

# Study of organophosphorus compound poisoning in a tertiary care hospital and the role of Peradeniya Organophosphorus Poisoning scale as a prognostic marker of the outcome

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## ABSTRACT

**Introduction:** Organophosphate compounds (OPC) cause most self-poisoning deaths in India due to their easy availability and lack of stringent laws. **Aim:** To evaluate the clinical profile and outcome of the patients presenting with OPC poisoning and to study the prognostic value of Peradeniya Organophosphorus Poisoning Scale (POPS) in predicting the clinical outcomes. **Methods and Materials:** This was a prospective study involving 100 patients of OPC poisoning admitted to Tata Main Hospital from June 2018 to May 2020 based on the inclusion criteria. Demographic profile, clinical features, treatment details, and need for ventilatory support were noted. POPS was applied on admission, and the patients were followed up for the outcome in terms of morbidity and mortality. **Observations:** Of the 100 patients, most patients were between 20 and 29 years with male to female ratio being 1.2:1. Vomiting (94%), followed by excessive secretions (84%) were the most common symptoms. Overall mortality was 22%. On grading of severity as per the POP scale, 27% of the patients had mild poisoning, 37% patients had moderate, whereas 36% had severe poisoning. Only 11.11% of the patients with POPS 0-3 required ventilator support, whereas 16.2% of the patients with POPS 4-7, and 100% of patients with POPS 8-11 required ventilator assistance ( $P < 0.0001$ ). Similarly, the total dose of atropine required ( $P < 0.0001$ ), length of intensive care unit (ICU) stay, complications, and mortality ( $P < 0.0001$ ) were significantly associated with higher POPS. **Conclusion:** POPS at admission, correlated well with the need for ventilator support, the total dose of atropine required, length of stay in the ICU, complications, and mortality. It can thus be used for prognostication and risk stratification of patients with OPC poisoning.

**Keywords:** Clinical score, organophosphorus, pesticides, poisoning, respiratory

## Introduction

Organophosphorus compounds (OPC) are commonly used as pesticides not only in agriculture and horticulture but also in households for control of vector-borne diseases such as malaria, dengue, etc., and are responsible for about 200,000 deaths due

to pesticide poisoning in the developing world.<sup>[1]</sup> According to the world health organization (WHO) report 2012, worldwide, there were about 193,460 deaths due to unintentional poisoning and 370,000 deaths due to suicidal pesticide poisoning.<sup>[2]</sup> The problem is more pronounced in rural Asia. In India, deaths due to OPC poisoning are more common in southern and central India.<sup>[3]</sup> They are widely used for self-harm due to their ready availability and easy accessibility.<sup>[4]</sup> In Indian studies, the incidence of suicidal poisoning using OPC ranges from 10.3% to 43.8%.<sup>[5]</sup> The situation is not different in the current COVID-19 pandemic,

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which has caused a lot of mental stress, anxiety, and depression. In a study done in Nepal by Shrestha R *et al.*,<sup>[6]</sup> OPC poisoning was still the most common mode of self-harm and suicide (56.4%).

OPC are irreversible inhibitors of choline esterase and pseudocholinesterase (butyrylcholinesterase) enzymes, which cause the breakdown of acetylcholine (neurotransmitter) into choline and acetic acid.<sup>[4,5]</sup> The clinical features of OPC poisoning comprise a triphasic response which includes an initial acute cholinergic phase, an intermediate syndrome (which is associated with high mortality), and nonlethal delayed polyneuropathy associated with morbidity. The cholinergic phase is characterized by symptoms produced due to excessive acetylcholine (ACh) level at the nicotinic, muscarinic, and central nervous system receptors and includes excessive salivation, lacrimation, abdominal cramps, vomiting, urination, and loose stools. They occur within minutes to hours of consumption of the compound. The signs include tachycardia or bradycardia, hypotension, miosis, frothing from the mouth, sweating, bronchospasm, and fasciculations.<sup>[4,5]</sup> These clinical features determine the severity of poisoning and are of prognostic importance. The mortality rate varies from 16.7% to 40% in the hospitalized patients.<sup>[7]</sup>

Early identification and aggressive management are often lifesaving, and hence predictive prognostic features would be useful for the clinicians to stratify the patients according to their risk of deterioration. Many clinical and laboratory parameters have been used to assess the severity of poisoning and to predict the clinical outcomes in patients admitted with OPC poisoning.

