

A Retrospective Observational Study on the Clinical Profile and Risk factors of severity in Organophosphorus poisoning in a Tertiary care Teaching Hospital

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Abstract:

Background: Organophosphorus (OP) poisoning is a critical public health issue, necessitating emergency medical intervention due to its severe toxic effects. This study aims to evaluate the clinical profile, complications, and outcomes of OP poisoning in a tertiary care setting.

Material & Methods: A retrospective observational study was conducted on 118 patients with acute OP poisoning admitted from November 2021 to October 2023 in Tata Main Hospital, Jamshedpur, and Jharkhand. Patients were evaluated based on socio-demographic variables, clinical manifestations, treatment received and outcomes. Diagnosis of the poisoning was based on the clinical history, clinical features and the evidence of the poison brought by the patients or their family member. We don't have the facility of serum/red blood cell cholinesterase level estimation in our hospital. We used the Peradeniya Organophosphorus Poisoning (POP) scale to assess poisoning severity.

Results: Most patients (66.1%) were aged 21-40 years, predominantly male (79.7%). Methyl Parathion was the most common poison (23.7%). Muscarinic and nicotinic symptoms were prevalent, with 40% requiring mechanical ventilation. Mortality was 25.4%, with respiratory failure being the leading cause. Severe cases exhibited significantly higher atropine requirements with more mortality. The mean hospital stay was longer for severe cases (13.5 ± 4.29 days).

Conclusion: OP poisoning predominantly common young males and requires judicious clinical suspicion of its occurrence, and prompt medical intervention to prevent severe complications and mortality.

Keywords: Organophosphorus Poisoning, Atropine, Mechanical Ventilation, Mortality.

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Introduction

Organophosphorus poisoning poses a significant public health concern globally, with a substantial number of cases requiring emergency medical attention and hospitalization [1]. The poisoning results from exposure to chemicals commonly found in pesticides, insecticides, and various industrial products.

The toxic effects of organophosphorus compounds are primarily attributed to their ability to inhibit acetylcholinesterase critical enzyme in the nervous system. Consequently, there is an accumulation of acetylcholine, leading to a cascade of detrimental effects on vital organs and physiological systems. Emergency department serves as the frontline for managing cases of organophosphorus poisoning, necessitating a comprehensive understanding of the complications and outcomes associated with this

toxic exposure. This assessment aims to explore and analyse the various complications that patients with organophosphorus poisoning may encounter during their admission to the emergency department [2]. Additionally, the study will delve into the overall outcomes of these patients, shedding light on factors influencing prognosis, treatment efficacy, and potential areas for improvement in emergency medical management.

Understanding the importance, complications, and outcomes in organophosphorus poisoning is necessary for healthcare professionals and emergency physicians. This knowledge can contribute to the refinement of protocols, the enhancement of medical interventions, and the development of targeted preventive measures. Through a systematic

examination of these aspects, this assessment seeks to contribute valuable insights to the broader landscape of emergency medical care for organophosphorus poisoning, ultimately aiming to improve patient outcomes and minimize the impact of this toxicological emergency on public health. Organophosphorus compounds (OPC) are most used as pesticides and insecticides. Some of them also have medical properties, (eg, Malathion- in shampoo). In developing countries, Organophosphorus compounds and other pesticides represent the most common causes of death from intoxication [3].

Organophosphates (OPC) are also used in chemical warfare. Although suicidal poisoning is the most attributed cause, accidental and even occupational exposure can also occur. In cases of severe poisoning, symptoms of OPC poisoning occurs usually within 6 hours of exposure and are unlikely to occur if the exposed person remains symptom-free for 12 hours post consumption [4].

OPC compounds are either phosphoric or phosphonic acid derivatives and they cause the irreversible inhibition of serum cholinesterase causing a syndrome complex of cholinergic excess involving the muscarinic, nicotinic, and central nervous system receptors [5]. The most common cause of death is due to respiratory failure [6].

