

Comparison of the Poisoning Severity Score, Sequential Organ Failure Assessment Score, and Acute Physiology and Chronic Health Evaluation II Score with Lactate to assess the outcome in Acute Organophosphorus Poisoning

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ABSTRACT

Introduction: Organophosphorus pesticide self-poisoning is estimated to kill around 200000 people yearly. Early recognition is life-saving as the mortality rates are high following OP Poisoning. Acute Physiology and Chronic Health Evaluation II Score (APACHE II) Sequential Organ Failure Assessment Score (SOFA), and Poisoning Severity Score (PSS) with Lactate, are used to evaluate the prognosis.

Materials and Methods: This prospective observational study included 236 individuals with acute OP poisoning who presented to the emergency department and were hospitalized in the critical care unit and step-down ICU. PSS, SOFA, and APACHE II scores were calculated at Emergency Department and followed up with the patient until discharge or death.

Results and Discussion: Patients had a mean age of 32.8 ± 13.4 years and were 49.2% female and 50.8% male. Out of 236 patients, 22 patients died and 214 were discharged. The best cut-off values for predicting mortality with PSS, SOFA, and APACHE II scores were 2, 3, and 15, with AUROC of 0.929, 0.970, and 0.984. In addition to Lactate to the above scores, the AUROC increased to 0.981, 0.993, and 0.992, respectively. The study found that SOFA and APACHE II scores with Lactate are significantly associated with mortality and have strong discriminative power in predicting mortality.

Keywords: Acute Physiology and Chronic Health Evaluation II, clinical outcome, lactate, Organo phosphorus poisoning, Poisoning Severity Score, Sequential Organ Failure Assessment score.

INTRODUCTION

Organo-phosphorus (OP) pesticide self-poisoning is estimated to kill around 200000 people annually, mainly in Asia, and it predominantly occurs in rural communities. as the mortality rates are high following OP

Poisoning, early recognition is life-saving in severe cases.^[1]

The principal pharmacological action of all Organo-phosphorus compounds is the inhibition of acetyl-cholinesterase; most patients die from cardiorespiratory failure.

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However, there is much variation in the timing of onset and clinical features depending on the particular OP. [2]

Many scoring systems are being implemented to appropriately measure the severity and prognosis of OP Poisoning patients. [1] Three scores are extensively used to assess the prognosis of severe patients. Several studies have demonstrated that they can be utilized to measure the severity of AOPP patients. However, the diagnostic efficacy varies. [3-5]

The Poison Severity Score (PSS) was developed by the International Program on Chemical Safety (IPCS), the European Community, and the European Association of Poisons Centers and Clinical Toxicologists to create a scoring system that produces a qualitative evaluation of the morbidity caused by different types of poisoning. [6]

The Acute Physiology and Chronic Health Evaluation II (APACHE II) score, a regularly used clinical scoring approach created by Knaus et al., may be used to evaluate the severity and prognosis of acute critical disorders. [7] Additionally, the Europe intensive care unit's sequential organ failure assessment (SOFA) score is used for assessing organ damage and predicting death in critical patients and has the advantages of being objective, reliable, straightforward, and easy to obtain. [8]

Arterial lactate (Lac) level has been identified as a valuable biomarker for assessing tissue microcirculation status. [9] AOPP increases acetylcholine accumulation, which results in a range of muscarinic, nicotine, and central nervous system symptoms, as well as a change in microcirculation state. [10]

OBJECTIVE

To assess the prognosis in Acute Organophosphate Poisoning patients using the Poison Severity Score (PSS), Acute Physiology and Chronic Health Evaluation II (APACHE II) score, Sequential Organ Failure Assessment (SOFA) score, and Lactate.

MATERIALS AND METHODS

This prospective observational study included 236 patients who presented to the Emergency Department with Acute Organo-Phosphorous Poisoning and were admitted to a tertiary care hospital (Sri Devraj Urs Medical College Hospital, Karnataka, India) between January 2020 and December 2021, after excluding the 12 patients who were lost to follow-up during the study. The sample size for a cross-sectional study was estimated based on the high diagnostic accuracy of the PSS score 81.1% (AUC) in a cross-sectional study (The evaluation of acute physiology and chronic health evaluation II score, poisoning severity score, sequential organ failure assessment score combine with lactate to assess the prognosis of the patients with acute organophosphate pesticide poisoning) by with precision of 5% estimated sample size will be 236.

Inclusion Criteria

1. Patients of age group more than 18 years
2. Patient with a history of Organo-Phosphorus compound consumption

Exclusion Criteria

1. Patients discharged against medical advice
2. Pregnant women with poisoning

We obtained the following information from the patient at the emergency room after the inclusion and exclusion criteria were met. OP Compound Type, Intake quantity, Time interval between consumption and presentation, Vital Signs, Glasgow Coma Scale (GCS), Routine Blood Investigations, Arterial Blood Gas, Serum Pseudo Cholinesterase levels, ICU, ward, and ventilator days. We calculated the PSS, SOFA score, and APACHE II scores at the emergency department and followed up with patients until discharge or death from the hospital.

