Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.69980/xcxchn20

INTENSIVE CARE MANAGEMENT OF ORGANOPHOSPHATE INSECTICIDE POISONING: A RETROSPECTIVE STUDY

Dr. Shakeel Ahmad Siddiqui[1*], Dr. Yousha Geelani [2], Dr. Riza Mohsin Shah[3]

[1*]Assistant Professor, Department of Anaesthesiology and Critical Care, Government Medical College Srinagar, India
[2]Senior Resident , Department of Anaesthesiology and Critical Care, Government Medical College Srinagar, India ,
[3]Senior Resident , Department of Anaesthesiology and Critical Care, Government Medical College Srinagar, India.

***Corresponding Author:** Dr. Shakeel Ahmad Siddiqui
*Assistant Professor, Department of Anaesthesiology and Critical Care, Government Medical College Srinagar, India, Mail id: shaqsiddiqui@gmail.com

Abstract

Background: Organophosphate (OP) insecticide poisoning is a major cause of preventable morbidity and mortality in developing countries, particularly in agrarian regions like the Kashmir valley. Both suicidal and accidental exposures are common due to the widespread availability of these compounds. Organophosphates inhibit acetylcholinesterase, leading to excessive cholinergic activity manifested as muscarinic, nicotinic, and central nervous system effects. Management in the intensive care unit (ICU) focuses on rapid decontamination, administration of antidotes such as atropine and pralidoxime, ventilatory support, and meticulous hemodynamic stabilization. Despite advances in critical care, outcomes depend heavily on early recognition and timely intervention. **Aim**: The present retrospective study was undertaken to assess the clinical profile, management strategies, and outcomes of patients admitted with organophosphate insecticide poisoning at Government Medical College Srinagar over a two-year period.

Methods: A retrospective observational study was carried out on 42 patients diagnosed with organophosphate poisoning between January 2023 and December 2024. Data were collected from ICU records regarding demographic details, route and intent of exposure, clinical features, laboratory findings, atropine and pralidoxime dosages, need for ventilatory support, ICU stay duration, and outcomes. Data analysis was performed using SPSS version 25.0, with results expressed as mean ± standard deviation for continuous variables and percentage for categorical variables. **Results**: A total of 42 patients were included, with 16 males (38.1%) and 26 females (61.9%), and a mean age of 36.5 ± 11.8 years. Suicidal ingestion accounted for most exposures (85.7 percent), and the mean time to hospital arrival was 6.4 ± 3.1 hours. The most common clinical features were miosis (90.4%), excessive salivation (76.1%), fasciculations (61.9%), respiratory distress (55.9%), and bradycardia (95.2%). Atropine was administered to 40 patients, and pralidoxime was given to all 42 patients. Mechanical ventilation was required in 19 patients (45.2%), with a mean duration of 7.4 ± 3.6 days, while the mean ICU stay was 9.6 ± 4.8 days. Respiratory failure (47.6%) and aspiration pneumonia (16.7%) were the most frequent complications. Overall survival was 81.0 percent, whereas mortality was 19.0%, with a higher death rate among those presenting more than 6 hours after ingestion. **Conclusion**: Organophosphate poisoning remains a significant medical emergency requiring prompt

ICU-based management. Early atropinization, adequate oxime therapy, and timely ventilatory support significantly improve survival outcomes. The study highlights the need for early referral, better community awareness about pesticide hazards, and stringent control over organophosphate distribution to minimize poisoning incidents.

Keywords: Organophosphate poisoning, Intensive care management, Atropine, Pralidoxime, Mechanical ventilation, Mortality .

Introduction

Organophosphate (OP) insecticides continue to present a major public-health challenge in many agrarian regions of the world. These compounds are widely used in farming, easily accessible, and often involved in intentional self-poisoning as well as accidental exposures [1]. Their mechanism involves inhibition of acetylcholinesterase at synapses, leading to accumulation of acetylcholine and overstimulation of both muscarinic and nicotinic receptors, with subsequent central nervous system effects [2, 3]. The resulting cholinergic crisis may manifest as salivation, bronchospasm, miosis, fasciculations, altered mental state, seizures and respiratory failure [2, 4].

