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Original Article

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Clinical Profile, Severity Assessment, Management and Outcomes of Acute Organophosphate Poisoning: A Prospective Observational Study

Jigarkumar B. Gosai [1], MD, Ramchandani Himanshu D [2,3], MD, Vidur V Joshi *[4], MD

[1]Associate Professor, Department of Emergency Medicine, B. J. Medical College, Civil Hospital, Asarwa, Ahmedabad, Gujarat, India.
[2]Senior Resident, Department of Emergency Medicine, Government Medical College, Vadodara, Gujarat, India.
[3]Past Affiliation: 3rd Year Resident, Department of Emergency Medicine, B. J. Medical College, Civil Hospital, Asarwa, Ahmedabad, Gujarat, India.
[4]Assistant Professor, Department of Emergency Medicine, B. J. Medical College, Civil Hospital, Asarwa, Ahmedabad, Gujarat, India.

*Corresponding Author: Dr Vidur Vishwarup Joshi; *vidur1988dr@gmail.com*

Abstract

Objectives: To study the epidemiological profile, clinical presentation, severity assessment using the Peradeniya Organophosphorus Poisoning (POP) score, treatment patterns, and clinical outcomes of patients with acute organophosphate poisoning. ***Methods:*** This prospective observational study was conducted in the Emergency Medicine Department of a tertiary care hospital in Western India from September 2023 to September 2025. A total of 120 patients with confirmed acute organophosphate poisoning were included. Demographic details, clinical features, POP score at admission, atropine requirement, ICU admission, need for mechanical ventilation, and in-hospital outcomes were recorded. Statistical analysis was performed using the Chi-square test, and a p-value < 0.05 was considered statistically significant. ***Results:*** The mean age of patients was 33.85 ± 14.65 years, with a marked male predominance (87.5%). Most patients were from rural areas and suicidal ingestion was the commonest mode of poisoning. Based on POP score at admission, 38.3% of patients had mild, 59.2% had moderate, and 2.5% had severe poisoning. ICU admission and mechanical ventilation were required in 22.5% of patients each. Mean atropine requirement increased with severity of poisoning (29.04 mg in mild, 55.44 mg in moderate, and 143.33 mg in severe cases). Overall mortality was 10% and increased significantly with POP score severity (χ^2 = 13.42, p = 0.0006). ***Conclusion:*** Acute organophosphate poisoning predominantly affects young adults and continues to cause significant morbidity and mortality. The POP score is a simple and effective bedside tool for early severity assessment and outcome prediction. Higher POP scores are associated with increased atropine requirement, need for intensive care, mechanical ventilation, and mortality. Routine use of POP scoring in emergency departments can aid in early triage, appropriate management, and optimal resource utilization.

Keywords: ***Organophosphate poisoning, POP score, atropine, intensive care, mechanical ventilation, mortality.***

Introduction

Organophosphate (OP) compounds are widely used as agricultural pesticides in developing countries such as India [1,2]. Easy accessibility, inadequate regulation, unsafe storage practices, and occupational exposure contribute to the high incidence of organophosphate poisoning. In addition, intentional self-poisoning using OP compounds remains a major cause of morbidity and mortality, particularly among young adults in rural communities [3,4].

Organophosphates exert their toxic effects by inhibiting acetylcholinesterase, resulting in accumulation of acetylcholine at synapses and neuromuscular junctions. This leads to excessive stimulation of muscarinic, nicotinic, and central nervous system receptors, producing a wide range of clinical manifestations. Patients may present with mild symptoms such as nausea, vomiting, salivation, and sweating, or severe manifestations including respiratory failure, seizures, altered sensorium, and coma [5,6].

The clinical course of OP poisoning can be unpredictable, and early identification of patients at risk of deterioration is essential for appropriate triage and timely escalation of care. Delay in recognizing severity may result in respiratory failure, prolonged mechanical ventilation, increased ICU stay, and higher mortality [7].

Several scoring systems have been evaluated to assess severity and prognosis in OP poisoning. General critical care scores such as the Glasgow Coma Scale, APACHE II, and SOFA score are useful but require laboratory parameters and are often cumbersome to apply in emergency settings. The Peradeniya Organophosphorus Poisoning (POP) score was developed as a simple bedside scoring

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system based on six clinical parameters: pupil size, respiratory rate, heart rate, level of consciousness, presence of fasciculations, and seizures. It can be calculated rapidly at presentation without the need for laboratory investigations [9,10].

This study was undertaken to comprehensively evaluate the epidemiological profile, clinical presentation, severity assessment using POP score, management, and outcomes of patients with acute organophosphate poisoning presenting to a tertiary care emergency department.

Materials and Methods

Study Design: This was a prospective observational study.

Study Area: The study was conducted in the Emergency Medicine Department, Civil Hospital, Asarwa, Ahmedabad, Gujarat, a tertiary care referral center catering to a large urban and rural population.

Study Period: The study was conducted over a period of two years, from September 2023 to September 2025.