Statistical analysis

The data were entered into a Microsoft Excel data sheet and analyzed with SPSS 22 (IBM

SPSS Statistics, Somers, NY, USA) software. Frequencies and proportions were used to represent categorical data. The chi-square test or Fischer's exact test (for 2x2 tables only) was employed as a significance test for qualitative data. The mean and standard deviation were used to describe continuous data. To determine the mean difference between two quantitative variables, an Independent t-test was utilized as a significance test. The receiver operating characteristic (ROC) and appropriate cut-off points were utilized to calculate sensitivity, specificity, and positive and negative predictive values. A test that predicts an outcome no better than chance has an area under the ROC curve of 0.5. An area under the ROC curve above 0.8 indicated a reasonably good prediction. **P-value** of <0.05 was considered statistically significant after assuming all the rules of statistical tests.

RESULTS

In our study, 236 individuals with Organo Phosphorus poisoning above 18 were included, with a mean age of 32.8 ± 13.4 years. Men accounted for 50.8% of the total (n=120), while women accounted for 49.2% (n=116). 42 were admitted to the intensive care unit, and 194 were admitted to the step-down intensive care unit. There were 22 deaths among the 236 patients, and 214 were discharged. The average period between intake and presentation was three hours (range 1–5 h). Out of 236 individuals, chlorpyrifos (62) is

the most common type of OP compound ingested, followed by Dichloroovas (38) and Profenophos (36) (Table 1).

Patients were divided into two groups based on their outcomes: survivors (N=214) and non-survivors (N=22). The baseline characteristics of the two groups are shown in Table 1. Lactate, APACHE II score, PSS, and SOFA score were substantially higher (P.05) in the Non-survival group, whereas GCS and pseudo cholinesterase levels were significantly lower (P.05).

The mean PSS, SOFA score, APACHE II scores, and Lactate among those discharged were 1, 1, 5, and 3, respectively. The mean PSS, SOFA score, APACHE II score, and Lactate among those who died were 3, 7, 28, and 9, respectively (Table 1). In our study, the mean PSS, SOFA, APACHE II, and Lactate scores were considerably higher in the deceased than in the living (Table 2).

For mortality prediction, the predictive accuracies of the PSS, SOFA score, and APACHE II score were assessed using receiver operator characteristic (ROC) curves. The best cut-off points for predicting mortality in Acute Organophosphate Poisoning patients were 2, 3, and 15, with a sensitivity of 95.45%, 95.45%, 95.45%, and specificity of 91.12%, 91.59%, and 95.79%, respectively. (Table 2) In the PSS, SOFA, and APACHE II scores, the area under the AUROC curve was 0.929, 0.970, and 0.984, respectively. (Figure 1)

Table 1: Characteristics of survivors and non-survivors.

Characteristics	Survivors		Non-Survivors		P Value
	Mean	SD	Mean	SD	
Age (years)	33	13	37	18	0.186
Amount (ml)	72	34	134	51	0.001*
MAP (mm of Hg)	88	12	75	21	0.012*
GCS	14	1	7	3	0.001*
Serum Pseudo Cholinesterase	837	397	384	235	0.001*
PSS SCORE	1	1	3	1	0.001*
SOFA SCORE	1	2	7	3	0.001*
APACHE II SCORE	5	5	28	9	0.001*
LACTATE	3	2	9	3	0.001*

The best cut-off values for predicting death in patients with Acute Organophosphate Poisoning were 8, 11, and 19, with sensitivity of 95.45%, 95.45%, and 100%, and specificity of 96.26%, 98.13%, and 95.79%, respectively, for PSS, SOFA, and APACHE II scores in addition to Lactate. (Table 3) The areas under the ROC curves for the PSS, SOFA, and APACHE II scores with Lactate were 0.981, 0.993, and 0.992, respectively. (See Fig. 2)

Adding Lactate to the PSS, SOFA, and APACHE II scores for mortality prediction in Acute Organophosphate Poisoning patients increases the AUROC curve from 0.929, 0.970, and 0.984 to 0.981, 0.993, and 0.992, respectively. PSS-Lac, SOFA-Lac, and APACHE II-Lac had better AUROC, Sensitivity, Specificity, Positive Predictive Value, and Negative Predictive Value in predicting mortality than PSS, SOFA score, and APACHE II.

