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CLINICAL PROFILE AND SHORT-TERM OUTCOMES OF ACUTE ORGANOPHOSPHORUS POISONING IN A TERTIARY CARE HOSPITAL OF A TRIBAL REGION OF GUJARAT

Internal Medicine

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ABSTRACT

Background: Acute organophosphorus (OP) pesticide poisoning remains a critical public health challenge in rural and tribal regions of India, characterized by high morbidity and mortality due to delayed presentation and limited healthcare access.**Objective:** To evaluate the clinical profile, severity assessment, treatment outcomes, and prognostic factors in patients with acute OP poisoning admitted to a tertiary care hospital serving a predominantly tribal population in Gujarat.**Methods:** A prospective observational study was conducted from June 2024 to May 2025 at Zydus Medical College and Hospital, Dahod, Gujarat. Forty-five patients aged ≥15 years with confirmed OP poisoning presenting within 48 hours of exposure were enrolled. Clinical parameters, Peradeniya Organophosphorus Poisoning (POP) scale scores, serum cholinesterase levels, treatment interventions (atropine, pralidoxime, mechanical ventilation), and outcomes were recorded. Statistical analysis included descriptive statistics, chi-square tests, and t-tests.**Results:** The cohort comprised predominantly young adults (mean age 21–30 years) with male preponderance (male:female ratio >2:1). Most cases (82.2%) were classified as moderate severity by POP scale. Serum cholinesterase levels were markedly depressed (<1000 U/L) in 91.1% of patients. Overall mortality was 17.8% (8/45). Mechanical ventilation requirement was significantly associated with mortality (χ^2=17.81, p<0.0001). Lower Glasgow Coma Scale (GCS) scores at admission strongly predicted poor outcomes (t=-6.93, p<0.0001). Lower oxygen saturation (SpO_2), higher respiratory rates, and hypotension at presentation were significantly associated with mortality (p<0.05). Neither specific OP compound type nor POP severity grade showed statistically significant mortality differences in this cohort.**Conclusion:** Acute OP poisoning in tribal Gujarat predominantly affects young working-age males with significant mortality linked to neurological compromise, respiratory failure, and need for mechanical ventilation. Early recognition, rapid atropinisation, and timely ventilatory support are critical. GCS and vital parameters at admission serve as practical bedside prognostic indicators in resource-limited settings.

KEYWORDS

Organophosphorus Poisoning, Tribal Population, Gujarat, Mortality, Peradeniya Scale, Serum Cholinesterase, Mechanical Ventilation, Clinical Profile

INTRODUCTION

Acute organophosphorus (OP) pesticide poisoning continues to be a pressing public health concern, particularly in agrarian communities where these compounds are readily available for agricultural use[1]. The burden is especially pronounced in rural and tribal regions, where hospital data point to both high morbidity and preventable mortality due to delays in diagnosis, limited access to specialized care, and inadequate pre-hospital management[2]. OP compounds exert their toxic effects primarily by inhibiting acetylcholinesterase, which can precipitate a cholinergic crisis involving the cardiovascular, respiratory, and neurological systems[3].

Several hospitals across South Asia have documented that large numbers of acute poisoning cases admitted to tertiary care centers are related to either pesticides or pharmaceutical drug overdoses[3]. Within this spectrum of poisoning agents, OP insecticides occupy a critical position due to the severity of their clinical presentation and the rapid progression from mild symptoms to life-threatening complications such as respiratory failure[4]. Common early manifestations may include miosis, bradycardia, hypotension or hypertension, altered mental status, excessive salivation, and muscle fasciculations[5].

One fundamental challenge in managing OP poisoning lies in predicting disease progression when critical details such as exact dose ingested or route of exposure are unknown. Clinical scales like the Peradeniya Organophosphorus Poisoning (POP) scale have shown promise for stratifying patients by severity using purely symptomatic criteria[6]. QTc interval prolongation on electrocardiography has been linked with higher requirements for mechanical ventilation and increased mortality rates among OP-poisoned individuals[7][8].

While atropine and oximes such as pralidoxime remain cornerstones of pharmacologic therapy, treatment efficacy is not solely determined by pharmacological interventions[9]. In rural referral hospitals serving agricultural populations, as is common in parts of Gujarat's tribal belt, clinicians must also contend with complicating factors like concomitant alcohol ingestion or coexistent medical comorbidities that alter patient trajectories[10][11].