The Peradeniya Organophosphorus Poisoning Scale (POPS) was one such attempt. It was developed by N Senanayake, HJ de Silva, and L Keralliceede, University of Peradeniya, Sri Lanka to assess the severity of OP intoxication.<sup>[4,8]</sup> It is an integrated scale that incorporates five common parameters of OP poisoning (pulse rate, respiratory rate, pupil size, fasciculations, level of consciousness, and seizure activity). Each parameter is scored from 0 to 2 at the initial presentation.<sup>[8]</sup> Various studies have demonstrated its usefulness in predicting morbidity and mortality in OPC poisoning.<sup>[4,9]</sup> As there is little data from the eastern part of the country, this study was undertaken to validate the role of POPS in predicting the severity of OPC poisoning and its clinical outcome.

### Aim of the study

1. To study the clinical profile and outcome of the patients presenting with OPC poisoning at a tertiary care hospital.
2. To study the prognostic value of the POPS in predicting the outcome of OPC poisoning.

### Methods and Materials

This was a prospective observational study conducted in Tata Main Hospital, Jamshedpur, Jharkhand. The study population constituted patients admitted in the medical wards and critical

care unit with the following inclusion criteria during the study period from June 2018 to May 2020 (2 years). The study was given clearance by the Institutional Ethics Committee (IEC). A consecutive sampling method was followed for recruiting the patients. Following patients were included in the study.

### Inclusion criteria

1. History of exposure or contact with organophosphorus pesticides (either sex and above 12 years) given by patient or attendant and examination of the container when available.
2. Characteristic clinical symptoms and signs of OPC poisoning (increased salivation, diarrhea, vomiting, sweating, fasciculations, and confusion) and characteristic odor of stomach wash or vomitus.

### Exclusion criteria

1. Patients with chronic exposure to pesticide/OPC poison
2. Non-OPC compound poison inhalation/exposure/consumption

### Data collection techniques and tools

Preformed proforma was used to note the demographic characteristics such as age, gender, occupation, socioeconomic and marital status and history such as mode of poisoning, type of poison, route of poisoning, time of onset of symptoms after intake of poison, history of alcoholism and other addiction, psychiatric illness, and specific symptoms of OPC poisoning. General physical examination with the recording of the vital parameters was done every 4 hours a day or more frequently as per the case. Signs specific to OPC poisonings such as the smell of the poison, miosis, diaphoresis, oronasal frothing, the involuntary passage of urine and stools, level of consciousness, and fasciculations were noted.

**Laboratory parameters** tested included complete blood picture including platelet count, liver function tests [serum bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), serum proteins (albumin and globulin), prothrombin time, international normalized ratio (INR)], and renal function tests (blood urea and serum creatinine). These were done using automated biochemical analyzers, on the day of admission and repeated every 48 h till discharge or death. Chest radiography and electrocardiogram were performed on the first or second day of admission and repeated if needed. Echocardiography was performed as per the discretion of the treating physician.

**Treatment protocol:** All patients were treated according to the standard line of management of OPC poisoning which included decontamination, blockade of muscarinic hyperactivity with atropine or glycopyrrolate, reversal of cholinesterase inhibition with oxime nucleophiles (pralidoxime), and correction of metabolic abnormalities. In unconscious patients, the adequate airway was maintained by endotracheal intubation, and ventilatory support was given, whenever indicated.

## Peradeniya Organophosphorus Poisoning (POP) scale

This scale was developed by N Senanaayake *et al.*<sup>[8]</sup> to assess the severity of OPC poisoning. Five common clinical manifestations of OPC poisoning have been selected as parameters, each were assessed on a 3-point scale varying from 0 to 2. The POP scale as shown in Table 1 was applied to all study subjects at the time of admission, and cases were graded as mild (score 0–3), moderate (score 4–7), and severe (score 8–11) poisoning.