The epidemiology of OP poisoning is characterised by a predominance in low- and middle-income countries where regulatory oversight may be limited and access to antidotes and critical care resources is constrained [5]. For instance, in a retrospective ICU series of 47 patients, 93.6 % had oral ingestion of OP compounds; the mortality was 21.6 % among non-ventilated and 50 % among ventilated patients [3]. Early decontamination, prompt antidote administration (atropine and oximes), and ventilatory support remain the pillars of treatment [6, 7]. Delay in presentation, inadequate ventilatory support, severity of poisoning (as reflected by GCS, APACHE II, SOFA scores) and presence of complications such as intermediate syndrome or respiratory failure are strong predictors of poor outcome [5, 8].

Intensive-care management specifically plays a pivotal role in determining outcomes in severe OP poisoning. Critical-care interventions include airway and respiratory support (often mechanical ventilation), aggressive atropinisation, oxime therapy, monitoring and treatment of complications (such as acute respiratory distress syndrome, aspiration pneumonia, arrhythmias, renal failure) [4, 6]. Despite this, mortality remains substantial. For example, a four-year review of ICU patients showed an ICU mortality rate of 40 % and identified high SAPS II scores, acidosis and low serum cholinesterase levels as independent adverse prognostic factors [8].

In the context of the Kashmir valley, where agriculture is a key livelihood and insecticide availability is widespread, there is a need to examine region-specific data on OP poisoning. An earlier local study from Srinagar indicated that among 254 OP-poisoned patients admitted to ICU, the mortality in ventilated patients was 27.6 % [9]. However, there is limited data explicitly detailing the intensive care management, complications, and outcomes over a defined period in a tertiary super-specialty ICU in this region.

The present retrospective study was therefore undertaken at Government Medical College Srinagar (GMC Srinagar) over a two year period. The objectives were to describe the clinical and demographic profile of admitted OP-poisoned patients, to assess the management strategies (including atropine, oximes, ventilatory support), to investigate the prevalence and nature of complications (such as respiratory failure, intermediate syndrome, arrhythmias), and to analyse short-term outcomes (duration of ICU stay, mortality, factors associated with survival). By doing so, we aim to provide insight into intensive care practices in this setting, identify prognostic factors, and offer data to inform local critical-care protocols for OP poisoning.

Aims and Objectives

The present study was undertaken to evaluate the intensive care management and clinical outcomes of patients with organophosphate insecticide poisoning admitted to the Intensive Care Units of Government Medical College Srinagar over a two-year period.

Aims:
To analyse the clinical profile, management strategies, complications, and outcomes of patients with organophosphate poisoning requiring intensive care.

Objectives:
1. To assess the demographic and clinical characteristics of patients presenting with organophosphate poisoning.
2. To evaluate the pattern and adequacy of intensive care interventions, including atropine and pralidoxime therapy, ventilatory support, and hemodynamic management.
3. To determine the frequency and types of complications occurring during ICU stay.
4. To analyse treatment outcomes in terms of duration of ICU stay, need for mechanical ventilation, and mortality.
5. To identify prognostic factors associated with adverse outcomes and prolonged ICU admission.

This study aims to provide insights into the existing management practices and outcomes of organophosphate poisoning in a tertiary care ICU setting and to contribute to the development of standardized management protocols for improved patient survival.

Materials and Methods
This retrospective observational study was conducted in the Intensive Care Units (ICUs) of Government Medical College Srinagar, a tertiary referral centre catering to critically ill patients from across the Kashmir valley. The study covered a two-year period from January 2023 to December 2024.

Study design
The study was designed as a retrospective analysis of medical records of patients diagnosed with organophosphate (OP) insecticide poisoning who required intensive care management. All relevant case sheets, ICU charts, laboratory records, and treatment notes were reviewed systematically.