Study Population: All patients aged 18 years and above presenting to the emergency department with acute organophosphate poisoning during the study period were included according to predefined inclusion and exclusion criteria.

Sample Size: A total of 120 patients were included in the study.

Inclusion Criteria

- Patients aged ≥18 years
- Patients with a history of exposure to organophosphate compounds
- Patients presenting with clinical features suggestive of organophosphate poisoning
- Patients or their legally acceptable representatives willing to provide written informed consent

Exclusion Criteria

- Patients with non-organophosphate poisoning
- Patients with mixed or unknown poisoning
- Pregnant women
- Patients who were referred or transferred from another hospital or healthcare facility
- Patients with incomplete clinical data

Methodology

The study was initiated after obtaining the ethical clearance from the institutional review board. The informed consent was obtained in written form from the patients included in the study. If patient was not able to give consent, it was taken from bystander. The relevant details of the clinical history including the time of injury, mode of injury, past and personal history were recorded. General and systemic examinations were carried out after primary survey and stabilization.

Patients with a history of **acute organophosphate poisoning** presenting to the Emergency Medicine Department were prospectively assessed for **demographic characteristics** including age, gender, residence, and mode of poisoning.

↓

Detailed history regarding **time of exposure, type of organophosphate compound, and intent of poisoning** was recorded.

↓

Clinical signs, symptoms, and findings of physical examination were documented in a structured data collection form.

↓

The following variables required for calculating the **Peradeniya Organophosphorus Poisoning (POP) score** were recorded at the time of presentation:

1. Pupil size
2. Respiratory rate
3. Heart rate
4. Presence of fasciculations
5. Level of consciousness
6. Occurrence of seizures

In addition, parameters related to management and outcome including **atropine requirement, need for intensive care unit (ICU) admission, requirement of mechanical ventilation, and duration of hospital stay** were documented.

All these parameters were measured **at the time of arrival to the emergency department**, prior to initiation of definitive treatment. Patients were then followed prospectively during their hospital stay to record their **final outcome** (expired or alive) and condition at discharge.

Outcome assessment was performed either **at the time of discharge or 72 hours after hospital admission**, whichever occurred earlier. Clinical outcome was categorized as **survived or expired**, with mortality being the primary outcome measure.

The **primary outcome** of the study was **in-hospital mortality**.

The **secondary outcomes** included **requirement of ICU admission, need for mechanical ventilation, and atropine dose requirement**.

Period of Follow-up

All patients were followed from the time of admission to the emergency department up to 72 hours post-admission or until discharge or death, whichever occurred earlier.

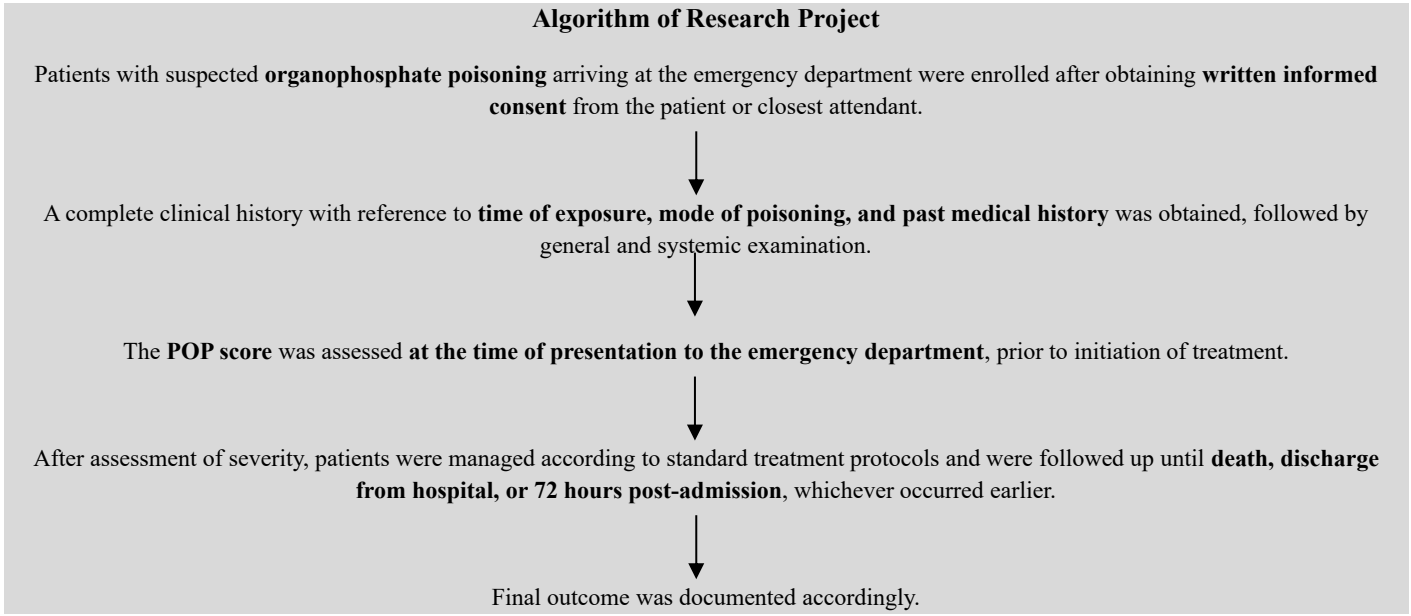
Statistical Analysis Plan

Statistical analysis included profiling of patients based on demographic and clinical parameters. A detailed analysis of POP score severity categories was undertaken. Continuous variables were

expressed as mean and standard deviation, and categorical variables were expressed as frequencies and percentages.