**Clinical outcomes** included were the length of stay (LOS), complications, dose of atropine required, requirement of ventilatory support, duration of support, and mortality. Correlations between the scores obtained on admission and outcome variables mentioned above was studied.

**Statistical analysis:** Continuous variables were summarized as mean  $\pm$  SD. For categorical variables, the percentages of patients in each category were calculated, and appropriate statistical test – Pearson's chi square test and odd's ratio were applied as indicated. The data were tabulated in Microsoft Excel and later analyzed using statistical package for social science (SPSS) software. A *P* value less than 0.05 was considered statistically significant.

## Results

A total of 100 subjects were enrolled, of which 54 (54%) were males and 46 (46%) were females, the male to female ratio being 1.2:1. The age of the study participants ranged from 15 to 74 years with the mean ( $\pm$ SD) being 32 ( $\pm$ 13.06) years. Most patients were between 20 and 29 years (28%), followed by 21% of patients in the age group 30–39 years. Only 8 (8%) patients were beyond the sixth decade of life. The age and sex distribution of cases are as shown in the Figure 1. Whereas 76 (76%) patients

consumed poison with suicidal intent, 24 patients (24%) had an accidental exposure. Occupation-wise, 34% of the patients were housewives, 26% were agriculture laborers, teachers and students were 8% and 4%, respectively.

The various compounds consumed by the patients included nine OPC chemicals. The most commonly consumed compound was monocrotophos (23%) followed by dichlorfos (13%). Other compounds taken were malathion and profenofos (12%). Our study included only those patients who presented within 24 h of consumption of the compound. The majority of the patients (42%) presented within 5–8 h of consumption of poison, 32% came within 1–4 h, whereas the delay in admission was more than 8 h in 26% of the patients. The mean delay in admission was  $3.7 \pm 4.8$  h.

The commonest symptom noted was vomiting (94%), followed by excessive secretions (84%). Seventy percent of the patients had breathlessness, and 28% of the patients had diarrhea. Altered levels of consciousness and seizures were relatively uncommon presentations and were reported by 22% and 12% of the patients, respectively [Figure 2].

Of the 100 patients enrolled in the study, 78 patients (78%) improved. The overall mortality in our study was 22% with the cause of death being ventilator-associated pneumonia (VAP) in 14 (14%) patients and sepsis with multi-organ dysfunction syndrome (MODS) in 8 (8%) patients. Other complications which could have contributed to the mortality were intermediate syndrome (IS) in 8 (8%) patients and acute kidney injury (AKI) in 13 (13%) with serum creatinine more than 5 mg/dL in 6 (6%) patients. Mean serum creatinine was 4.70 mg/dL  $\pm$  2.03 and 2.45 mg/dL  $\pm$  1.65 in the expired and survived group, respectively. Whereas the mean serum potassium level was 5.01 mmol/L  $\pm$  0.496 in the expired group and was 4.58 mmol/L in the survival group, which was statistically significant ( $P < 0.0001$  and  $P = 0.0179$ , respectively).

Using the POP scale, 18% of the patients had a POP scale score of 10, and 12% had a score of 5. A POPS score of 3 and 4 was present in 8% each of the patients. Two patients had a POPS score of 0, whereas four patients had a full score of 11. According to the severity of poisoning using POPS score, 36% of the patients had severe poisoning, whereas 27% had mild poisoning, and 37% of the patients had moderate poisoning [Figure 3].

Only 11.11% of the patients with mild poisoning needed ventilatory support, whereas 16.2% of patients with moderate poisoning and 100% of patients with a severe grade of poisoning required ventilator assistance. This was statistically significant (95% CI-0.3253 to 0.6264, Pearson's correlation coefficient  $r = 0.4903$ ,  $P$  value 0.0001) [Table 2].