Study population and sample size
A total of 42 patients admitted to the ICUs during the study period with confirmed organophosphate poisoning were included. Diagnosis was based on history of exposure, characteristic clinical features such as miosis, salivation, fasciculations, and respiratory distress, and biochemical confirmation through decreased serum cholinesterase levels.

Inclusion criteria
1. Patients aged 18 years and above diagnosed with organophosphate poisoning.
2. Patients who required intensive care management during the hospital stay.
3. Patients with complete medical records, including treatment and outcome details.

Exclusion criteria
1. Patients with mixed or unknown poisoning.
2. Patients discharged against medical advice before stabilization.
3. Patients with incomplete documentation or missing data.

Data collection
Data were extracted from hospital records using a predesigned structured proforma. The following parameters were recorded:
* Demographic details (age, sex, and occupation).
* Circumstances and route of exposure (accidental, suicidal, or occupational).
* Time interval between exposure and hospital admission.

* Clinical features at presentation, including cholinergic signs and Glasgow Coma Scale (GCS) score.
* Laboratory parameters, including serum cholinesterase and arterial blood gas (ABG) analysis.
* Details of management, including atropine dosage and duration, use of oximes (pralidoxime), ventilatory support, and adjunctive therapies.
* Complications encountered during ICU stay.
* Duration of mechanical ventilation and ICU stay.
* Final outcome (recovery or death).

All information was handled confidentially, and no personal identifiers were used. Ethical approval for the study was obtained from the Institutional Ethics Committee of Government Medical College Srinagar prior to data collection.

Treatment protocol in ICU

All patients received standard intensive care management according to established treatment protocols for organophosphate poisoning. Gastric lavage was performed were appropriate, followed by administration of activated charcoal. Atropine therapy was initiated with bolus doses (1–3 mg intravenously every 5 minutes) until signs of adequate atropinization were achieved, such as clear chest, dry mucosa, and stable heart rate. Maintenance atropine infusion was then continued and titrated according to clinical response.

Pralidoxime (oxime) was administered as a loading dose of 30 mg/kg intravenously, followed by continuous infusion at 8–10 mg/kg/hr for 24–48 hours, depending on clinical improvement.

Patients with respiratory distress, severe bronchorrhea, or hypoxia were managed with endotracheal intubation and mechanical ventilation. Ventilation was maintained until respiratory muscle function recovered and secretions were controlled. Fluid management, vasopressor support, and antibiotic prophylaxis were provided as required. Continuous monitoring of vital parameters, electrocardiography, and urine output was carried out.

Statistical analysis

All data were entered and analysed using Statistical Package for Social Sciences (SPSS) software, version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were used to summarize the data. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Chi-square test was used for comparison of categorical variables, and Student's t-test was used for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Results

The study included 16 males (38.1 percent) and 26 females (61.9 percent), with a mean age of 36.5 ± 11.8 years. Most exposures were due to suicidal ingestion (85.7 percent), while 14.3 percent were accidental. A majority of cases originated from rural areas (78.6 percent). The mean time from exposure to hospital arrival was 6.4 ± 3.1 hours.

Table 1: Demographic and Epidemiological Characteristics of Patients (n = 42)

Parameter	Category	Number of Patients	Percentage (%)
Age (years)	18–30	25	59.5
	31–40	12	28.6
	40–50	5	11.9

Gender	Male	16	38.1
	Female	26	61.9
Residence	Rural	33	78.6
	Urban	9	21.4
Mode of exposure	Suicidal ingestion	36	85.7
	Accidental	6	14.3
Mean time for exposure to hospital (hours)	—	6.4 3.1	—

The most frequent presenting symptom was miosis (90.4 percent), followed by excessive salivation (76.1 percent). Fasciculations were seen in 61.9 percent, while respiratory distress occurred in 55.9 percent. Bradycardia was present in 95.2 percent. Altered sensorium was documented in 35.7 percent, and seizures in 4.8 percent of the patients.