The association between POP score severity and clinical outcomes, including mortality, ICU admission, and mechanical ventilation, was analyzed using cross-tabulation. The Chi-square test was used to test the significance of association between categorical variables. Comparison of mean atropine requirement among different POP score categories was performed using appropriate statistical tests.

A p-value < 0.05 was considered statistically significant. Statistical analysis was carried out using SPSS software version 22.0.



Result

A total of 120 patients with acute organophosphate poisoning who fulfilled the inclusion and exclusion criteria were included in the present study.

In our study, the age of patients ranged from below 20 years to more than 70 years. The highest proportion of patients belonged to the 21–30 years age group (34.16%), followed by 31–40 years (27.5%) and 41–50 years (13.33%). Elderly patients aged more than 60 years constituted a small proportion of the study population.

The mean age of patients was 33.85 ± 14.65 years, indicating that organophosphate poisoning predominantly affected young adults (**Table 1, Figure I**).

Out of 120 patients, 105 (87.5%) were males and 15 (12.5%) were females, showing a marked male predominance with a male-to-female ratio of approximately 7:1 (**Table 1, Figure 2**).

A majority of patients, 107 (89.16%), were residents of rural areas, whereas only 13 (10.84%) were from urban areas. This highlights the higher burden of organophosphate poisoning in rural populations where agricultural pesticide exposure is common (**Table 1, Figure 3**).

The most common route of exposure was oral ingestion, observed in 109 patients (90.83%). Inhalational exposure was seen in 7 patients (5.83%), while 4 patients (3.33%) had dermal exposure (**Table 1**).

The predominant mode of poisoning was suicidal ingestion, accounting for 106 patients (88.33%), while 14 patients (11.67%) had accidental exposure (**Table 1**).

The most frequently consumed organophosphate compound was Monochrotophos (36.67%), followed by Chlorpyriphos (19.17%) and Methyl parathion (17.50%). Other compounds collectively accounted for approximately one-fourth of cases (**Table 1, Figure 4**).

The majority of patients presented within 8–12 hours (29.17%) of ingestion, followed by 4–6 hours (21.67%) and 2–4 hours (17.5%).

The mean time to presentation was 7.9 ± 5.02 hours, indicating a significant delay in reaching medical care in many patients.

Muscarinic symptoms were the most commonly observed manifestations. Miosis (85.83%), sweating (79.17%), vomiting (78.33%), diarrhea (73.33%), and abdominal pain (70.0%) were the predominant symptoms.

Central nervous system involvement was seen in the form of altered sensorium, seizures, and "killer Bs," while nicotinic manifestations such as muscle fasciculations were less common (**Table 2, Figure 5**).

The most frequently observed POP score was 4.0 (33.06%), followed by 3.0 (22.31%) and 5.0 (14.88%). Extreme scores (≥8) were uncommon.

The mean POP score was 3.96 ± 1.61, indicating that most patients presented with moderate severity poisoning (**Table 3, Figure 6**).

The majority of patients required atropine doses between 20–40 mg (31.4%), followed by 40–60 mg (23.97%). Very few patients required doses above 100 mg.

The mean atropine dose administered was 47.20 ± 28.15 mg, reflecting wide variability in atropine requirement depending on poisoning severity (**Table 4, Figure 7**)

Out of 120 patients, 27 (22.5%) required ICU admission, while 93 (77.5%) were managed without ICU care (**Table 7, Figure XII**).

A total of 98 patients (81.67%) recovered, 12 patients (10.0%) died, and 10 patients (8.33%) left against medical advice (LAMA)

In the mild POP score group (0–3), only 5 patients (10.9%) required ICU admission or ventilation, and no deaths were reported.

In the moderate group (4–7), 20 patients (28.2%) required ICU care, 19 (26.8%) required mechanical ventilation, and 12 patients (16.9%) died.

All patients in the severe group (8–11) required ICU admission and ventilation, and all succumbed to poisoning.

The association between POP score severity and ICU admission was statistically significant ($\chi^2 = 13.42$, $p = 0.0006$) (**Table 3, Figure 6**). The mean atropine dose increased progressively with severity of poisoning:

- Mild: 29.04 ± 15.19 mg
- Moderate: 55.44 ± 24.55 mg
- Severe: 143.33 ± 3.05 mg

This demonstrates a strong positive correlation between POP score severity and atropine requirement (**Table 5.14, Figure 5.14**).