This study was planned to evaluate organophosphorus poisoning admitted and to clinical profile and biochemical outcomes among them and descriptive analysis of organophosphorus poisoning based on age, sex, types of organophosphorus poisoning, time from consumption to admission, clinical features, and outcomes.

Material and methods: This was a retrospective observational study conducted on 118 patients with organophosphorus poisoning admitted to the medical wards or ICU at Tata Main Hospital, Jamshedpur, and Jharkhand between November 2021 to October 2023.

Inclusion Criteria:

1. Patient >15 years exposed to organophosphorus immediately before admission.
2. Duration of presentation to the hospital within 24 hours.

Exclusion Criteria:

1. Patient treated outside and referred to our hospital.
2. Patient presenting after 24 hours of ingestion.
3. Suffering from any other serious systemic diseases.
4. Multiple substance poisoning.

5. Unconfirmed diagnosis regarding the substance of poisoning.

The diagnosis of acute organophosphorus poisoning was confirmed using specific criteria: (1) a history indicating exposure to or contact with insecticide; (2) the presence of characteristic clinical signs and symptoms associated with organophosphate poisoning. The POP (Perandeniya Organophosphorus Poisoning) scale, developed by N. Senanayake, H.J. de Silva, and L. Keralliceede in 1993, served as a scoring system to assess acute cholinergic manifestations of organophosphorus poisoning upon initial presentation, before medical intervention. Parameters such as pupil size, respiratory rate, heart rate, presence of fasciculations, level of consciousness, and seizure activity are rated on a scale from 0 to 2. The cumulative score categorizes poisoning severity: 0-3 indicated mild poisoning, 4-7 as moderate poisoning, and 8-11 as severe poisoning.

Methods of collection of data: Data were collected retrospectively from the hospital medical record section using ICD-10 system. The demographic profile, case history, clinical information was noted on the excel sheet. Reports of complete blood count, liver function test, kidney function test, peripheral smear, random blood sugar, urine routine microscopy, venous and/or arterial blood gas analysis, X ray Chest, Computed tomography scan (if indicated) and Magnetic Resonance Imaging (if indicated) were accumulated. The treatment for organophosphorus poisoning was carried out according to standard protocols. Complications if any were noted and managed with haemodialysis/peritoneal dialysis, ventilatory support and temporary pacing. In hospital outcomes, i.e. discharge and death were noted. Total duration of hospital and intensive care unit stay was recorded. A detailed psychiatric evaluation was done by psychiatry team and needful was advised.

Data entry and analysis: Data were analyzed using STATA version 10.1 (2011). Descriptive statistics were calculated to summarize quantitative variables as means and standard deviations, and qualitative variables as frequencies and percentages. Inferential statistics included the Chi-square test and t- test to assess the significance of differences in proportions across various subgroups or strata of baseline characteristics, such as age, gender, and other demographics. A p-value of less than 0.05 was considered statistically significant.

Results

A total of 118 subjects were included in the final analysis.