Given these multifaceted challenges, a clear need exists for prospective investigations that integrate clinical presentation patterns with therapeutic response metrics while capturing complications arising during hospitalization[2]. Systematic data collection at tertiary care hospitals will therefore provide opportunities to establish locally relevant prognostic indicators while also informing broader national strategies aimed at prevention and capacity-building within poisoning management services.

Materials and Methods

Study Design

A hospital-based prospective observational study was conducted to evaluate the clinical profile, severity, management, and outcomes of organophosphorus (OP) poisoning among patients admitted to a tertiary care hospital serving the tribal population of North-East Gujarat.

Study Site

The study was carried out in the Department of General Medicine, Zydus Medical College and Hospital, Dahod, Gujarat, which caters primarily to the tribal population. The hospital has well-equipped emergency and intensive care units (ICU) capable of managing toxicological emergencies and provides comprehensive laboratory and ventilatory support.

Study Duration

The study was conducted over 12 months, from June 2024 to May 2025, covering all cases of organophosphorus poisoning reported during this duration.

Study Population and Sample Size

The study population included all patients diagnosed with organophosphorus poisoning presenting to the emergency department or medicine wards during the study period and fulfilling the inclusion criteria. A total of 45 patients were included.

The sample size was determined using OpenEpi software, considering:

- Estimated prevalence of organophosphorus poisoning: 3%
- Confidence interval: 95%

- Margin of error: 5%

This yielded a minimum required sample of 45 subjects, achieved through consecutive sampling.

Inclusion Criteria
- Patients of either gender, aged ≥15 years, diagnosed clinically with organophosphorus compound ingestion or exposure
- Patients presenting within 48 hours of ingestion/exposure
- Patients providing informed consent (or consent given by relatives in unconscious patients)

Exclusion Criteria
- Patients with mixed or unknown compound poisoningPatients with chronic exposure to OP compounds
- Patients unwilling to participate in the study

Data Collection
All patients fulfilling inclusion criteria were enrolled after obtaining consent. A pre-designed proforma was used to collect:
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- Demographic details: age, sex, residence, occupation
- Poisoning details: compound type, route, quantity, time interval between ingestion and treatment
- Clinical parameters at admission: blood pressure, pulse rate, respiratory rate, oxygen saturation, Glasgow Coma Scale (GCS) score
- Laboratory investigations: serum cholinesterase levels, blood glucose, renal and liver function tests
- Severity assessment: Peradeniya Organophosphorus Poisoning (POP) score at admission
- Treatment details: use of atropine, pralidoxime, need for mechanical ventilation, duration of ICU stay
- Outcome assessment: recovery, complications, or death during hospital stay

Severity Grading
Severity was graded using the Peradeniya Organophosphorus Poisoning (POP) Scale, which includes parameters such as pupil size, fasciculations, respiratory rate, heart rate, level of consciousness, and seizures. Patients were categorized as:
- **Mild** (Score 0–3)
- **Moderate** (Score 4–7)
- **Severe** (Score 8–11)

Statistical Analysis
Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Descriptive statistics (mean, standard deviation, frequencies, percentages) were calculated. Chi-square tests and t-tests were used to assess associations between categorical and continuous variables, respectively. A p-value <0.05 was considered statistically significant.

Results
Demographic Characteristics
The study cohort of 45 patients demonstrated a clear male preponderance with a male-to-female ratio exceeding 2:1. The majority of patients were young adults, predominantly in the 21–30 year age group, reflecting both occupational exposure risks and socio-economic stressors associated with agricultural labor in tribal regions[12][13]. Most patients resided in rural areas with limited immediate access to advanced medical infrastructure.

Clinical Presentation
Mode of Exposure
Oral ingestion was the predominant route of exposure, consistent with intentional self-harm being a major driver of OP poisoning in this population[14]. Occupational inhalational or dermal exposures occurred less frequently.

Organophosphorus Compounds Implicated
The most commonly identified compounds were:
- Chlorpyrifos (26.7%)
- Monocrotophos (35.6%)
- Other/Unknown (37.8%)

These findings align with local agricultural pesticide use patterns[15].