The mean total dose of atropine needed for treatment in patients with mild poisoning was 146.37 mg. In moderate

**Table 1: Peradeniya Organophosphorus Poisoning (POP) scale**

Parameters	Value	Points
Pupil size	>2 mm	0
	<2 mm	1
	Pin point	2
Respiratory rate	>20	0
	<20	1
	<20 with central cyanosis	2
Heart Rate	>60	0
	41-60	1
	<40	2
Fasciculations	Absent	0
	Present-generalized/continuous	1
	Generalized and continuous	2
Level of Consciousness	Conscious and coherent	0
	Impaired	1
	No response to verbal commands	2
Seizures	Absent	0
	Present	1

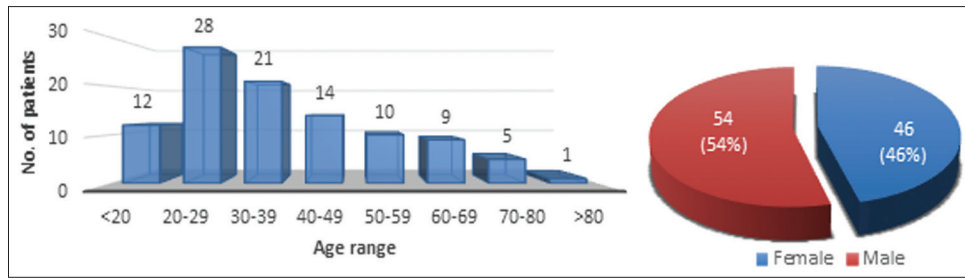


Figure 1: Age and gender distribution of patients (n = 100)

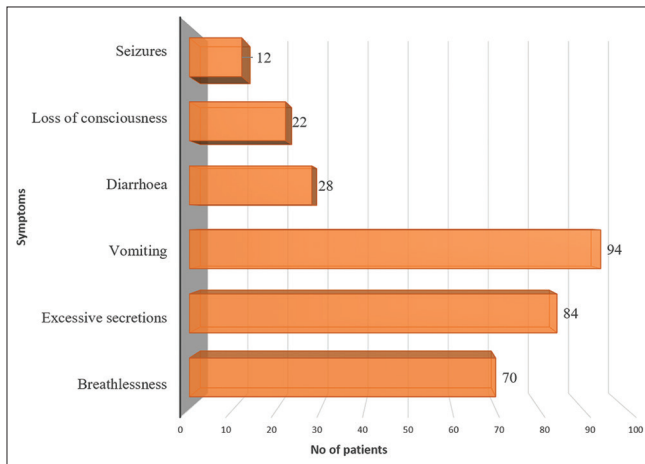


Figure 2: Bar diagram showing frequency of symptoms (n = 100)

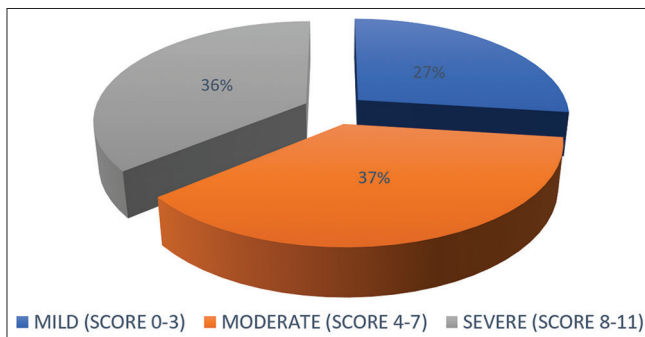


Figure 3: Pie chart showing the distribution of severity of cases as per POP score (n = 100)

grade of poisoning, it was 176.89 mg, whereas in severe grade poisoning, it was 323.19 mg. When analyzed by ANOVA test, these associations were found to be statistically significant (F-ratio-16.769,  $P < 0.001$ ).

All patients except one with mild grade poisoning in POPS scale improved. The mortality rate was 5.4% in moderate grade poisoning and 52.8% in severe poisoning. This association was found to be statistically significant (95% CI- 0.3073 to 0.6141,  $r=0.475$ ,  $P < 0.0001$  [Table 3]).

The mean duration of treatment in mild grade poisoning was  $5.1 \pm 1.02$  days. It was  $7.2 \pm 2.3$  days for moderate grade poisoning and  $10.5 \pm 3.4$  days for severe poisoning. When

analyzed by ANOVA test, these associations were found to be statistically significant between the groups (F-ratio-3.865, significance level  $P < 0.001$ ).

