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Original Research Article

Prognostic Markers of Insecticidal Poisoning : A One Year Institution Based Cross Sectional Study in Bundelkhand Region

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Abstract :

Background : Organophosphorus compounds (OPC) are widely used as pesticides and are a leading cause of poisoning in rural India. This study aimed to identify clinical and biochemical parameters influencing prognosis and duration of hospital stay in OPC poisoning cases.

Materials and Methods: A cross-sectional study was conducted over one year on patients with acute OPC poisoning admitted to the emergency ward and ICU of a tertiary hospital in Bundelkhand. Demographic, clinical, and laboratory parameters were collected retrospectively. Severity was assessed using the Peradeniya Organophosphorus Poisoning (POP) scale. Statistical analysis was performed using SPSS 26.0.

Results: Of 106 patients, 97 met inclusion criteria. Mean age was 34.2 ± 11.4 years; 59.8% were male. Mean ingestion-to-presentation interval was 3.8 ± 2.7 hours, and mean POP score was 2.8 ± 1.9. Longer hospital stay was significantly associated with low pH (p = 0.014), high lactate (p = 0.020), elevated serum sodium (p = 0.004), higher POP score (p = 0.002), and need for invasive ventilation (p = 0.005). Mortality occurred in 11 patients (11.3%) and was significantly linked to low pH (p = 0.039), hypokalemia (p = 0.015), elevated total leukocyte count (p = 0.021), raised SGOT (p = 0.016), SGPT (p = 0.012), and blood urea (p = 0.001). Blood urea had the strongest predictive value for mortality (AUROC 0.811).

Conclusion: Metabolic acidosis, electrolyte imbalance, elevated hepatic and renal markers, and high POP scores are significant predictors of outcome in OPC poisoning. Early recognition and monitoring of these parameters can improve management and reduce mortality.

***Keywords**:* organophosphorus compounds; poisoning; prognosis; hospital stay; mortality; biomarkers; peradeniya score.

Introduction

Organ phosphorus compounds (OPC) are used as pesticides in farming as well as household and community pest control and are responsible for about 740,000 unintentional pesticide poisonings, resulting in 7446 deaths across 141 countries and approximately 258,234 deaths each year globally with intentions of self-harm.[1][2] The problem is more pronounced in rural agricultural areas of developing countries of south Asia like India. Incidence rate of use of organophosphate for suicidal poisoning in India ranges from 10.3% to 43.8%.[3] According to a study conducted in state Uttar Pradesh the relationship between suicidal to accidental organophosphate poisoning in rural areas is 2.4:1 and in urban areas is 3.7:14.[4] The organo-phosphate compounds on the basis of their chemical differences are divided into phosphates, phosphorothioates, phosphoramidates, phosphonates and others with most common

being phosphorothioates and need biotransformation for their biological activity which occurs mostly but not exclusively in liver by the cytochrome enzymes.[5] The organophosphate compound poisoning occurs via exposure to skin, ingestion or inhalation of the substances.

As most of organs of body have acetylcholine receptors, a "cholinergic syndrome" develops, which may include increased sweating, salivation, increased bronchial secretion, bronchoconstriction, miosis, increased gastrointestinal motility, loose stools, tremors, muscular twitching, and various central nervous system effects like seizures and may cause death due to respiratory failure due to inhibition of respiratory centres in the brain stem, bronchoconstriction and increased bronchial secretion, and flaccid paralysis of respiratory muscles.[6] Early treatment in the form of decontamination by removing the cloths, washing the skin with soap and water.[7] The first signs and symptoms to develop are muscarinic which may or may not be accompanied by nicotinic depending upon dose, duration and type compound consumed. Early identification of these signs and symptoms and then aggressive management has been found to reduce morbidity and mortality in these patients and reducing the total duration of hospital stay.[7] Several clinical such as Peradeniya Organophosphorus Poisoning (POP) scale as well as laboratory parameters have been studied and used for the prediction of prognosis in organophosphate poisoning patients.[8] The aim of this study is to determine the parameters which affect the clinical outcome and well as duration of in hospital stay of organophosphate poisoning patients.

Materials and Methods

Present study is a cross-sectional study. Data of patients with acute insecticidal poisoning who were admitted to the emergency ward and intensive care unit ofour institution from January 2023 to December 2023 was collected retrospectively from the bed head ticket records(BHT), including age,sex, type of compound, time interval from consumption to hospital admission, time of shock, use of ventilator support, development of cardiac events (if any). Patients were clinically scored for severity on Peradeniya Organophosphorus Poisoning (POP) scale.