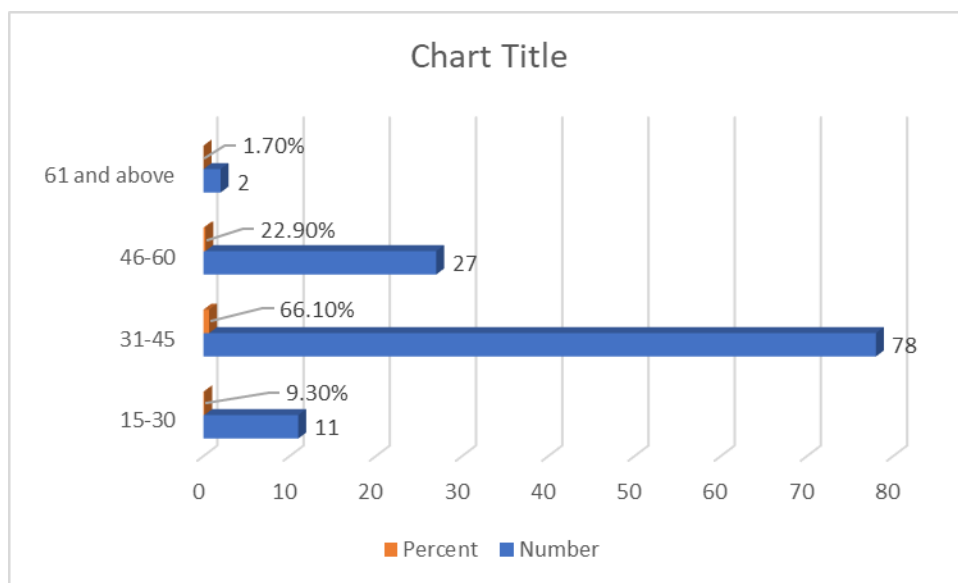


Figure 1: Distribution of Age

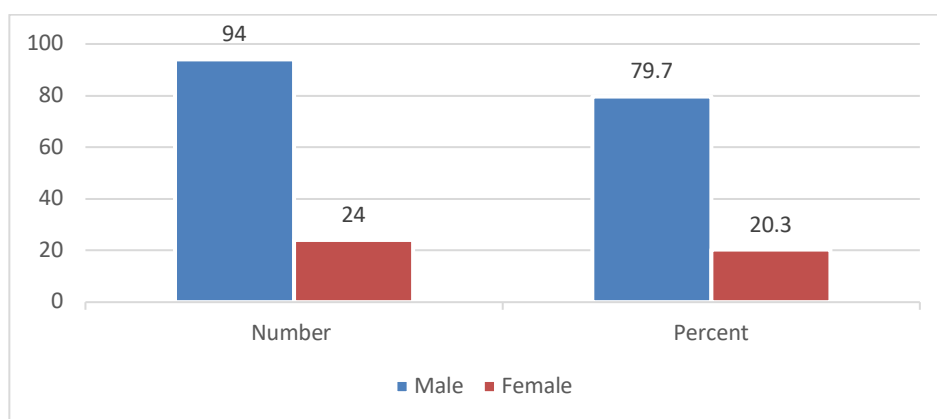


Figure 2: Gender distribution

The descriptive analysis of the age and gender distribution of the 118 patients as shown in figure- 1, shows that the majority fall within the 31-45 age group, comprising 66.1% (78 individuals), followed by 22.9% (27 individuals) in the 46-60 age group,

9.3% (11 individuals) under 30 years old, and 1.7% (2 individuals) over 60. In terms of gender, the sample is predominantly male, with 79.7% (94 individuals) being male and 20.3% (24 individuals) being female (figure -2).

Table 1: Distribution of Types of Organophosphorus Poisoning

Type of Poisoning	Number	(%)
Methyl Parathion	28	23.7
Chlorpyrifos	23	19.5
Monocrotophos	18	15.3
Quinalphos	13	11
Dimethoate	13	11
Phosmidan	6	5.1
Phorate	4	3.4
Total	118	100

The distribution of type of organophosphorus poison among 118 patients is detailed in the table-1. Methyl Parathion is the most common, accounting for 23.7% (28 patients) of the cases. This was followed by Chlorpyrifos at 19.5% (23 patients) and Monocrotophos at 15.3% (18 patients). Both Quinalphos

and Dimethoate each represented 11.0% (13 patients) of the poisoning cases.

Phosmidan and Phorate are less common, with 5.1% (6 patients) and 3.4% (4 patients) respectively. These figures highlight the prevalence of different organophosphorus compounds in poisoning cases,

with Methyl Parathion being the most frequently encountered.