The mean duration of ICU stay was  $<7$  days in 24 (88.9%) out of 27 mild cases, 7 (18.9%) of 37 moderate cases, and one of 36 (2.9%) severe cases, whereas 3 (11.1%) of the 27 mild cases, 30 (81.8%) of the 37 cases, and 35 (97.2%) of the 36 severe cases required ICU stay of  $>7$  days.

Analyzing each component of the POP score [Table 4], only one patient without miosis required ventilatory support. Among the patients with miosis score of 1, 8.3% required ventilation, whereas those with pinpoint pupil, 80% required ventilatory support which was statistically significant ( $P < 0.0001$ ). A total of 14.3% of the patients without fasciculations required ventilatory assistance. In those with fasciculation scores 1 and 2, 78.6% and 100% of patients, respectively required ventilatory support ( $P < 0.0001$ ). Those patients who had respiratory rate  $<20$ /min did not require ventilator support. But 71.1% of patients with respiratory rate  $>20$ /min and 100% of the patients with tachypnoea and cyanosis at the time of admission required ventilatory support ( $P < 0.0001$ ). Among the patients with a pulse rate  $> 60$ /min, 6.3% required ventilatory support. A total of 72.7% of the patients with pulse rate 41–60/min and 100% of the patients with  $<40$ /min needed ventilator support ( $P < 0.0001$ ). A total of 17.4% of fully alert patients needed ventilatory assistance. Of those with impaired level of consciousness, 92.9% required ventilator support, and 92.3% of patients in a stuporous state were connected to the ventilator ( $P = 0.0044$ ). Eight patients (8%) developed seizures and all needed ventilatory assistance ( $P = 0.0033$ ).

Monochrotophos was the most commonly consumed compound. Phorate proved to be the most toxic compound in the list. Sixty percent of the patients who consumed phorate needed ventilatory support, whereas only 28.5% of patients with chlorpyrifos poisoning needed ventilatory assistance. Mortality was highest (38.46%) in patients who consumed dichlorfos. A mortality rate of 33.33% was seen in patients who consumed profenofos and difenofos, and 28.57% in those patients who consumed chlorpyrifos and diazinon. However, no significant association was found between the compounds consumed and clinical outcome ( $P = 0.39$ ).

**Table 2: Association between POP score and need for ventilator support**

POPS Severity	Ventilator Support		Total	Chi square	P
	No	Yes			
Mild					
Count	24	3	27	68.914	P<0.0001
percent	88.89%	11.11%	100.0		
Moderate					
Count	31	6	37		
Percent	83.78%	16.22%	100.0		
Severe					
Count	0	36	36		
Percent	0.00%	100.00%	0.00%		

**Table 3: Correlation between POPS score and clinical outcome (survival) (n=100)**

POPS Scale	Outcome		Chi square	P
	Expired	Survived		
Mild (score 0-3)				
Count	1	26	36.918	P<0.0001
Percent	3.70%	96.30%		
Moderate (score 4-7)				
Count	2	36		
Percent	5.4%	94.6%		
Severe (score 8-11)				
Count	19	16		
Percent	52.8%	48.2%		

**Table 4: Comparison of individual components of POP scale in predicting the clinical outcome**

POP parameters	Points	Survival		Total	Chi square	P
		Yes	No			
Miosis	0	42	1	43	36.651	P<0.0001
	1	22	2			
	2	14	19			
Fasciculations	0	70	6	76	38.491	P<0.0001
	1	6	8			
	2	2	8			
Respiratory rate	0	55	0	55	54.557	P<0.0001
	1	22	10			
	2	1	12			
Pulse rate	0	64	2	66	50.736	P<0.0001
	1	12	8			
	2	2	12			
Level of consciousness	0	56	8	64	50.736	P=0.0044
	1	20	11			
	2	2	3			
Seizures	0	70	14	84	8.615	P=0.0033
	1	8	8			

### Discussion

Self-poisoning with OPC pesticides is a major public health problem across most rural Asia.<sup>[10,11]</sup> Every year, of the estimated 500,000 deaths from self-harm in the region, about 60% are due to pesticide poisoning, and OPC accounts for two-thirds of these

deaths.<sup>[12]</sup> Deaths from intentional poisoning are more common in regions where highly toxic OPC pesticides are readily available. Respiratory failure is the main cause of mortality in OPC poisoning. Its cause is multifactorial and includes aspiration of gastric contents, loss of central respiratory drive, bronchorrhoea resulting in fluid overload in the lungs causing hypoxia due to stimulation of nicotinic receptors, followed by neuromuscular junction failure producing respiratory muscle paralysis.<sup>[5,13]</sup> Many of these patients require ventilator support.