The pH value of blood, arterial blood carbon dioxide partial pressure (PaCO2), arterial partial pressure of oxygen (PaO2), lactate levels (Lac), serum albumin (Alb), total bilirubin, alanine aminotransferase (ALT), serum creatinine (Cr), serum potassium (K), serum calcium (Ca), serum sodium (Na), blood chloride (Cl), serum troponin I (cTNI), white blood cell count (WBC), haemoglobin (Hb), platelet count (Plt), and other laboratory parameters of patients were also collected. Duration of hospital stay, and the time of death (if any) are also recorded.

Inclusion Criteria: (1) age >18 years old (2) Patients meeting the criteria of organophosphate poisoning, i.e., with a clear history of exposure to organophosphate compound, muscarinic symptoms, such as miosis, increased salivation, diarrhoea, vomiting and increased respiratory secretions, and nicotinic symptoms, such as weakness and fasciculation, which could be significantly improved by intravenous atropine administration.

Exclusion Criteria: (1) Patients with malignancy or pregnant patients; (2) Patients who were admitted to the hospital >24 h after poisoning; (3) Patients who gave up treatment within 24 hours. (4) Patients with incomplete clinical and laboratory data.

Statistical Analysis: SPSS 26.0 statistical software was used for the statistical analysis of the data. The measurement data with normal distribution were expressed as $x \pm s$, and the independent sample t-test was used to compare the two groups. The data without normal distribution were expressed as M (P25, P75), and the Wilcoxon rank-sum test was used to compare the two groups. The categorical data were expressed as the case (%), and the chi-square test was used to compare the two groups. A $p < 0.05$ was considered statistically significant.

Results

A total of 106 patients were admitted to our hospital for insecticidal poisoning. Nine

patients were excluded, including 3 patients younger than 18 years and 6 patients with incomplete or lost medical information. Finally, 97 patients with insecticidal poisoning who met all the inclusion criteria of our study were included. There were 58 men and 39 women, with the median age of34.24 ± 11.42 years. All 97 patients were exposed to insecticide orally. The mean Ingestion to Presentation Interval (Hours) was 3.83 ± 2.70. The mean Peradeniya Score was 2.76 ± 1.89.70 (72.2%) of the participants had Peradeniya Score Category: 0 to 3. 26 (26.8%) of the participants had Peradeniya Score Category: 4 to 7. 1 (1.0%) of the participants had Peradeniya Score 9.[Table 1

We studied prognosis of insecticidal poisoning in the form of duration of hospital stay and death. Out of allclinical and laboratory parameters studied pH, Lactate, S. Na (mEq/L), Peradeniya Score andinvasive ventilation requirement were significantly associated ($p<0.05$) with the duration of hospital Stay in days. [Table 2]

Table 1: General Clinical Data of 97 Patients with Insecticidal Poisoning

Basic Details	**Mean ± SD || Median (IQR) || Min-Max OR N (%)**
Age (Years)	34.24 ± 11.42 || 34.00 (25.00-45.00) || 15.00 - 65.00
Age	
<20 Years	8 (8.2%)
20-29 Years	31 (32.0%)
30-39 Years	27 (27.8%)
40-49 Years	16 (16.5%)
50-59 Years	14 (14.4%)
60-69 Years	1 (1.0%)
Gender	
Male	58 (59.8%)
Female	39 (40.2%)
Ingestion to Presentation Interval (Hours)	3.83 ± 2.70 || 3.30 (1.98-5.14) || 0.48 - 14.00
Peradeniya Score	2.76 ± 1.89 || 3.00 (1.00-4.00) || 0.00 - 9.00
Peradeniya Score Category	
0 to 3	70 (72.2%)
4 to 7	26 (26.8%)
8 to 11	1 (1.0%)

Table 2: Summary Table for Association between Duration of Stay (Days) and Parameters