Table 2: Clinical Manifestations of Organophosphorus Poisoning

Clinical manifestations	Number (%)	Clinical Manifestations	Number (%)
Muscarinic		Nicotinic	
Gastrointestinal tract		Skeletal muscle	
Nausea/vomiting	95 (80.5%)	Fasciculations	38 (32.2%)
Abdominal pain	78 (66.1%)	Paralysis	18 (15.2%)
Diarrhoea	21 (15.2%)	Autonomic dysfunction	
Respiratory system		Tachycardia	11 (9.3%)
Frothing	29 (24.5%)	Hypertension	5 (4%)
Cyanosis	19 (16%)	Nervous system	
Pulmonary edema	31 (30.5%)	Altered sensorium	66 (55.9%)
Cardiovascular system		Intermediate syndrome	10 (8.4%)
Bradycardia	32 (27.1%)	Seizure	9 (7.6%)
Hypotension	11 (9.3%)		
Eyes			
Miosis	88 (74.5%)		
Excess lacrimation	12 (10.1%)		
Exocrine gland			
Excess sweating	32 (27.1%)		
Urinary bladder			
Incontinence	18 (15.2%)		

Table 2, describes the clinical manifestations observed in 118 patients with organophosphorus poisoning. Among muscarinic manifestations, gastrointestinal symptoms such as nausea and vomiting were reported by 80.5% while abdominal pain was present in 66.1%. Diarrhoea was less common, affecting 15.2%. Respiratory symptoms included frothing from nose or mouth in 24.5%, cyanosis in 16%, and pulmonary edema in 30.5%. Cardiovascular manifestations included bradycardia in 27.1% and hypotension in 9.3%. Ocular symptoms showed miosis in 74.5% while excessive lacrimation was seen in

10.1%. We noted increased sweating in 27.1% and urinary incontinence in 15.2%. Nicotinic manifestations involved skeletal muscle issues such as fasciculations in 32.2% and paralysis in 15.2%, as well as autonomic symptoms like tachycardia in 9.3% and while hypertension was seen in 4%. Neurological manifestations included altered consciousness in 55.9%, and intermediate syndrome in 8.4%. This detailed distribution underscores the variety and frequency of symptoms experienced by patients suffering from organophosphorus poisoning.

Table 3: Proportion of Patients Requiring Mechanical Ventilation (N = 118)

Mechanical Ventilation Required	Number (%)
Yes	47 (40%)
No	71 (60%)
Total	118 (100%)

This table shows that out of 118 patients, 47 (40%) required mechanical ventilation, while 71 (60%) did not require mechanical ventilation during the study period.

Table 4: Association between ventilatory requirement with gender and age of patients.

Parameter	Ventilated N=47 (39.8%)	Not ventilated N=71 (60.2%)	p-value
Gender			
Male	33 (35%)	61 (65%)	0.06
Female	14 (58.3%)	10 (41.7%)	
Age group (in years)			<0.05
15-30	4 (36.4%)	7 (63.6%)	
31-45	25 (32%)	53 (68%)	
46-60	17 (63%)	10 (37%)	
61 and above	1 (50%)	1 (50%)	

The table shows that the requirement of ventilator was more in females (58.3%) than in males (35%) without a significant association. Among the various age groups, it was noted that 63% patients in the age category 46 to 60

years had a requirement of ventilators as compared to 36.4% in 15-30 years and 32% in 31 to 45 years category than those who did not. This was statistically significant with a p-value less than 0.05.

Table 5: Mortality and Recovery Rates (N = 118)

Outcome	Number (%)
Mortality	30 (25.4%)
Recovery	88 (74.6%)
Total	118 (100%)

This table indicates that out of 118 patients, mortality was seen in 30 (25.4%) while 88 (74.6%) recovered during the study period.

Table 6: Association between age and gender with mortality

Parameters	Mortality N=30(25.4%)	Recovery N=88(74.5%)	p-value
Gender			
Male	22 (23.4%)	72 (76.6%)	0.31
Female	8 (33.3%)	16 (66.7%)	
Age Group (in years)			
15-30	1 (9%)	10 (91%)	0.37
31-45	19 (24.3%)	59 (75.7%)	
46-60	9 (33.3%)	18 (66.7%)	
61 and above	1 (50%)	1 (50%)	

Table 7: Secondary Complications and Mortality (N = 30)

Secondary Complication	Number (%)
Respiratory paralysis	10 (33.3%)
Respiratory and cardiac arrest	8 (26.7%)
Septic shock	7 (23.3%)
CNS depression	5 (16.7%)
Total	30 (100%)

This table now shows the distribution of secondary complications among the 30 deceased patients in the study, with percentages representing the proportion of each complication among the total deaths.