In a study by Chintale KN *et al.*,<sup>[3]</sup> of the total 136 cases, 112 (82.35%) cases were suicidal, accidental cases were 19 (13.67%), and 5 (3.67%) cases were homicidal. A study done by Agarwal *et al.*<sup>[14]</sup> reported 67.4% of the cases had suicidal intent, whereas 15.8% of the cases were due to accidental poisoning. However, a study by Khan FY *et al.*<sup>[15]</sup> reported a much higher incidence of accidental exposure in 87.3% of patients in Qatar. In our study, there was no case of homicidal poisoning, whereas 76% cases were suicidal, and 24% cases were accidental poisoning, probably because these compounds are cheap, easily available over the counter, and commonly used as a major pesticide in agricultural farming throughout India.

Studies done by Gannur DG *et al.*,<sup>[16]</sup> Nigam M *et al.*<sup>[17]</sup>, and Kar SM *et al.*<sup>[18]</sup> revealed the highest incidence of poisoning in the young age group of 16–30 years. Our observation was similar to these studies. The younger age individuals are more impulsive, ambitious, constitute the working class, and have more responsibilities on their shoulders. Therefore, during this phase of life, they are most vulnerable to various emotional conflicts.

In our study, males outnumbered the females (54%). Similar male preponderance was observed by Goel *et al.*,<sup>[19]</sup> Gannur DG *et al.*,<sup>[16]</sup> Rehiman *et al.*,<sup>[20]</sup> and Khan FY *et al.*<sup>[15]</sup> in their studies. However, in studies by Joshi S *et al.* (70.2%),<sup>[21]</sup> Dubey TN *et al.* (52%)<sup>[4]</sup>, and Chaudhary R *et al.* (70.2%),<sup>[7]</sup> there was a female preponderance of cases.

The commonest mode of OPC poisoning was oral intake in our study (95%) followed by inhalational mode (5%). Similar results were reported in the study by Chintale KN *et al.*,<sup>[3]</sup> which reported oral intake in 97 (71.32%) patients followed by combined dermal and inhalation mode of exposure in 24 (17.64%) patients, inhalational exposure in 9 (6.61%) patients, and dermal mode of exposure in 4 (2.94%) patients. Yürümez *et al.*<sup>[22]</sup> reported ingestion followed by inhalation as a mode of poisoning in 86.8% and 9.3% of the patients, respectively.

Occupation-wise, most of the patients who consumed poison in our study were housewives (46%) and 26% were agriculture laborers. Domestic problems (30.6%), marital discord (21.8%), financial stress (30.3%), and alcohol abuse (9.3%) were important risk factors for suicidal pesticide consumption. These risk factors were respectively seen in 50.8%, 3.57%, 11.6%, and 9.8% of the patients in the study by Chintale KN *et al.*<sup>[3]</sup> Our study showed monochrotophos (23%) as the most common compound

consumed followed by dichlorofos (13%), whereas a study done by Rajeev H *et al.*<sup>[23]</sup> showed that the most commonly consumed compound was methyl parathion. This could reflect regional variations in the availability of the compounds according to local agriculture and economy.