The mean ICU stay was highest among patients who died (5.0 ± 5.74 days), followed by recovered patients (1.56 ± 4.74 days).

A Kruskal–Wallis test showed a statistically significant difference in ICU stay duration across outcome groups ($p < 0.001$), indicating that prolonged ICU stay was associated with worse outcomes

Table 1: General characteristics of patients

Age	**Frequency (n)**	**Percentage (%)**
18–30 years	49	40.8
31–45 years	38	31.7
46–60 years	22	18.3
>60 years	11	9.2
Total	120	100
Gender	**Frequency (n)**	**Percentage (%)**
Male	105	87.5
Female	15	12.5
Total	120	100
Residence	**Frequency (n)**	**Percentage (%)**
Rural residence	102	85.0
Urban residence	18	15.0
Total	120	100
Route of Exposure	**Number of Patients**	**Percentage (%)**
Oral	109	90.83
Inhalational	7	5.83
Dermal	4	3.33
Total	120	100
Mode of Poisoning	**Frequency (n)**	**Percentage (%)**
Suicidal ingestion	106	88.3
Accidental ingestion	14	11.7
Total	120	100
Type of OP compound	**Frequency (n)**	**Percentage (%)**
Monochrotophos	44	36.67
Chlorpyriphos	23	19.17
Methyl parathion	21	17.50
Other	32	26.67
Total	120	100

Table 2: Signs And Symptoms [N=120]

Symptom	**Number of Patients**	**Category**	**Percentage (%)**
Miosis	103	Muscarinic	85.83
Sweating	95	Muscarinic	79.17
Vomiting	94	Muscarinic	78.33
Diarrhea	88	Muscarinic	73.33
Abdominal pain	84	Muscarinic	70.00
Killer Bs	55	CNS	45.83
Bradycardia	27	Muscarinic	22.50
Respiratory Distress	22	Muscarinic	18.33
Altered Sensorium	22	CNS	18.33
Muscle Fasciculations	11	Nicotinic	9.17
Salivation	10	Muscarinic	8.33
Lacrimation	2	Muscarinic	1.67
Seizures	1	CNS	0.83

Table 3: POP Severity vs Outcome

POP Severity	**Total**	**ICU**	**Ventilated**	**Deaths**
-	46	5	5	0
Moderate (4–7)	71	20	19	12
Severe (8–11)	3	3	3	3

Table 4: POP Severity vs Atropine Requirement

POP Severity	Mean Atropine (mg)	SD	N
Mild	29.04	15.19	46
Moderate	55.44	24.55	71
Severe	143.33	3.05	3