Table 8: Comparison of Parameters by Severity Scale

Parameters	Mild N =49(41.5%)	Moderate N= 37(31.3%)	Severe N= 32(27.1%)	p-value
1-Atropine Requirements				
(A)-Initial 24 Hrs Dose (Mean)	32.14	79.48	135.47	< .05
(B)-Total Illness Dose (Mean)	61.4	134.25	328.15	< .05
2- Mean Time Delay				
(A) < 4 Hrs (N = 83)	30(36.1%)	27(32.5%)	26(31.3%)	-
(B) > 4 Hrs (N = 35)	19(54.2%)	10(28.5%)	6(17.1%)	-
3-Mean Length of Stay (Mean±SD)	6.14 ±1.38	11.81 ±3.68	13.5 ±4.29	.05
4-Mortality, N=30 (25.4%)	4(13.3%)	11(36.6%)	15 (50%)	<.05

The study categorized patients into three severity levels —mild, moderate, and severe—based on the parameters of acute organophosphorus poisoning. Atropine requirements during the initial 24 hours and total illness doses also showed significant increases with severity, with mean initial doses of 32.14 mg in mild cases, 79.48 mg in moderate cases, and 135.47 mg in severe cases ($p < 0.05$), and mean total doses of 61.4 mg, 134.25 mg, and 328.15 mg, respectively ($p < 0.05$). The mean time delay from exposure to treatment showed longer intervals in more severe cases, with 30 patients (36.14%) in the < 4 hours group and 19 patients (19.46%) in the > 4 hours group in mild cases, compared to 27 (29.73%) and 10 (10.31%) in moderate cases, and 26 (26.55%)

and 6 (6.19%) in severe cases. Mean hospital durations also increased with severity, with mild cases averaging 6.14 ± 1.38 days, moderate cases 11.81 ± 3.68 days, and severe cases 13.5 ± 4.29 days ($p = 0.05$). Mortality rates were notably lower cases, with 4 deaths (13.33%) compared to 11 deaths (36.67%) in moderate cases and 15 deaths (50%) in severe cases, that was statistically significance with p-value lesser than 0.05.

Discussion

The demographic profile of our study cohort, consisting of 118 patients with acute organophosphorus poisoning, reveals significant trends in age distribution and gender predominance. Most patients fell

within the 31-45 age group (66.1%), reflecting a demographic likely exposed due to occupational or environmental factors associated with pesticide handling. This age distribution underscores the vulnerability of economically active individuals to such toxic exposures. This was in contrast to the finding of maximum cases below thirty years of age in studies done in Africa (70%) and Pakistan (80%) [7,8].

Gender-wise, the sample skewed heavily towards males (79.7%), consistent with higher male representation in occupations involving pesticide application or industrial settings. This was higher than 56% and 58.7% found in other studies [7,9]. This was due to more males having out of house movements due to societal and employment reasons and easy availability of the compounds.

Regarding the types of organophosphorus poisoning observed, methyl parathion emerged as the most frequently encountered compound (23.7%), followed by chlorpyrifos (19.5%) and Monocrotophos (15.3%). Methyl parathion was the most common poison consumed (27%) followed by Chlorpyrifos (22%) in the study by Banerjee et al-[10], while Dimethoate was most common in the studies of Banday et al-[11]. Other Asian countries have chlorpyrifos, dichloro and parathion in the decreasing order of frequency [12,13].

This variation in the type of poison consumed can be attributed to the regional availability of pesticides in different regions with different farming practices. Such insights are crucial for targeted prevention strategies and regulatory interventions aimed at mitigating pesticide-related health risks.