Parameters	Duration of Stay (Days)	p value
Age (Years)	Correlation Coefficient (rho) = -0.05	0.632[1]
Gender		0.350[3]
Male	2.91 ± 2.14	
Female	2.95 ± 2.96	
Ingestion to Presentation Interval (Hours)	Correlation Coefficient (rho) = -0.17	0.094[1]
pH* **	Correlation Coefficient (rho) = -0.25	0.014[1]
pCO2	Correlation Coefficient (rho) = 0.03	0.740[1]
pO2	Correlation Coefficient (rho) = 0.1	0.308[1]
Lactate* **	Correlation Coefficient (rho) = 0.24	0.020[1]
Chloride	Correlation Coefficient (rho) = 0.08	0.409[1]
S. Na (mEq/L)* **	Correlation Coefficient (rho) = 0.29	0.004[1]
S. K (mEq/L)	Correlation Coefficient (rho) = 0.06	0.537[1]
S. Ca (mg/dL)	Correlation Coefficient (rho) = 0.13	0.205[1]
Haemoglobin (g/dL)	Correlation Coefficient (rho) = -0.02	0.820[1]
TLC (/mm³)	Correlation Coefficient (rho) = 0.11	0.284[1]
Platelet Count (Lacs)	Correlation Coefficient (rho) = 0.07	0.515[1]
Total Bilirubin (mg/dL)	Correlation Coefficient (rho) = 0.06	0.568[1]
S. Albumin (g/dL)	Correlation Coefficient (rho) = -0.05	0.658[1]
SGOT (U/L)	Correlation Coefficient (rho) = 0.16	0.123[1]
SGPT (U/L)	Correlation Coefficient (rho) = 0.08	0.433[1]
Blood Urea (mg/dL)	Correlation Coefficient (rho) = 0	0.988[1]
S. Creatinine (mg/dL)	Correlation Coefficient (rho) = 0.18	0.073[1]
Peradeniya Score* **	Correlation Coefficient (rho) = 0.32	0.002[1]
Shock		0.692[3]
Yes	5.00 ± 5.66	
No	2.88 ± 2.43	
Ventilator* **	0.005[3]	
Yes	5.56 ± 3.32	
No	2.66 ± 2.24	
Death		0.687[3]
Yes	2.64 ± 2.06	
No	2.97 ± 2.55	

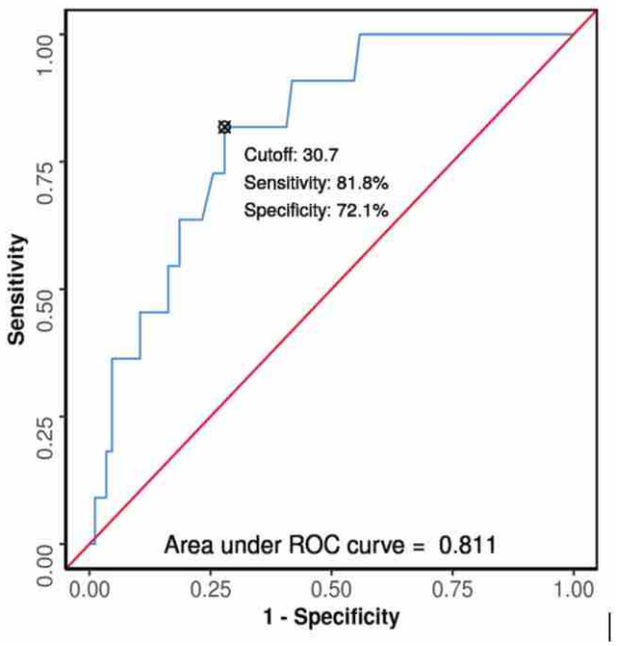
****Significant at p<0.05, 1: Spearman Correlation, 2: Kruskal Wallis Test, 3: Wilcoxon-Mann-Whitney U Test*
Among entire sample(97), there were 11 deaths.Out of all the parameters studied in our study pH, Sr.K (mEq/L), TLC (/mm³), SGOT (U/L), SGPT (U/L) and Blood Urea (mg/dL) were significantly associated (p<0.05) with mortality of patients.[Table 3]

Table 3: Summary Table for Association between Death and Parameters

Parameters	Death		p value
	Yes (n = 11)	No (n = 86)	
Age (Years)	36.00 ± 14.20	34.01 ± 11.10	0.673[1]
Gender			0.341[2]
Male	5 (45.5%)	53 (61.6%)	
Female	6 (54.5%)	33 (38.4%)	
Ingestion to Presentation Interval (Hours)	4.03 ± 2.56	3.80 ± 2.73	0.553[1]
pH* **	7.20 ± 0.22	7.32 ± 0.10	0.039[1]
pCO2	37.40 ± 11.86	37.79 ± 9.84	0.678[1]
pO2	90.59 ± 45.70	96.02 ± 49.68	0.621[1]
Lactate	3.95 ± 3.2	43.43 ± 2.23	0.923[1]
Chloride	115.64 ± 6.70	113.92 ± 10.56	0.442[1]
S. Na (mEq/L)	148.00 ± 12.14	149.31 ± 40.87	0.891[1]
S. K (mEq/L)* **	2.94 ± 0.42	3.34 ± 0.79	0.015[1]
S. Ca (mg/dL)	1.31 ± 0.55	2.46 ± 12.40	0.212[1]
Hemoglobin (g/dL)	11.75 ± 2.40	11.87 ± 2.82	0.793[1]
TLC (/mm³)* **	16218.18 ± 5943.37	10790.74 ± 7078.83	0.021[1]
Platelet Count (Lacs)	1.62 ± 1.02	1.72 ± 0.96	0.350[1]
Total Bilirubin (mg/dL)	0.58 ± 0.14	0.60 ± 0.38	.546[1]
S. Albumin (g/dL)	3.97 ± 0.38	4.47 ± 8.88	0.829[1]
SGOT (U/L)* **	73.70 ± 50.00	46.51 ± 48.70	0.016[1]
SGPT (U/L)* **	93.96 ± 137.70	35.22 ± 35.67	0.012[1]
Blood Urea (mg/dL)* **	37.36 ± 9.86	27.32 ± 11.56	0.001[1]
S. Creatinine (mg/dL)	1.36 ± 0.84	0.84 ± 0.39	0.190[1]
TROP I (Positive)	0 (0.0%)	0 (0.0%)	1.000[3]
Peradiniya Score	3.45 ± 1.92	2.67 ± 1.88	0.133[1]
Shock (Yes)	1 (9.1%)	1 (1.2%)	0.215[2]
Ventilator (Yes)	2 (18.2%)	7 (8.1%)	0.270[2]
Cardiac Event (Yes)	0 (0.0%)	0 (0.0%)	1.000[3]
Duration of Stay (Days)	2.64 ± 2.06	2.97 ± 2.55	0.687[1]