Table 2: Clinical Features at Presentation (n = 42)

Clinical Feature	Number of Patients	Percentage (%)
Miosis	38	90.4
Excessive salivation	32	76.1
Fasciculations	26	61.9
Respiratory distress	24	55.9
Bradycardia	40	95.2
Hypotension	14	33.3
Altered sensorium	15	35.7
Seizures	2	4.8

Atropine therapy was administered in 40 patients (95.2 percent), while continuous infusion was required in 38 patients. Pralidoxime therapy was given to all 42 patients (100 percent) as part of the revised management protocol. Atropine toxicity was documented in 2 cases. Mechanical ventilation was required in 19 patients (45.2 percent), with the mean duration increased to 7.4 ± 3.6 days. Antibiotics were given to 40 patients (95.2 percent), and vasopressor support was required in 12 patients.

Table 3: Treatment Modalities and Supportive Management

Treatment Parameter	Number of Patients	Percentage (%)
Atropine therapy	40	95.2
Continuous atropine infusion	38	90.5
Pralidoxime therapy	42	100
Glycopyrrolate substitution (for atropine toxicity)	2	4.8
Mechanical ventilation	19	45.2
Mean duration of ventilation (days)	--	3.9 ± 2.4
Vasopressor support	12	28.6
Antibiotic coverage	40	95.2

Respiratory failure was the most common complication, occurring in nearly half (47.6 percent) of patients. Aspiration pneumonia was noted in 16.7 percent. Intermediate syndrome and acute kidney injury occurred in 7.1 percent each. Hypotension requiring vasopressors was seen in 28.6 percent.

Table 4: Complications During ICU Stay

Complication	Number of Patients	Percentage (%)
Respiratory failure	20	47.6
Intermediate syndrome	3	7.1
Aspiration pneumonia	7	16.7
Cardiac arrhythmia	4	9.5
Hypotension requiring vasopressors	12	28.6
Acute kidney injury	3	7.1
Atropine toxicity	3	4.8

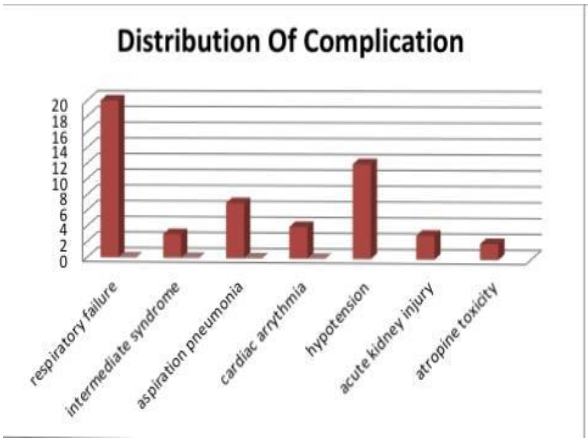
The mean ICU stay increased to 9.6 ± 4.8 days, reflecting prolonged care requirements. A total of 34 patients (81.0 percent) survived and were discharged, while 8 patients (19.0 percent) died. Mortality among patients presenting later than 6 hours after exposure remained high at 33.3 percent (6 out of 18).

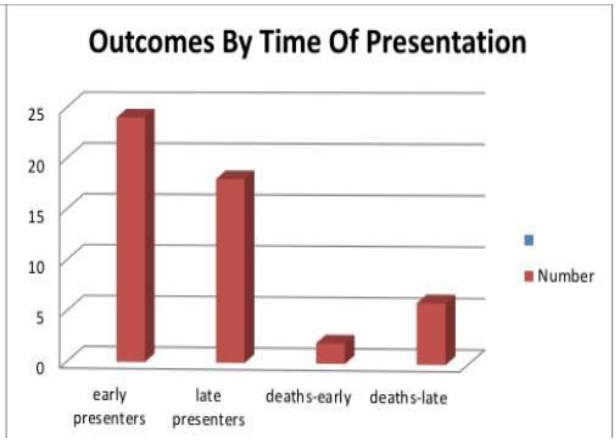
Table 5: Patient Outcomes and Prognostic Indicators