Table 2: Comparison of the PSS, SOFA, and APACHE II scores in predicting the outcome

Scores	C u t off	Sensitivity (%)	Specificity (%)	+PV (%)	-PV (%)	AUROC	95% CI b	P value
PSS SCORE	2	95.45	91.12	52.5	99.5	0.929	0.889 to 0.958	0.001*
SOFA score	3	95.45	91.59	53.8	99.5	0.970	0.940 to 0.988	0.001*
APACHE II score	15	95.45	95.79	70.0	99.5	0.984	0.958 to 0.996	0.001*

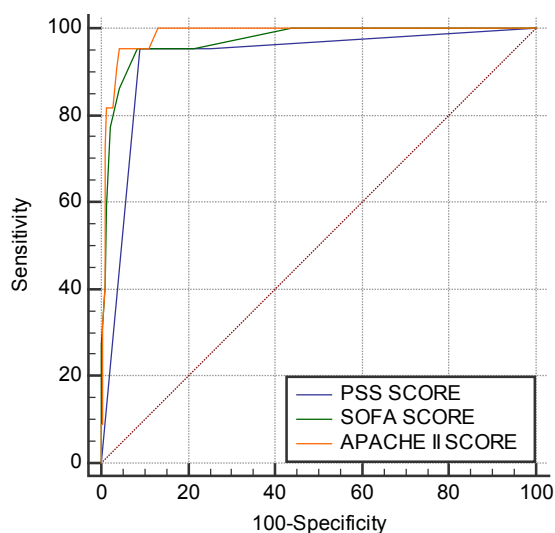


Fig. 1: Comparison of ROC curve for PSS, SOFA, and APACHE II scores in predicting mortality.

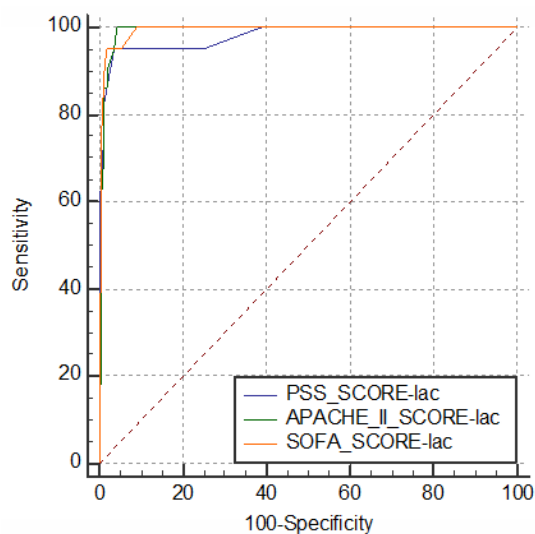


Fig. 2: Comparison of ROC curve for PSS, SOFA, and APACHE II scores in predicting mortality after combining with Lactate.

Table 3- Comparison of the PSS, SOFA, and APACHE II scores with Lactate in predicting the outcome

Scores	Cut off	Sensitivity (%)	Specificity (%)	+PV (%)	-PV (%)	AUROC	95% CI b	P value
PSS Lac	8	95.45	96.26	72.4	99.5	0.981	0.954 to 0.994	0.001*
SOFA Lac	11	95.45	98.13	84	99.5	0.993	0.971 to 0.999	0.001*
APACHE II Lac	19	100	95.79	71.0	100	0.992	0.970 to 0.999	0.001*

DISCUSSION

According to the findings, all three scores did well in predicting clinical outcomes due to acute OP poisoning. However, when Lactate was added to the scores, all three showed improvement. Out of 236 acute OP-poisoned patients, 50.8% were men (n=120), and 49.2% were women (n=116), with a mean age of 32.8 years. Yuan S et al.'s study comprised 59 individuals with a mean age of 56, with 54% of the samples being men and 46% women. ^[10]

In our study, the mean PSS, SOFA, and APACHE II score among individuals discharged were 1, 1, and 5, respectively, and Among expired patients, 3, 7, and 28. According to Yuan S et al.'s study, Discharged patients had PSS, SOFA, and APACHE II scores of 2, 2, and 10, respectively; among expired patients, it was 4, 8, and 24. ^[10] According to Kim Y H et al. study, discharged patients had mean SOFA and APACHE II scores of 3 and 9.2, respectively. There were 6.7 and 13.3, respectively, among the deceased. ^[3]

The AUROC for predicting mortality in patients with Acute Organophosphate Poisoning with PSS, SOFA, and APACHE II scores was 0.929, 0.970, and 0.984, respectively, in our research. The AUROCs of the PSS, SOFA, and APACHE II scores, according to Yuan S et al., were 0.811, 0.837, and 0.876, respectively. ^[10] In the Kim Y H et al. study, the AUROC of SOFA and APACHE II scores were 0.70 and 0.76, respectively. ^[3]

The AUROC for predicting mortality in Acute Organophosphate Poisoning patients with PSS, SOFA score, and APACHE II scores in addition to Lactate was 0.981, 0.993, and 0.992, respectively, in our study. The AUROCs of the PSS, SOFA score, and APACHE II score with Lactate were 0.878, 0.956, and 0.922, respectively, according to Yuan S et al. ^[10]

PSS, SOFA, and APACHE II scores performed well in our study compared to other studies; however, SOFA and APACHE II scores with Lactate had high prediction rates compared to others.

CONCLUSION

Eventually, the SOFA and APACHE II scores with Lactate are significantly associated with mortality and exhibit great discriminative power in predicting death in acute organophosphorus poisoning patients.

Conflict of Interest: None

Source of Funding: Self

Ethical Clearance: This research has received ethical approval from Sri Devraj Urs Medical College Institutional Ethical Committee with Number SDUMC/KLR/IEC/241/2019-2020

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