Baseline Clinical and Laboratory Profile
Table 1: Table 1: Baseline clinical and laboratory profile at admission

Parameter	Value	Range/Category
Vital Signs at Admission (Mean ± SD)		
Systolic BP (mmHg)	123.2 ± 18.8	
Diastolic BP (mmHg)	71.0 ± 11.1	
Heart Rate (bpm)	93.5 ± 23.4	
Respiratory Rate (/min)	18.6 ± 5.5	
SpO_2 (%)	92.2 ± 6.9	
Glasgow Coma Scale		
GCS Mean ± SD	10.9 ± 4.1	
GCS Median (IQR)	12.0	(8.0–15.0)
POP Severity Grade, n (%)		
Mild	8 (17.8%)	
Moderate	37 (82.2%)	
Serum Cholinesterase (U/L), n (%)		
<1000	41 (91.1%)	
1000–2000	2 (4.4%)	
2000–4000	2 (4.4%)	
>4000	0 (0.0%)	

Aggregate vitals showed mild tachycardia with preserved blood pressure and oxygenation at baseline. GCS scores ranged from mild to moderate depression of consciousness. The majority of patients (82.2%) were classified as moderate severity by POP scale, and 91.1% had markedly depressed cholinesterase levels (<1000 U/L), indicating severe acetylcholinesterase inhibition.

Treatment Interventions and Outcomes
Table 2: Table 2: Treatment interventions and in-hospital outcomes

Variable	n	%
Treatment Administered		
Atropine	45	100.0
Pralidoxime	45	100.0
Mechanical Ventilation	14	31.1
Clinical Outcome		
Survived	37	82.2
Death	8	17.8

All patients received standard treatment protocols including atropine and pralidoxime. Fourteen patients (31.1%) required mechanical ventilation due to respiratory muscle weakness or central respiratory depression. Most patients (82.2%) survived to discharge, with a mortality rate of 17.8% (8/45).

Prognostic Factors Associated with Mortality
Table 3: Table 3: Prognostic factors associated with mortality

Parameter	Death	Survived	Test	Statistic	p-value
Continuous Variables (Mean ± SD)					
GCS Score	5.6 ± 2.1	12.0 ± 3.4	t-test	t = -6.93	<0.0001
Heart Rate (bpm)	106.2 ± -	90.7 ± -	t-test	t = 1.51	0.1638
RR (/min)	13.5 ± -	19.6 ± -	t-test	t = -3.92	0.0016
SpO_2 (%)	82.8 ± -	94.2 ± -	t-test	t = -2.89	0.0224
SBP (mmHg)	107.9 ± -	126.5 ± -	t-test	t = -3.97	0.0008
DBP (mmHg)	64.4 ± -	72.5 ± -	t-test	t = -2.77	0.0122
Cholinesterase (U/L)	670.1 ± 994.0	396.9 ± 392.8	t-test	t = 0.76	0.4681
Categorical Variables, n					
Ventilator Requirement			χ^2	17.81	<0.0001
~~No	0	31			
~~Yes	8	6			
POP Grade			χ^2	0.88	0.3470
~~Mild	0	8			
~~Moderate	8	29			
Compound Type			χ^2	1.00	0.6060
~~Chlorpyrifos	2	10			
~~Monocrotophos	4	12			
~~Other/Unknown	2	15			

Mechanical ventilation requirement was strongly associated with mortality (χ^2=17.81, p<0.0001). Lower GCS at presentation was significantly associated with mortality (t=-6.93, p<0.0001). Non-survivors exhibited significantly lower oxygen saturation, higher respiratory rates initially, and lower blood pressure at presentation (all

p<0.05). Serum cholinesterase levels, POP severity grade, and compound type did not show statistically significant mortality differences.

Severity Markers and Ventilator Requirement

Table 4: Table 4: Severity markers and ventilator requirement

Parameter	No Ventilator (n=31)	Ventilator (n=14)	Test	Statistic	p-value
POP Score (Mean ± SD)	4.0 ± 0.9	5.4 ± 0.9	t-test	t = -5.20	<0.0001
GCS Score (Mean ± SD)	13.3 ± 1.8	5.6 ± 2.0	t-test	t = 12.35	<0.0001

Higher POP scores (t=-5.20, p<0.0001) and lower GCS scores (t=12.35, p<0.0001) were significantly associated with ventilator requirement, underscoring these scales' ability to anticipate airway needs and guide intensive care triage.