Outcome Parameter	Number of Patients	Percentage (%)
Total patients	42	100
Recovered and discharged	34	81.0
Deaths	8	19.0
Mean ICU stay (days)	--	9.6 ± 4.8
Patients presenting >6 hours post ingestion	20	42.9
Mortality among late presenters	6	33.3

The study demonstrated that organophosphate poisoning predominantly affected females aged 18–50 years, with suicidal ingestion being the most common mode of exposure. Early administration of atropine and ventilatory support were associated with improved survival, while delayed hospital presentation and respiratory complications were major determinants of mortality. Cases of atropine toxicity were effectively managed using glycopyrrolate, suggesting it as a safe and practical alternative in such situations.

Bar graph: Distribution of Complications among OP Poisoning Patients.
Bar graph : Outcome by Time of Presentation.





Discussion

This two-year retrospective study of 42 patients admitted with acute organophosphate (OP) insecticide poisoning at Government Medical College Srinagar provides important insights into the demographic pattern, clinical presentation, management, and outcomes of OP toxicity in a tertiary care setting. A significant finding was the clear female predominance (61.9 percent), which contrasts with earlier studies where males were more commonly affected in developing regions. The increasing representation of females likely reflects rising psychosocial stressors and greater access to toxic agents in rural households, consistent with trends reported in recent regional literature [10,11]. This shift underscores a growing public health concern regarding intentional self-poisoning among young rural women, aligning with observations from similar studies in South Asia [12]. While earlier research attributed higher exposure to males due to occupational pesticide handling [13,14], the changing demographic profile suggests the need for gender-focused preventive strategies.

The mode of exposure in this cohort was predominantly suicidal ingestion (85.7 percent), which aligns with documented national patterns [10,12]. The mean time to presentation was 6.4 ± 3.1 hours, and delayed arrival continued to be a critical prognostic factor. Mortality among patients presenting after six hours was 33.3 percent, consistent with published evidence demonstrating that early atropinisation and airway management significantly improve survival compared with delayed intervention [15].

The clinical profile was dominated by muscarinic manifestations such as miosis (90.4 percent) and excessive salivation (76.1 percent), accompanied by nicotinic effects such as fasciculations (61.9 percent). Bradycardia was highly prevalent (95.2 percent), reflecting profound cholinergic excess. The near-universal use of atropine in this group (95.2 percent) demonstrates appropriate adherence to standard treatment guidelines [16,17]. Atropine toxicity occurred in two patients and was successfully managed by substituting glycopyrrolate. As a peripheral antimuscarinic agent with minimal central effects, glycopyrrolate has been recognized as an effective alternative in patients exhibiting atropine-related adverse effects, as supported by previous studies [18,19].

Respiratory complications were major determinants of morbidity. Respiratory failure occurred in 47.6 percent of patients, and aspiration pneumonia in 16.7 percent, reflecting the severe cholinergic crisis and compromised airway protection. These findings are consistent with earlier literature highlighting respiratory muscle weakness and bronchorrhea as major contributors to morbidity and mortality in OP poisoning [20]. A key difference in this study was the prolonged ventilatory support requirement, with a mean duration of 7.4 ± 3.6 days, which is higher than previous tertiary-care cohorts reporting shorter durations [21]. This extended requirement may reflect greater toxicity, delayed presentation, or more severe neuromuscular involvement. Early airway protection and adequate atropinisation remain essential strategies to prevent aspiration and reduce the need for prolonged ventilatory support [22].