****Significant at p<0.05, 1: Wilcoxon-Mann-Whitney U Test, 2: Fisher's Exact Test, 3: Chi-Squared Test*
Among the parameters which were significantly associated with mortality, the overall best in terms of the area under the ROC curve (AUROC) was Blood Urea. AUROC For Blood Urea predicting Death: Yes, vs Death: No was 0.811 (95% CI: 0.696 - 0.926), thus demonstrating good diagnostic performance.At a cutoff of Blood Urea (mg/dL) ≥30.7, it predicted Death with a sensitivity of 82%, and a specificity of 72%.[Figure 1]

Figure 1: ROC Curve Analysis Showing Diagnostic Performance of Blood Urea (mg/dL) in Predicting Death (n = 97)



DISCUSSION

Organophosphate poisoning remains a major public health issue in developing countries like India, particularly in rural agricultural regions where these compounds are widely used and readily available. This retrospective study of 97 patients of insecticidal poisoning provides insight into the clinical and biochemical parameters associated with outcomes such as duration of hospital stay and mortality.

The majority of patients were young adults with a median age of 34.2 years and a male predominance (59.8%). This demographic trend aligns with previous studies that have noted high incidence among individuals of young-middle age, often due to psychosocial stressors leading to intentional ingestion.[9,10] The ingestion-to-presentation interval (mean 3.83 hours) was relatively short, suggesting prompt access to healthcare for most patients, which may have contributed to their favourable outcome.

Predictors of Hospital Stay

This study identified several significant predictors of prolonged hospital stay, including low pH (acidosis), elevated serum lactate, hypernatremia, higher Peradeniya Organophosphorus Poisoning (POP) scores, and the need for invasive ventilation. Metabolic acidosis and higher lactate levels reflect tissue hypoperfusion and hypoxia, which are indicative of more severe poisoning and systemic involvement. These findings are consistent with prior studies, where elevated lactate and acidosis have been associated with increased severity duration of hospital stay.[11,12]

Patients requiring ventilatory support had notably longer stays, reinforcing that respiratory compromise is a major determinant of the clinical course.[13]

Predictors of Mortality

Out of the 97 patients, 11 patients died (11.3%). Mortality was significantly associated with lower blood pH, hypokalaemia, elevated total leukocyte count (TLC), and increased SGOT, SGPTand blood urea. Among these, blood urea demonstrated the highest diagnostic accuracy for predicting mortalitymaking it a potentially valuable prognostic marker in clinical practice.

The elevated liver enzymes and blood urea levels suggest systemic toxicity and hepatic and renal involvement, which is a known complication in severe organophosphate poisoning.[14,15] Elevated TLC may indicate an acute systemic inflammatory response or stress-related leucocytosis, both of which have been previously associated with poor outcomes in acute poisonings.[16]

Interestingly, despite clinical expectations, factors such as gender, time to presentation, and serum creatinine did not significantly impact mortality or hospital stay. The lack of a statistically significant association between Peradeniya score and mortality (p=0.133) may be due to the relatively small number of deaths, limiting statistical power.

Conclusion

This study highlights that metabolic acidosis (low pH), elevated lactate, hypernatremia, higher Peradeniya scores, and need for mechanical ventilation are significantly associated with prolonged hospital stay in patients with organophosphate poisoning. In terms of mortality, key predictors include low pH,