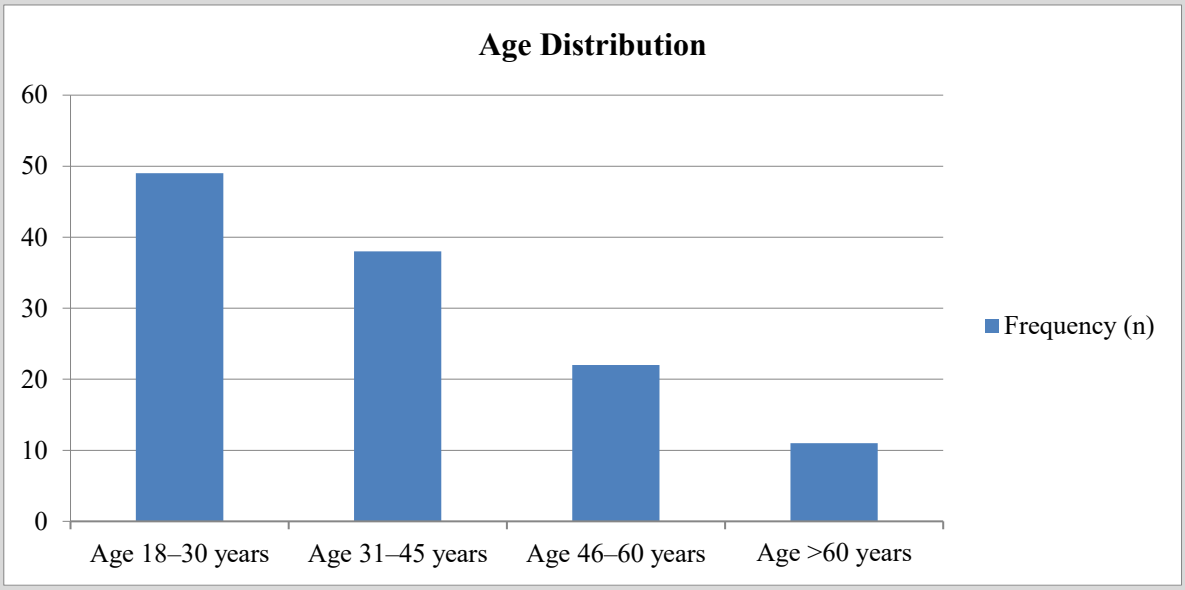


Figure 1; Age Distribution

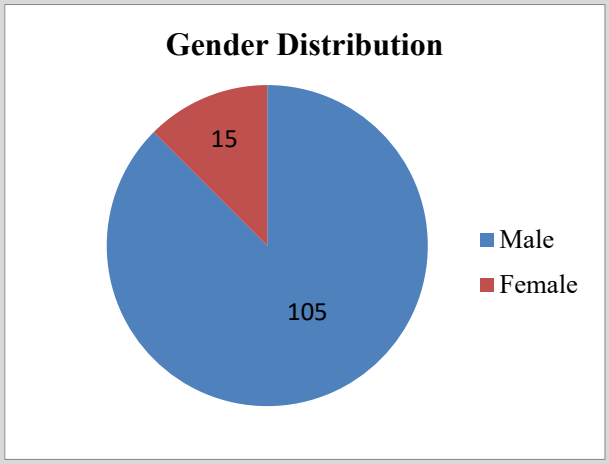


Figure 2: Gender Distribution

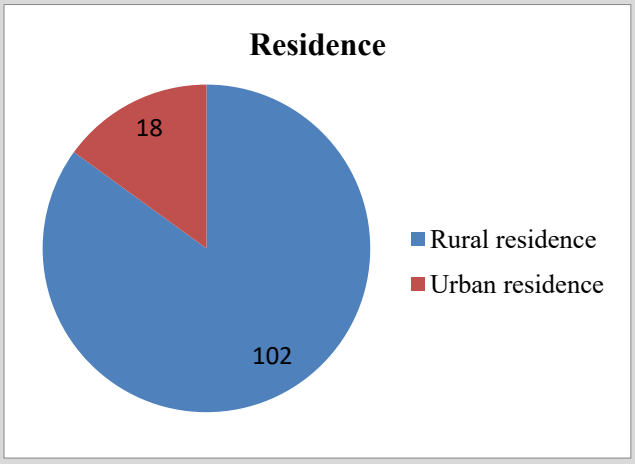


Figure 3: Residence

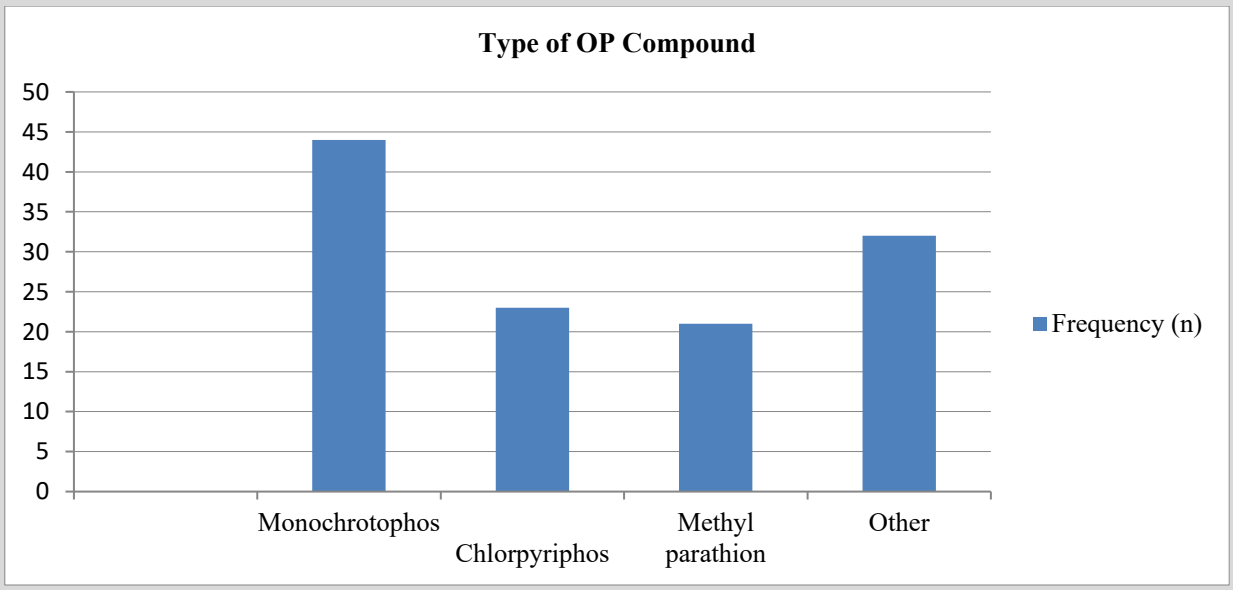


Figure 4: Type of OP compounds

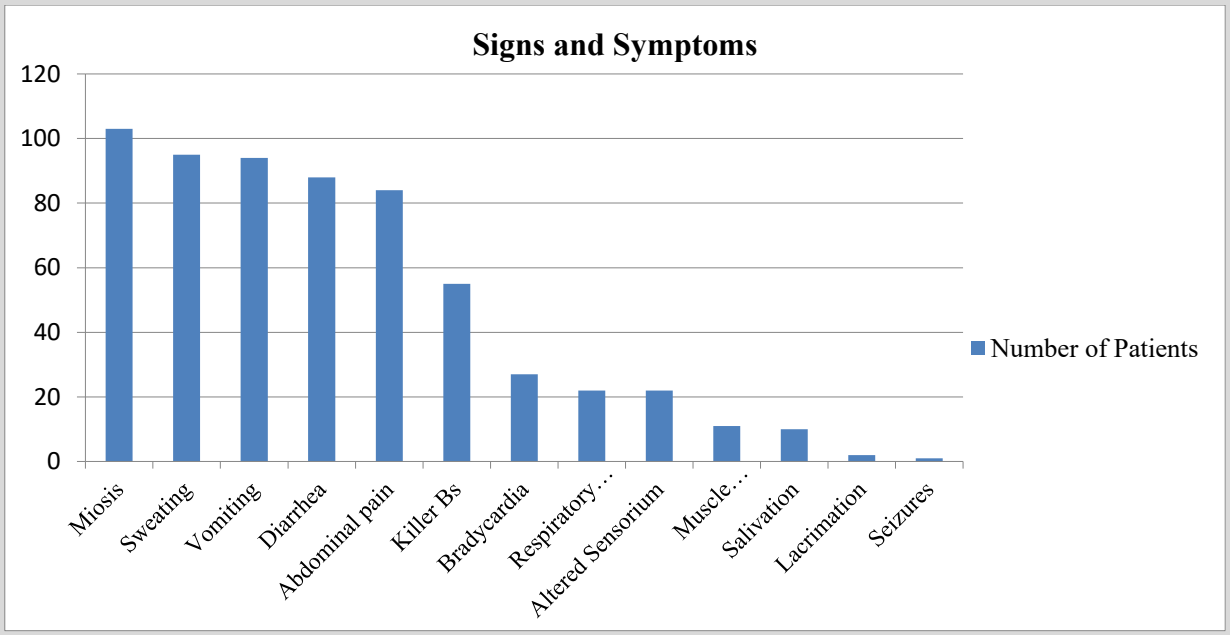


Figure 5: Signs and Symptoms

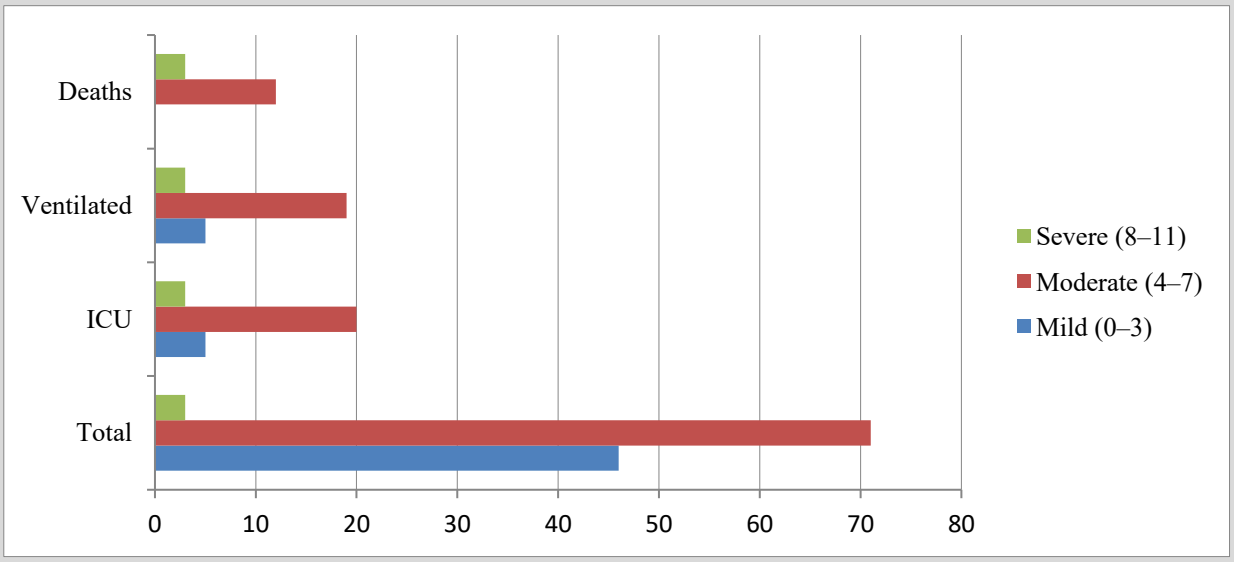


Figure 6: POP Severity vs Outcome

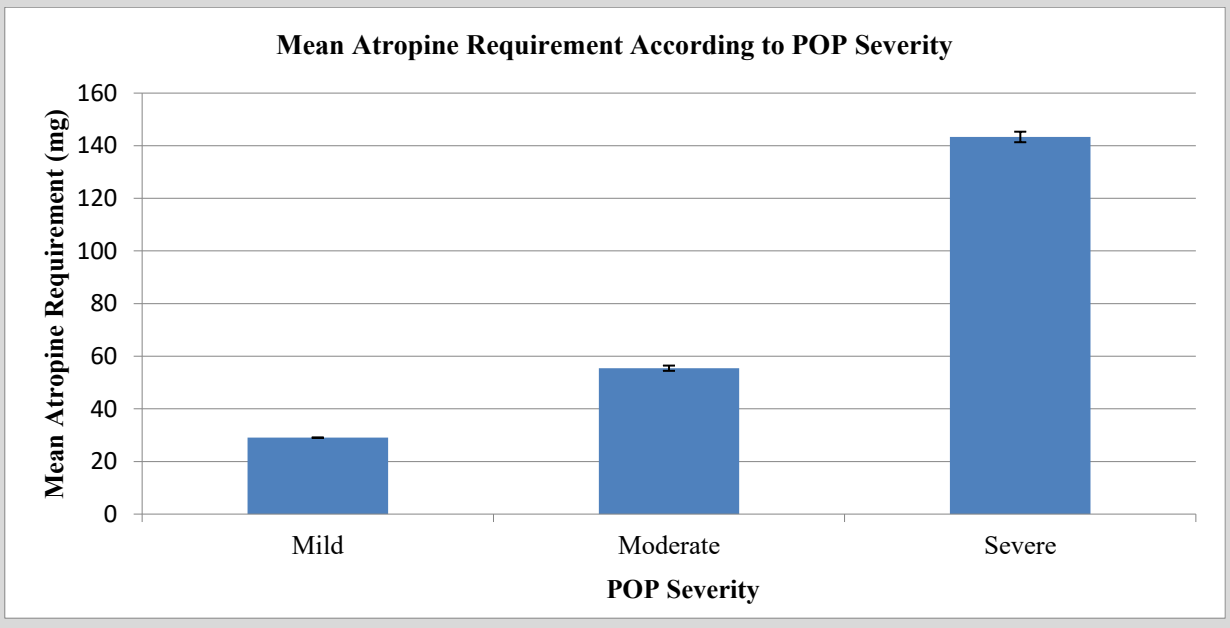


Figure 7: Relationship Between POP Severity and Atropine Requirement (Mean ± SD)

Discussion

Acute organophosphate poisoning continues to be a major cause of morbidity and mortality in developing countries, particularly in agrarian regions where pesticide availability is widespread. The present study evaluated the demographic profile, clinical characteristics, severity assessment using the Peradeniya Organophosphorus Poisoning (POP) score, management parameters, and outcomes in patients presenting with acute organophosphate poisoning, and compared these findings with previously published literature.

In our study, the mean age of patients was 33.85 years, with the highest incidence seen in the 21–30 year age group. This finding is consistent with several Indian and international studies, including those by Kamath et al.,[12], Patil et al.,[13] and Sinha et