The study also implemented uniform pralidoxime administration in all 42 patients (100 percent), reflecting strict alignment with WHO recommendations. Although the benefit of oximes remains debated in literature and appears time-dependent [23], their consistent use in this cohort ensures that all patients received guideline-based therapy during the early management phase.

Complications such as aspiration pneumonia (16.7 percent), cardiac arrhythmias (9.5 percent), and acute kidney injury (7.1 percent) were comparable to previous hospital-based studies [24]. The increased antibiotic use (95.2 percent) likely reflects both aspiration risk and prolonged ventilation duration. The mean ICU stay in this study was 9.6 ± 4.8 days, which is longer than earlier reports but consistent with severe cases requiring extended supportive care.

The overall mortality rate was 19 percent, aligning with mortality figures (15–25 percent) reported in tertiary care analyses [25]. Mortality was particularly high among delayed presenters and those with severe respiratory failure, reinforcing the critical importance of timely treatment, aggressive airway management, and sustained ICU monitoring.

The findings of this study highlight important demographic and clinical patterns, especially the increasing prevalence among young rural females, high rates of respiratory complications, the need for prolonged ventilation, and the role of glycopyrrolate in managing atropine toxicity. Although limited by its retrospective design and modest sample size, the study offers practical insights for improving critical care management strategies in OP poisoning.

Conclusion

This retrospective study provides valuable insights into the clinical profile, therapeutic strategies, and outcomes of acute organophosphate poisoning in a tertiary-care ICU. The predominance of young female patients highlights shifting demographic patterns and emphasizes the need for community-based mental health interventions and better regulation of pesticide availability. The majority of patients presented with severe cholinergic manifestations requiring prompt atropine therapy, oxime administration, and close hemodynamic and respiratory monitoring.

The requirement for mechanical ventilation in nearly half of the patients, along with a prolonged mean ventilatory duration of 7.4 ± 3.6 days and an extended ICU stay of 9.6 ± 4.8 days, underscores the severity of toxicity and the complexity of supportive care. Respiratory failure, aspiration pneumonia, and delayed presentation were the strongest predictors of adverse outcomes, contributing significantly to the overall mortality rate of 19 percent. The study also highlights the importance of recognizing atropine toxicity early and the utility of glycopyrrolate as an effective alternative in such cases.

Overall, the outcomes reinforce that early diagnosis, rapid atropinisation, timely oxime therapy, and aggressive respiratory support are central to improving survival in OP poisoning. Strengthening emergency response systems, enhancing prehospital care, and promoting safe pesticide practices remain essential public health priorities. Larger prospective studies are warranted to further clarify prognostic markers and optimize management protocols for OP poisoning in critical care settings.

Conflict of interest: Nil
Funding: Nil

References:

1. Nazima S. N., Bashir Y., Nabi S., Bashir N., “Intensive care management of organophosphorus poisoning patients: an experience from tertiary care centre,” International Journal of Advances in Medicine, 5(2):257-264, 2018.
2. Kumar R., Sinha S. N., “A review of the clinical management of current organophosphate poisoning treatments in humans,” International Journal of Health Sciences, 6(S9):…, 2022.