DISCUSSION

This prospective observational study from a tribal tertiary care hospital in Gujarat provides crucial insights into the clinical profile, severity, and short-term outcomes of acute OP poisoning in a vulnerable population. Our findings align with broader regional and national trends while highlighting unique challenges faced in resource-limited tribal settings.

Demographic and Epidemiological Profile

The predominance of young adult males (21–30 years) in our cohort reflects both occupational exposure risks inherent to agricultural labor and the socio-economic pressures driving intentional ingestion. This demographic pattern is consistent with observations by Ghaleb et al., who documented similar age and gender distributions in toxicology admissions, attributing them to agricultural exposure and suicidal intent in economically stressed populations[1]. Siddique et al. similarly reported young male predominance in pesticide poisoning admissions at tertiary care centers in agricultural regions[2].

The male-to-female ratio exceeding 2:1 mirrors gendered agricultural labor patterns and differential access to pesticides. Chaudhary et al. described comparable gender disparities in fatal poisoning cases, linking them to occupational handling practices and cultural factors influencing method choice in suicide attempts[3].

The overwhelming majority of cases involved oral ingestion, underscoring intentional self-harm as a major contributor to OP poisoning burden in this region. Dabholkar et al. demonstrated that pesticide ingestion remains the predominant route in suicide attempts across South Asian rural populations, emphasizing the urgent need for mental health integration into toxicological emergency care[4].

Clinical Severity and Biochemical Markers

The preponderance of moderate severity cases (82.2%) by POP scale reflects appropriate triage to tertiary care, with milder cases likely managed at peripheral centers and the most severe cases succumbing before hospital arrival. Malaviya et al. validated the POP scale as an effective severity and prognostic marker in emergency departments, demonstrating strong correlations between higher scores and adverse outcomes[5].

The near-universal depression of serum cholinesterase (<1000 U/L in 91.1% of patients) confirms significant acetylcholinesterase inhibition across the cohort. Bhat et al. similarly reported profound cholinesterase depletion in severe OP poisoning, correlating enzyme levels with clinical severity and need for prolonged atropinization[6].

GCS scores at admission emerged as a powerful prognostic indicator in our study, with non-survivors presenting with markedly lower consciousness levels (mean GCS 5.6 vs 12.0, p<0.0001). This finding aligns with observations by Jha et al., who identified GCS as one of the most reliable bedside predictors of mortality in OP and carbamate poisoning, superior to many laboratory parameters[7].

Respiratory Complications and Mechanical Ventilation

Respiratory failure requiring mechanical ventilation was the strongest predictor of mortality in our cohort. All eight deaths occurred among the 14 patients requiring ventilation (57% mortality in ventilated group vs 0% in non-ventilated group). Giyanwani et al. comprehensively reviewed respiratory failure mechanisms in OP poisoning, highlighting the convergence of central depression, neuromuscular weakness, and pulmonary complications as primary drivers of mortality[8].

The significantly lower SpO_2 and altered respiratory patterns in non-survivors at admission suggest that early respiratory compromise serves as a bedside red flag. Mani et al. documented laryngeal dysfunction and airway compromise as underrecognized contributors to respiratory failure in OP poisoning, emphasizing the need for early airway assessment and protection[9].

Maddireddy et al. demonstrated that lag time between poisoning identification and treatment initiation, coupled with acute respiratory failure, were the most significant mortality determinants in Indian OP poisoning cohorts, reinforcing the critical window for intervention[10].

Cardiovascular Instability

Hypotension (both systolic and diastolic) at presentation was significantly associated with mortality in our study. This likely reflects the complex interplay between muscarinic-mediated bradycardia, nicotinic-stimulated sympathetic surges, and distributive shock. El-Ebiary et al. found that electrocardiographic abnormalities, particularly QTc prolongation, correlated with cardiovascular instability and increased mortality, suggesting cardiac monitoring should be integral to OP poisoning management[11].

Sobeeh et al. identified cardiovascular dysfunction as a key predictor of poor outcomes in chlorpyrifos poisoning, with hypotension and arrhythmias significantly elevating mortality risk independent of cholinesterase levels[12].

Prognostic Utility of Clinical Scoring Systems

While the POP scale effectively stratified severity and predicted ventilator requirements (p<0.0001) in our cohort, it did not reach statistical significance for mortality prediction (p=0.3470). This may reflect the relatively modest sample size or the overwhelming influence of timely ventilatory support once respiratory failure develops. Malaviya et al. similarly noted that while POP scores correlated with severity and ICU admission, mortality prediction required integration with other clinical parameters[5].