al.,[14], which also reported that organophosphate poisoning predominantly affects young adults. Eddleston et al.,[3] in a large South Asian cohort, reported a slightly lower median age, but similarly highlighted that young individuals are the most vulnerable group. The predominance of poisoning in this economically productive age group may be attributed to psychosocial stress, impulsive behavior, and easy access to pesticides in rural settings. These findings emphasize the need for focused mental health interventions and pesticide regulation targeting young adults.

A marked male predominance (87.5%) was observed in the present study, which is higher than that reported in most previous studies. Kamath et al.,[12] Patil et al.,[13] and Murali et al.,[15] reported male proportions ranging from 66% to 70%, while Eddleston et al.,[3] reported a lower male predominance. The higher male representation in the present study likely reflects greater occupational exposure among men, sociocultural factors, and higher rates of intentional self-poisoning. Similar observations have been made by WHO reports and Sudakin [20] et al., who noted that males are more frequently exposed to organophosphates due to involvement in agricultural activities and direct handling of pesticides.

The majority of patients in this study had suicidal ingestion (88.3%), which is comparable to findings from Kamath et al.,[12] and Murali et al.,[15] and slightly lower than the very high rates reported by Patil et al. Intinternationaludies, including those by Eddleston et al.,[3] and Gunnell et al.,[4] have consistently shown that intentional ingestion accounts for the majority of pesticide-related poisoning cases in low- and middle-income countries. The predominance of suicidal poisoning highlights the critical role of mental health disorders, impulsivity, and unrestricted access to highly toxic compounds. These findings support global recommendations advocating stricter pesticide control, safe storage practices, and expansion of rural mental health services.

Oral ingestion was the most common route of exposure in the present study (90.83%), consistent with findings from Banerjee et al.,[16] Patil et al.,[13] and Eddleston et al.,[3] all of whom reported oral exposure in more than 90% of cases. Dermal and inhalational exposures were uncommon, supporting the observation that oral ingestion is the predominant route in intentional poisoning, while non-oral exposure is more frequently seen in occupational settings. This pattern underscores the importance of preventive strategies such as limiting pesticide bottle sizes, improving labeling, and restricting access to highly concentrated formulations.