In our study, the commonest symptom observed was vomiting (94%) followed by excessive secretions (84%). Seizure was present in 16% of the study group but relatively uncommon in other studies. Vomiting was also the commonest symptom reported in the study by Goel *et al.*<sup>[19]</sup> (97.08%). Excessive salivation was the most common symptom in the study by Chintale KN *et al.*<sup>[3]</sup> (72.1%) and Khan FY *et al.* (100%)<sup>[15]</sup> Other symptoms encountered in the study by Chintale KN *et al.*<sup>[3]</sup> were vomiting (23.5%), abdominal cramps (20.6%), diarrhea (13.97%), breathlessness (11.8%), agitation (10.3%), and convulsion (1.5%). In the study by Chintale KN *et al.*,<sup>[3]</sup> the commonest physical finding was miosis, found in 71.3% of the patients similar to that found in our study (57%). Whereas fasciculations were more common in the study by Chintale KN *et al.* (63.23%), it was noted only in 24% of the patients in our study. Other signs noticed in the study by Chintale KN *et al.*<sup>[3]</sup> and our study were bradycardia in 57.4% vs 34%, altered sensorium in 5.88% vs 36%, and oro-nasal frothing in 10.29% vs 26.1%, respectively.

According to Peradaniya score, 36% of the patients in our study had severe poisoning, 27% had mild poisoning, and 37% of the patients had moderate poisoning. Of the 45 patients who needed ventilatory support, 3/27 (11.1%) of the patients had mild poisoning (score 0–3), 6/37 (16.2%) of patients had moderate poisoning (score 4–7), and 36/36 (100%) of patients had severe poisoning (score 8–11). This was statistically significant ( $P$  value 0.0001). In a study by Soni P *et al.*,<sup>[24]</sup> involving 100 patients, 2/67 (2.28%) patients with mild poisoning, 4/19 (21.1%) patients with moderate poisoning, and 8/14 (57.14%) patients with severe poisoning respectively required mechanical ventilation. A similar observation was made by Philip SM *et al.*<sup>[25]</sup> and Goel A *et al.*,<sup>[19]</sup> in their studies. This indicates Peradaniya score can be used as a tool for the prediction of respiratory failure. Acute respiratory failure (less than 24 h) was seen in 33% of the patients with acute poisoning and was due to cholinergic overactivity.<sup>[5,8]</sup> In our study, of the 45 patients who required ventilator support, 30 (66.67%) required it within the first 24 h after exposure to organophosphorus compound. Tsao *et al.*<sup>[26]</sup> reported respiratory failure in 40.2% of his patients, of which 80.2% developed during 24 h after exposure, whereas Soni P *et al.*<sup>[24]</sup> reported early respiratory failure in 9/14 (64.3%) patients.

Peradaniya score was also correlated with the clinical outcomes. In a study by Vernekar PV *et al.*,<sup>[9]</sup> all patients in the mild group survived, whereas 2 of the 3 (66.6%) in the severe group and 4 of the 22 (18.18%) in the moderate group died. Hundred percent of patients with severe poisoning (POP score 11) died in a study by Dubey T *et al.*<sup>[4]</sup> Similar results were seen in our study – 1 of the 27 (3.7%) in the mild group, 2 of 37 (5.4%) in the moderate,

and 19 of 36 (52.8%) in the severe group expired. This result was of statistical significance ( $P < 0.0001$ ).

The total dose (mean  $\pm$  SD) of atropine received was significantly higher with a higher Peradeniya Score (higher grades of poisoning) in studies by Chaudhary R *et al.*<sup>[7]</sup> and Rehiman S *et al.* ( $P < 0.05$ ).<sup>[20]</sup> This was in comparison with our result. Further studies by Vernekar PV *et al.*,<sup>[9]</sup> Girish TS *et al.*<sup>[27]</sup>, and Prakash M *et al.*<sup>[28]</sup> revealed higher Peradeniya Score was associated with prolonged ICU stay ( $>7$  days), which was in concurrence with our observation.

When individual parameters of the POP scale namely miosis, fasciculations, respiratory rate, pulse rate, level of consciousness, and seizures were compared with the requirement of ventilatory assistance, all carried a significant correlation in our study. Rajeev H *et al.*<sup>[23]</sup> and Soni P *et al.*<sup>[24]</sup> in their study found that patients with pinpoint pupils and higher fasciculation scores had a significant association with the need for ventilatory support ( $P < 0.001$ ).