3. Sungurtekin H., Balcı C., "Organophosphate poisoning in the intensive care unit," Critical Care, 7(Supplement 2):P244, 2003.
4. Eddleston M., Roberts D., Buckley N., "Management of severe organophosphorus pesticide poisoning," Critical Care, 6:259, 2002.
5. Khanum E., Islam M. A., Salim M., Islam S. R., Haque M. R., "Management of OPC and Carbamate Poisoning in Intensive Care Unit of Enam Medical College & Hospital, Savar, Dhaka," Journal of Enam Medical College, 8(3):144-152, 2018.
6. Dovepress article: "Usefulness of serum lactate as a predictor of successful discontinuation of continuous atropine infusion in patients with severe acute organophosphate poisoning," Clinical and Experimental Emergency Medicine, 5(3):177, 2018.
7. Usha M., et al., "Developing a Standard Treatment Protocol Towards Organophosphorus Poisoning for Emergency Department in a Hospital, India," Journal of Basic and Clinical Pharmacy, 8(S1):S70, 2017.
8. Sá A., Tomas E., Silva J., et al., "Characterization of organophosphate poisoning patients in the ICU: a 4-year review," Critical Care, 13(Suppl 1):P492, 2009.
9. Malik G. M., Romshoo G. J., Mubarik M., Basu J. A., Rashid S., Hussain T., Wani M. A., "Increasing Incidence of Organophosphorous Poisoning in Kashmir Valley (A Preliminary Study)," JK Pract., 5(2):117-120, 1998.
10. Banerjee I., Tripathi S.K., Roy A.S., "Epidemiology of organophosphate poisoning and its outcome among patients in a tertiary care hospital," Indian Journal of Critical Care Medicine, 2022, 26(5): 589-596.
11. Peter J.V., Cherian A.M., "Organic insecticides," Indian Journal of Medical Research, 2000, 112: 301-313.
12. Gunnell D., Eddleston M., Phillips M.R., Konradsen F., "The global distribution of fatal pesticide self-poisoning: systematic review," BMC Public Health, 2007, 7: 357.
13. Srivastava A., Peshin S.S., Kaleekal T., Gupta S.K., "An epidemiological study of poisoning cases reported to the National Poisons Information Centre, AIIMS, New Delhi," Human & Experimental Toxicology, 2005, 24(6): 279-285.
14. Batra A.K., Keoliya A.N., Jadhav G.U., "Poisoning: an unnatural cause of morbidity and mortality in rural India," Journal of the Association of Physicians of India, 2003, 51: 955-959.
15. Kang E.J., Seok S.J., Lee K.H., "Factors affecting the survival of patients with organophosphate poisoning," Korean Journal of Internal Medicine, 2020, 35(3): 682-691.
16. Hulse E.J., Davies J.O., Simpson A.J., Sciuto A.M., Eddleston M., "Respiratory complications of organophosphorus nerve agent and insecticide poisoning: implications for respiratory and critical care," Toxicology, 2014, 323: 35-58.
17. Coskun R., Gundogan K., Sezgin G.C., Topaloglu U.S., Güven M., "A retrospective review of intensive care management of organophosphate insecticide poisoning," Nigerian Journal of Clinical Practice, 2015, 18(5): 644-650.
18. Abedin M.J., Sayeed A.A., Basher A., et al., "Efficacy of glycopyrrolate versus atropine in the management of acute organophosphorus poisoning," Journal of Critical Care, 2012, 27(2): 190-194.
19. Rahimi R., Nikfar S., Abdollahi M., "A comparative meta-analysis of glycopyrrolate and atropine in human organophosphate poisoning," Human & Experimental Toxicology, 2015, 34(9): 905-912.
20. Sungur M., Güven M., "Intensive care management of organophosphate insecticide poisoning," Critical Care, 2001, 5(4): 211-215.
21. Singh S., Sharma N., "Neurological syndromes following organophosphate poisoning," Neurology India, 2000, 48(4): 308-313.
22. Peter J.V., Moran J.L., Graham P.L., "Oxime therapy and outcomes in human organophosphate poisoning: an evaluation using meta-analytic techniques," Critical Care Medicine, 2006, 34(2): 502-510.

23. Eddleston M., Buckley N.A., Eyer P., Dawson A.H., “Management of acute organophosphorus pesticide poisoning,” Lancet, 2008, 371(9612): 597-607.
24. Banday T.H., Shah A.M., Bhat M.A., Lone N.A., “Predictors of morbidity and mortality in organophosphate poisoning: a hospital-based study,” International Journal of Critical Illness and Injury Science, 2015, 5(3): 156-159.
25. Zoofaghari S., Maghami-Mehr A., Abdolrazaghnejad A., “Organophosphate poisoning: review of prognosis and management,” Advances in Biomedical Research, 2024, 13: 82.