Monocrotophos was the most commonly ingested compound in the present study, followed by chlorpyrifos and methyl parathion. Similar compound distributions have been reported by Banerjee et al.,[16] Kamath et al.,[12] and Patil et al.,[13] reflecting regional pesticide usage patterns. Studies by Eddleston et al.,[3] and Peter et al.,[19] have demonstrated that certain compounds, including monocrotophos and dimethoate, are associated with higher toxicity, increased incidence of intermediate syndrome, and greater mortality. Identification of the specific compound ingested is therefore important, as it may influence clinical course, response to oxime therapy, and prognosis.

Delayed presentation to hospital was common in the present study, with only a small proportion of patients arriving within two hours of ingestion. This finding is consistent with previous studies by Kamath et al.,[12] and Patil et al.,[13] which reported significant pre-hospital delays. Eddleston et al.,[3] emphasized that delayed presentation is a major determinant of poor outcome, particularly in rural populations where transport facilities and early medical care are limited. These delays reduce the effectiveness of early atropinisation and decontamination, contributing to increased morbidity and mortality.

Severity assessment using the POP score showed that most patients had moderate poisoning, followed by mild and a small proportion of severe cases. This distribution closely mirrors findings from Kamath et al.,[12] Patil et al.,[13] and Sinha et al.,[14] The POP score, originally described by Senanayake et al.,[11] has been validated in multiple studies as a simple and reliable bedside tool for predicting need for ventilation, ICU admission, and mortality. The relatively low proportion of severe cases in the present study may reflect early recognition and timely initiation of treatment.

A strong association was observed between POP score severity and clinical outcomes. Mortality increased progressively with increasing POP score, reaching 100% in severe cases, a pattern consistently reported in studies by Senanayake et al.,[11] Kamath et al.,[12] and Patil et al.,[13] The need for mechanical ventilation was also strongly associated with higher mortality, similar to observations by Eddleston et al.,[3] and Murali et al.,[15] where ventilated patients had significantly poorer outcomes. These findings reinforce that ventilation requirement is a marker of severe toxicity and advanced disease.

Atropine requirements increased proportionately with POP score severity in the present study. Similar dose–severity relationships have been reported by Kamath et al.,[12] Patil et al.,[13] and Malaviya et al.,[17] supporting the role of atropine requirement as a surrogate marker of poisoning severity. Higher atropine doses were associated with increased ICU admission and mortality, emphasizing the importance of early aggressive atropinisation guided by clinical severity.

All patients in the present study received pralidoxime (PAM), yet overall mortality remained 10%. This aligns with findings from Kamath et al.,[12] Patil et al.,[13] and Eddleston et al.,[3] who reported limited or inconsistent mortality benefit with PAM, particularly when administered late or in certain compound exposures. Meta-analyses by Buckley et al.,[18] have also questioned the routine universal use of PAM. These findings suggest that while PAM remains part of standard therapy, its benefit may be compound-specific and time-dependent, and should be guided by clinical severity rather than routine use.

The overall mortality rate of 10% in the present study is comparable to rates reported by Eddleston et al.,[3] and Malaviya et al.,[17] and lower than those reported by Kamath et al.,[12] Mortality was consistently associated with higher POP scores, need for mechanical ventilation, prolonged ICU stay, and delayed presentation. The relatively lower mortality in the present study may be attributed to early atropinisation, structured emergency care, and close monitoring.

Overall, the findings of our study are consistent with existing Indian and international literature and further validate the utility of the POP score as a simple, effective, and practical tool for early severity assessment and prognostication in acute organophosphate poisoning. Early triage using POP scoring, combined with prompt supportive care, remains critical in reducing morbidity and mortality in resource-limited settings.

Conclusion

Acute organophosphate poisoning continues to cause significant morbidity and mortality, particularly among young adults in rural populations. The Peradeniya Organophosphorus Poisoning (POP) score is a simple, rapid, and reliable bedside tool for early severity assessment and outcome prediction.

Higher POP scores are strongly associated with increased atropine requirement, need for intensive care, mechanical ventilation, and mortality. Routine implementation of POP scoring at the time of presentation can improve triage decisions, timely escalation of care, and optimal utilization of healthcare resources, thereby potentially reducing mortality associated with organophosphate poisoning.

Declarations

Ethical Clearance

The study was approved by Institutional Ethics Committee, B. J. Medical College & Civil Hospital, Ahmedabad vide no. EC/Approval/221/2024/23/08/2024.

Conflict of interest

None

Funding/ financial support

None

Contributors

SVS: Conceptualisation (lead), Writing (editing and review), Writing original draft (lead), Data analysis (supporting)

VP: Methodology (lead), Writing original draft (lead), Writing (review and editing) (lead), Data analysis (supporting), Data acquisition, data analysis and software (lead)

SG: Writing (editing and review) (supporting), Methodolgy (supporting), Writing (review) (supporting), Data acquisition, data analysis and software (supporting).

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