The overall mortality following OP poisoning described in various studies varies between 4% and 30%. Whereas in our study, it was 22%, in a study by Ahmed SM *et al.*,<sup>[5]</sup> it was 18.6%. In a study by Safdar *et al.*,<sup>[29]</sup> 20.4% of patients who were mechanically ventilated ultimately expired. In another study by Murat S *et al.*,<sup>[30]</sup> mortality was 50% in patients requiring mechanical ventilation. This was comparable to the mortality of 48.9% in our patients requiring ventilation. Mortality was 33.3% (3/9) in patients who required mechanical ventilation for more than 7 days, whereas it was 54.3% (19/35) in our study. Paradoxically, mortality was 100% (8/8) in those who needed mechanical ventilation for  $<2$  days in the study by Ahmed SM *et al.*,<sup>[5]</sup> probably due to the severe degree of poisoning in this group.

The complications reported in the study by Ahmed *et al.*<sup>[5]</sup> were AKI in 6.98% patients and VAP in 10.5% patients, whereas VAP was seen in 14% of our cases. Respiratory failure was the most common complication found in 8.1% of the patients followed by intermediate syndrome (IS) in six cases (4.4%), aspiration pneumonia in three (2.2%) patients, and septic shock in one (0.7%) patient in the study by Chintale KN *et al.*<sup>[4]</sup> AKI was not found in their study, whereas it was seen in 13% of our cases. The causes of AKI in OPC poisoning described in the literature are direct toxicity to renal tubules, rhabdomyolysis, hypovolemia due to dehydration, and oxidative stress.

Goel A *et al.*<sup>[19]</sup> showed a significant correlation between delay in initiating treatment and need of ventilatory support. The study by Soni P *et al.*<sup>[24]</sup> also showed 17% of their patients whose treatment was delayed by more than 3 h required ventilation. Similar findings were also observed in our study, where the mean delay in initiation of treatment was 9.64 h in the group requiring ventilation, whereas that of patients not requiring ventilation was 4.84 h, which was statistically significant ( $P < 0.001$ ). Rajeev H *et al.*<sup>[23]</sup> showed the time lag in starting the treatment directly affected the need for mechanical ventilation. A total of 91.7% of the patients

who presented beyond 4 h of poisoning required mechanical ventilation. Thus, the delay in the presentation and higher POPS score (severe grade of poisoning) were both associated with a greater need for ventilatory support and poor clinical outcomes.

## Conclusion

OPC poisoning leads to life-threatening intoxication. Most cases are due to suicidal intent due to easy availability. Delay in hospital admission is associated with poor outcomes. Increased severity of the poisoning according to POPS score at the time of admission is associated with higher dose of atropine for treatment, long duration of hospital stay, increased requirement of ventilatory support, increased rate of complications, and higher mortality. Individual parameters of the POPS score also correlate well with the clinical outcome. Thus, the Peradeniya OP poisoning scale is a useful marker to predict clinical outcomes in patients with OP poisoning and can be used for risk stratification in these patients.

## Relevance of the paper to the practice of primary care physician

Organophosphorus (OP) insecticide self-poisoning results in significant mortality and morbidity. This is particularly so in Asian countries due to the easy availability of these compounds. Proper and early treatment results in the resolution of the symptoms, whereas delay in treatment results in significant morbidity and deaths. Hence, the primary care physician should be aware of the clinical signs and symptoms of OP compound poisoning so as to initiate early and appropriate treatment. This paper gives an overview of OPC poisoning and our experience in the treatment of such patients.

## Key points

1. Organophosphate (OP) poisoning is a frequent cause for admission to hospitals and intensive care units in developing countries.
2. The clinical features are those of stimulation of peripheral (muscarinic and nicotinic) and central nervous system receptors resulting in salivation, lacrimation, urination, defecation, gastric cramps, and emesis (SLUDGE) symptoms in the acute phase.
3. Symptoms may occur as a continuum, wherein patients with acute symptoms may progress to develop delayed symptoms and signs of other systems. The severity of poisoning can be assessed using Peradeniya Organophosphorus Poisoning (POP) Scale.
4. Complications include respiratory failure, pneumonia, intermediate syndrome, renal failure, and death.
5. POP scale at admission, correlates well with the need for ventilator support, the total dose of atropine required, length of ICU stay, complications, and mortality and can thus be used for prognostication and risk stratification of these patients.

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## Conflicts of interest

There are no conflicts of interest.

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