Clinical manifestations in our patients exhibited a diverse array of symptoms, encompassing both muscarinic and nicotinic effects typical of organophosphorus poisoning. The common clinical features observed were nausea and vomiting (80.5%), miosis (74.5%), and abdominal pain (66.1%), altered sensorium (55.9%), and fasciculations (32.2%). On the other hand nausea and vomiting was noted in 83% cases in another study [14]. There were 30% cases in another study with diarrhoea in comparison to ours (18%)-[9]. Respiratory symptoms, including pulmonary edema (30.5%) and oronasal froth (24.5%), leading to the severity of respiratory compromise in affected individuals. The nicotinic manifestations, notably skeletal muscle issues like fasciculations (32.2%) and paralysis (15.2%), alongside autonomic dysregulation (e.g., tachycardia and hypertension), further delineated the multisystemic impact of these toxins. The common clinical presentations in the study by V. Khonje et al were miosis, bronchorrhea, fasciculations and diarrhea in the decreasing order of frequency-[7]. These variations in the clinical features can be attributed to different lipophilicity, volume of distribution and/or body mass index. A Korean study noted that higher body mass

index was associated with prolonged mechanical ventilation, extended stays in the intensive care unit (ICU), and an increased total length of hospital admission- [15].

Mechanical ventilation was required for 39.8% of our patients, indicating significant respiratory distress with or without altered sensorium and the need for intensive care support. The need for ventilation was seen in 58.3% females compared to 35% males even though males were four-fold commoner than females in our study. Although, this was not statistically significant. Most of the patients (63%) who were ventilated were in the age 46 to 60 years group as compared to the younger ones. This was lesser (39.8%) compared to ventilatory support requirement in another study (53.7%)-[7]. In that study indication of ventilation was mostly due to respiratory involvement while our cases had more neurological manifestations than respiratory. This was in favour of an Indian study by Gagarin P.Y. et al- [14]. The association between age and need of ventilatory support was significantly positive. This could be due to age factor and comorbid conditions.

Mortality rates were substantial, with 25.4% of patients succumbing to the poisoning, predominantly in severe cases characterized by markedly escalated atropine requirements. We did not find a significant difference between mortality and gender and age category but death was more in females (33.3%) compared to males (23.4%). This was supported by another study-[16]. In contrast another study with predominantly male patient in it showed higher (78.9%) mortality as compared to female cases (21.1%)-[17]. In the clinical evaluation early diagnosis and prompt management lead to mitigating adverse outcomes. All our patients who expired were moderate to severely affected and hence were being treated in critical care. Sungur et al. reported a mortality rate of 50% for the patients who were mechanically ventilated and 21.6% for the patients who were not. Shah et al. in their study observed complete recovery and mortality rate as 66.47% and 16.47% among cases respectively-[18,19]. The severity assessment using the POP scale revealed that patient who were in the more severe group needed escalation of the therapy with high atropine doses, more of organ support, prolonged intensive care unit and hospital stay and mortality.

Conclusion

This study highlights the significant burden of organophosphorus poisoning on public health, particularly affecting the young, economically active males. The analysis suggests the need of early diagnosis and prompt management in improving outcomes. Severe cases demonstrated higher atropine requirements, and prolonged hospital stays, necessitating intensive care and mechanical ventilation in a substantial proportion of patients. The findings

emphasize the need for enhanced preventive strategies, regulatory interventions, and fast visit to the health care facility. Continued research is essential to validate these findings across diverse settings and to refine treatment approaches, ultimately aiming to reduce mortality and improve recovery rates.

Limitations of our study include its retrospective design and potential biases inherent in data collection methods. Variations in individual patient responses to treatment modalities and differences in pesticide formulations may have influenced clinical outcomes. Future research could benefit from prospective, multicenter studies to validate findings across diverse geographical and occupational settings, further refining treatment algorithms and enhancing patient care strategies in Organophosphorus Poisoning.