Conversely, simple bedside parameters—GCS, SpO_2, blood pressure, and respiratory rate—demonstrated robust prognostic value in our study. Mary and Jena reported comparable findings in their epidemiological study of poisoning outcomes, where vital sign abnormalities at presentation outperformed biochemical markers in predicting mortality[13].

Pradeep and Mahajan explored neutrophil-to-lymphocyte ratio (NLR) as an inexpensive prognostic marker in OP poisoning, suggesting it could complement clinical scores in resource-limited settings where advanced laboratory support is unavailable[14].

Compound-Specific Considerations

The lack of significant mortality difference among chlorpyrifos, monocrotophos, and other/unknown compounds (p=0.6060) in our cohort suggests that dose ingested, time to treatment, and quality of supportive care outweigh intrinsic compound toxicity differences. This observation contrasts with experimental data by M. Mz et al. demonstrating dose-dependent toxicity in animal models of paraoxon poisoning[15], but aligns with clinical experience where syndrome severity drives management.

Kumar and Sinha reviewed clinical management approaches across diverse OP compounds, concluding that while pharmacokinetic differences exist, standardized aggressive supportive care protocols yield consistent outcomes regardless of specific agent[16].

Treatment Implications

Our findings reinforce that early, aggressive atropinization, timely oxime administration, and readiness for mechanical ventilation constitute the cornerstone of OP poisoning management. The zero mortality among non-ventilated patients suggests that appropriate supportive care can achieve excellent outcomes in mild-to-moderate cases.

Falia et al. reported similar mortality patterns in rural South India,

where patients receiving timely atropine and ventilatory support had significantly better survival despite delayed presentations[17]. Farooqui et al. used latent class trajectory analysis to demonstrate that biochemical parameter trends, when coupled with aggressive ICU support, strongly influenced mortality outcomes[18].

For severe cases, the availability of ICU beds and ventilators becomes rate-limiting. In our tribal setting, resource constraints occasionally necessitated difficult triage decisions. Expanding critical care capacity in rural tertiary hospitals serving agricultural populations should be a health policy priority.

Limitations

This single-center study with a sample size of 45 patients limits generalizability and statistical power for some comparisons. The relatively short follow-up (hospital discharge) precluded assessment of chronic sequelae such as delayed polyneuropathy or neuropsychiatric outcomes. Furthermore, unavailability of advanced neurodiagnostics and variability in pre-hospital management likely influenced outcomes but could not be systematically quantified.

Future Directions

Larger multicenter studies incorporating longer follow-up, standardized pre-hospital protocols, and assessment of novel prognostic markers would further refine risk stratification and treatment algorithms for OP poisoning in resource-limited settings. Pradeep et al. provided a comprehensive review of NLR's role in predicting OP poisoning outcomes, suggesting its potential integration into routine prognostic protocols[19].

Integration of mental health screening and suicide prevention strategies into poisoning management pathways represents another critical frontier. Dabholkar et al. demonstrated measurable reductions in pesticide suicide rates following regulatory interventions and mental health support programs in Pakistan, offering a roadmap for similar initiatives in India[4].

CONCLUSION

Acute organophosphorus poisoning in tribal Gujarat predominantly affects young working-age males, with intentional ingestion as the dominant mode of exposure. Mortality of 17.8% was significantly associated with respiratory failure requiring mechanical ventilation, profound neurological compromise reflected in low GCS scores, and cardiovascular instability at presentation.

Simple bedside clinical parameters—GCS, SpO_2, blood pressure, and respiratory rate—demonstrated robust prognostic value and can guide triage and intervention in resource-limited settings. While serum cholinesterase depression was near-universal, its prognostic utility was limited compared to clinical markers.

Early recognition, rapid atropinization, timely oxime administration, and readiness for mechanical ventilation remain the pillars of effective OP poisoning management. Expanding critical care capacity in rural tertiary hospitals and integrating mental health support into care pathways are essential strategies for reducing the burden of OP poisoning in vulnerable agricultural populations.

Declarations

Funding: - This study received no external funding.

Conflicts of interest: - The authors declare no conflicts of interest.

Ethical Considerations: - The study was approved by the Institutional Ethics Committee of Zydus Medical College and Hospital, Dahod. Written informed consent was obtained from all participants or their legal guardians.

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