L)	2.02 ± 0.64	6.74 ± 1.28	< 0.001
Serum lactate, 72 hours (mmol/L)	1.78 ± 0.38	7.43 ± 1.29	< 0.001
ICU stay (days)	7.0 ± 2.4	3.4 ± 1.4	—
Hospital stay (days)	11.6 ± 4.0	4.3 ± 1.5	—

Values are presented as mean ± standard deviation. p values for SOFA score and serum lactate were obtained using the Mann-Whitney U test. SOFA, Sequential Organ Failure Assessment; ICU, intensive care unit.

DISCUSSION

This prospective observational study, involving 81 acutely poisoned patients managed in an intensive care setting, demonstrates that both the SOFA score and serum lactate function as robust and independent predictors of in-hospital death. Serial measurements significantly enhanced prognostic utility. Non-survivors were distinguished not only by higher initial values, but by a distinct lack of improvement over the first 72 hours observation window.[4]

An overall case fatality rate of 8.64% in our cohort is consistent with figures reported from comparable Indian and international series examining poisoning-related intensive care admissions. Balmuchu et al,[5] studying a series of organophosphate-poisoned patients, similarly observed that both the SOFA score and serum lactate predicted outcome, with fatal cases exhibiting higher values at all measured intervals. Kim et al,[6] working with a larger organophosphate-poisoned intensive care cohort, reported that the SOFA score outperformed the APACHE II and SAPS II severity indices in terms of ease of application while maintaining comparable prognostic accuracy. Our data align with and extend these prior observations by demonstrating that the inter-group separation in both markers becomes progressively more prominent with each successive measurement, highlighting the particular value added by repeated over single-point assessments.[7]

Serum lactate is a functional index of the mismatch between oxygen supply and cellular metabolic demand at the tissue level. In the context of acute poisoning, lactate may accumulate through several concurrent mechanisms: respiratory insufficiency leading to hypoxaemia, haemodynamic compromise reducing tissue perfusion, convulsive activity increasing metabolic load, or direct mitochondrial toxicity from the offending agent. The contrasting lactate trajectories observed here — sustained clearance in survivors versus a relentlessly rising trend in non-survivors — are conceptually consistent with the well-established role of lactate clearance as a real-time indicator of resuscitation effectiveness in the broader critically ill population. A single admission lactate, though informative, inherently fails to capture these temporal dynamics; serial measurement, as employed in the present study, therefore contributes prognostic information that cannot be obtained from any solitary measurement.[8]

The robust associations between mechanical ventilatory support, prolonged pre-hospital delay, and mortality are clinically interpretable. Patients who arrive late and those who require assisted ventilation inherently represent a more toxicologically severe subgroup, and their disproportionately elevated admission SOFA scores and lactate concentrations reflect this greater physiological burden. These findings clinically suggest: an elevated or non-declining SOFA score or lactate level — especially in a ventilated or late-presenting patient — should serve as a trigger for urgent reassessment and escalation of therapeutic intensity.[9]

The practical limitations of the study are, single-centre design and relatively modest enrolment restrict the generalisability of the findings, and the small absolute number of deaths constrains the precision of the discriminatory estimates and renders formal multivariable regression impractical. Furthermore, as organophosphate poisoning accounted for the large majority of cases, the predictive performance of these parameters for other toxicological agents cannot be directly inferred from these data. Multicentre investigations with larger and more heterogeneous samples will be required to establish validated threshold values for serial SOFA scores and lactate across the broader spectrum of acute poisoning.[10]

CONCLUSION

Repeated assessment of the SOFA score and serum lactate over the first three days of hospitalisation constitutes an accessible, affordable, and operationally simple method for stratifying mortality risk in patients with acute poisoning. Elevated values on admission are independently prognostic, but the most discriminating information is derived

ISSN (O): 2687-5365; ISSN (P): 2753-6556

from the failure of either parameter to improve by 72 hours, which consistently identified the highest-risk individuals in this cohort. Integrating this serial monitoring approach into routine intensive care practice may facilitate earlier recognition of patients destined for deterioration and enable more timely intensification of supportive management.

Acknowledgments

The authors gratefully acknowledge the nursing and paramedical staff of the intensive care unit for their invaluable support during data acquisition.

REFERENCES

1. Mew EJ, Padmanathan P, Konradsen F, et al. The global burden of fatal self-poisoning with pesticides 2006-15: systematic review. J Affect Disord. 2017;219:93-104.
2. Peter JV, Sudarsan TI, Moran JL. Clinical features of organophosphate poisoning: a review of different classification systems and approaches. Indian J Crit Care Med. 2014;18(11):735-745.
3. Eddleston M, Buckley NA, Eyer P, Dawson AH. Management of acute organophosphorus pesticide poisoning. Lancet. 2008;371(9612):597-607.
4. Vincent JL, Moreno R, Takala J, et al. The SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. Intensive Care Med. 1996;22(7):707-710.
5. Ferreira FL, Bota DP, Bross A, Melot C, Vincent JL. Serial evaluation of the SOFA score to predict outcome in critically ill patients. JAMA. 2001;286(14):1754-1758.
6. Kim YH, Yeo JH, Kang MJ, et al. Performance assessment of the SOFA, APACHE II scoring system, and SAPS II in intensive care unit organophosphate poisoned patients. J Korean Med Sci. 2013;28(12):1822-1826.
7. Balmuchu G, Mohanty MK, Sahu MR, Hansda U, Naveen A, Lenka PK. Outcome prediction using sequential organ failure assessment (SOFA) score and serum lactate levels in organophosphate poisoning. J Family Med Prim Care. 2023;12(4):777-782.
8. Peter JV, Thomas L, Graham PL, et al. Performance of clinical scoring systems in acute organophosphate poisoning. Clin Toxicol (Phila). 2013;51(9):850-854.
9. Nguyen HB, Rivers EP, Knoblich BP, et al. Early lactate clearance is associated with improved outcome in severe sepsis and septic shock. Crit Care Med. 2004;32(8):1637-1642.
10. Sekhar S, Pratap V, Gaurav K, et al. The value of the Sequential Organ Failure Assessment (SOFA) score and serum lactate level in sepsis and its use in predicting mortality. Cureus. 2023;15(7):e42683..

ISSN (O): 2687-5365; ISSN (P): 2753-6556