References

- Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world. *Q J Med.* 2000; 93:715-731. doi: 10.1093/qjmed/93.11.715.
- Wadia RS. Treatment of organophosphate poisoning. *Indian J Crit Care Med* 2003, 7:85-87
- Karalliedde L, Eddleston M, Murray V. The global picture of organophosphate insecticide poisoning. In: Karalliedde, Feldman F, Henry J, Marrs T, editors. *Organophosphates and Health*. London Imperial Press, 2001:432-71.
- Jeyaratnam J. Acute pesticide poisoning, a major health problem. *World Health Stat Q* 1990; 43:139-45.
- Mutalik GS, Wadia RS, Pai VR. Poisoning by diazinon an organophosphorous insecticide. *J Indian Med Assoc* 1962; 38:67-70.
- Ganesvaran T, Subramaniam S, Mahadevan K. Suicide in a northern town of Sri Lanka. *Acta Psychiatrica Scandinavia* 1984; 69:420-5.
- Vanessa Khonje, Jedd Hart, Jakus Venter, Saisha Deonarain, Saul Grossberg, Acute organophosphorus toxicity in a regional hospital in Johannesburg, South Africa: A retrospective chart review, *African Journal of Emergency Medicine*, Volume 13, Issue 2, 2023, Pages 104-108, ISSN 2211-419X, <https://doi.org/10.1016/j.afjem.2023.04.002>.
- Amir A, Raza A, Qureshi T, Mahesar GB, Jafferri S, Haleem F, Ali Khan M. Organophosphate poisoning: demographics, severity scores and outcomes from national poisoning control Centre, Karachi. *Cureus.* 2020; 12(5):e8371. doi: 10.7759/cureus.8371. PMID: 32626615; PMCID: PMC7328692.
- Bhattad PH, Bhattad SP. Clinical profile of patients with acute organophosphorus poisoning in a tertiary care hospital. *Int J Res Med Sci* 2022; 10:2236-9.
- Banerjee I, Tripathi S, Roy AS. Clinico-epidemiological characteristics of patients presenting with organophosphorus poisoning. *N Am J Med Sci.* 2012;4(3)147-150. doi: [Article] [Crossref] [PubMed] [Google Scholar]
- Banday TH, Tathineni B, Desai MS, Naik V. Predictors of Morbidity and Mortality in Organophosphorus Poisoning- A Case Study in Rural Hospital in Karnataka, India. *N Am J Med Sci.* 2015;7(6)259-265. doi: [Article] [Crossref] [PubMed] [Google Scholar]
- Reddy BS, Skaria TG, Polepalli S, Vidyasagar S, Rao M, Kunhikatta V, Nair S, Thunga G. Factors associated with outcomes in organophosphate and carbamate poisoning: a retrospective study. *Toxicol Res* 2020; 36(3):25
- Perera PM, Shahmy S, Gawarammana I, Dawson AH. Comparison of two commonly practiced atropinization regimens in acute organophosphorus and carbamate poisoning, doubling doses vs. ad hoc: a prospective observational study. *Hum Exp Toxicol* 2008; 27(6):513-18 PMID: 18784205; PMCID: PMC3145133. doi: 10.1177/0960327108091861.
- Gagarin PY, Rajagopal RL. Clinical profile and outcome of organophosphorus poisoning in a tertiary care centre, a prospective observational study. *Int J Med Res Rev.* 2020; 8(2):148-153.
- Lee DH, Jung KY, Choi YH, Cheon YJ. Body mass index as a prognostic factor in organophosphate-poisoned patients. *Am J Emerg Med.* 2014 Jul; 32(7):693-6.
- Razwiedani L, Rautenbach P. Epidemiology of Organophosphate Poisoning in the Tshwane District of South Africa. *Environmental Health Insights.* 2017; 11. doi: 10.1177/1178630217694149.
- Sontakke T, Kalantri S (July 02, 2023) Predictors of Mortality in Hospitalized Patients with Pesticide Poisoning. *Cureus* 15(7): e41284. doi:10.7759/cureus.41284.
- Sungur M, Guven M. Intensive care management of organophosphate insecticide poisoning. *Crit Care.* 2001; 5(4):211-215.
- Shah SM, Asari PD, Amin AJ. Clinico-epidemiological profile of patients presenting with acute poisoning. *Int J Curr Res Rev.* 2016; 8(13):35-41.