



## Electrolyte Derangements as a Prognostic Marker in Acute Organophosphorus Poisoning

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### Abstract

**Background:** Organophosphorus compounds (OPC) are one of the common causes of poisoning in rural India. Although serum cholinesterase is used to diagnose OP compound poisoning, it is not a reliable marker in prognostication of OP poisoning. This study is done to analyze the role of serum electrolytes in assessing the prognosis of OP poisoning.

**Aim:** To estimate the serum electrolytes in patients, who consumed organophosphorus compound (OPC) and to determine its role in prognosis.

**Materials and Methods:** This is a prospective cross-sectional study. Seventy patients who have consumed OPC, admitted in Rajah Muthiah Medical College and Hospital were selected, with age of eighteen years and above. They were chosen regardless of the type of exposure and sex and were subjected for study. Assessment of patients was done clinically by Peradeniya OPC Poisoning scale and then patients were categorized based on severity. Serum electrolytes were estimated at the time of admission.

**Results:** Out of 70 patients in the study, 56 were male (80%) and 14 were female (20%) with male:female ratio of 4:1. Majority of patients belong to the age group between 18 and 30 years. Monocrotophos was the commonly consumed poison in this study and most patients presented with moderate clinical severity, graded based on peradeniya OP poisoning scale. Hypokalemia was the common electrolyte derangement observed in the study and it significantly correlated with increased ventilator requirement and mortality in OPC poisoning.

**Conclusion:** It was concluded from this study that hypokalemia contributes significantly to the ventilator requirement and outcome in OPC poisoning. Routine measurement of serum potassium should be done, as it can be a cost-effective and reliable marker and will be helpful in prognostication and predicting the outcome in OPC poisoning. Aggressive correction of hypokalemia can be a life saving measure in these patients.

**Keywords:** Organophosphorus compound poisoning, hypokalemia, prognosis.

### Introduction

Organophosphorus compounds are commonly used pesticides in India. By virtue of its low cost and easy availability, OP compound poisoning is more common in rural India. OPC are responsible

for approximately 50% of all poisoning deaths in India in the past 25 years. OPC inhibits acetyl cholinesterase enzyme, which is responsible for acetyl choline metabolism, resulting in the collection of acetylcholine at nicotinic and

muscarinic receptors<sup>(1)</sup>. This produces cholinergic symptoms depending upon the site of action of acetylcholine.

Once the patient consumes OP compounds, symptoms start to appear within 30 minutes. But it may also appear as late as 24 hours in lipophilic compounds<sup>(2)</sup>. The acronym SLUDGE describes muscarinic manifestation produced by OPC, which stands for salivation, lacrimation, urination, defecation, gastrointestinal distress, and emesis<sup>(3)</sup>. Muscle twitching, fasciculation and respiratory muscle paralysis are the prominent nicotinic manifestations<sup>(4)</sup>.

Respiratory paralysis is the major cause of mortality in OP poisoning, which can occur either in the acute cholinergic crisis phase or during the intermediate syndrome, which usually occurs within 1-4 days after consumption of poison<sup>(5)</sup>. Early recognition and prompt ventilatory assistance are of utmost importance in the survival of patients. Evidence-based protocol for prognostication in OP poisoning is not available. This study is designed to identify, whether serum electrolytes can be used to determine the prognosis in OP poisoning.

The present study was done with an objective to estimate Serum electrolyte levels in patients, who consumed OP compounds and to find its association with the outcome and ventilatory requirement in OP poisoning.

**Materials and Methods**

This is a prospective cross-sectional study conducted among the inpatients of acute OP poisoning, admitted in Rajah Muthiah Medical College and Hospital in the period between November 2018 and September 2020. After getting institutional human ethical committee clearance and informed consent from the patient or their attenders, seventy cases of acute OPC poisoning of both sexes, aged eighteen years and above, regardless of the type of exposure were selected and subjected for this study.

**Exclusion Criteria**

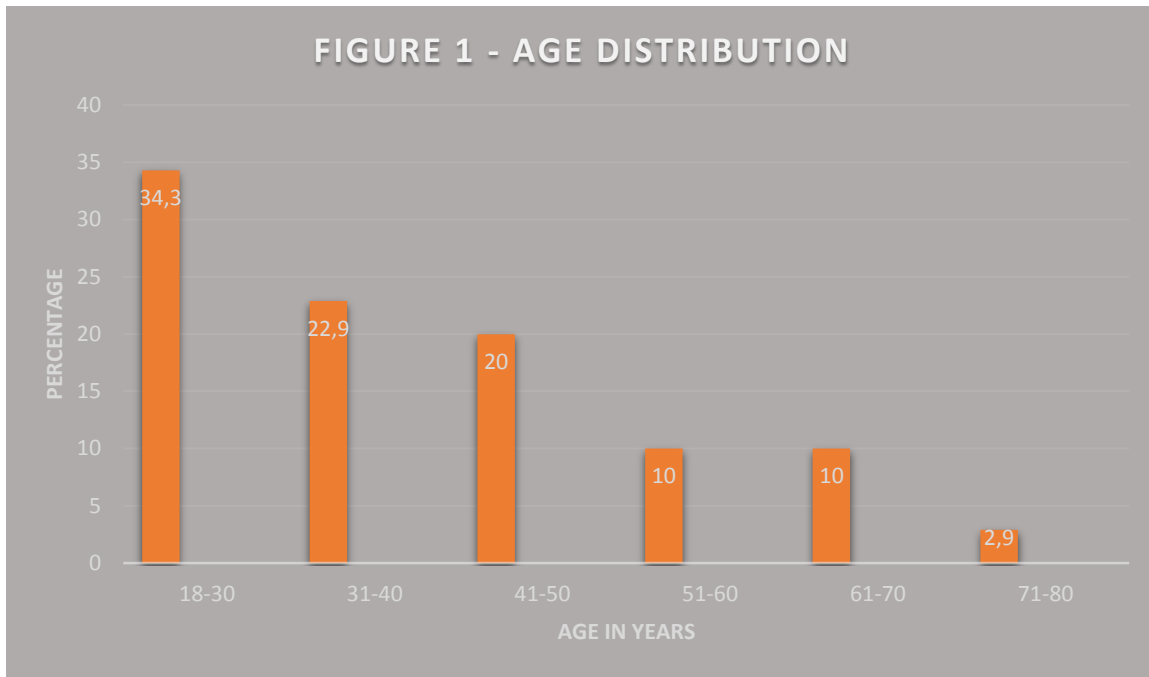
- Patient aged below 18 years
- Patient with a history of consumption of mixed poison
- Patients with known chronic kidney disease
- Patient on medications that cause electrolyte imbalance

Peradeniya OPC Poisoning scales was used on admission to categorize the patients clinically, based on severity. Routine investigations like blood sugar, serum creatinine, blood urea, serum acetyl cholinesterase and ECG were carried out for all patients. They were also subjected to the estimation of serum electrolytes during admission. Serum electrolytes were measured using indirect ion selective electrode method. Treatment was done as per protocol with atropine, pralidoxime, other supportive measures and mechanical ventilation, if needed. Assessment of Clinical course and outcome of the patients was done. Data were analyzed using Statistical Package of Social Sciences (SPSS) 23 software.

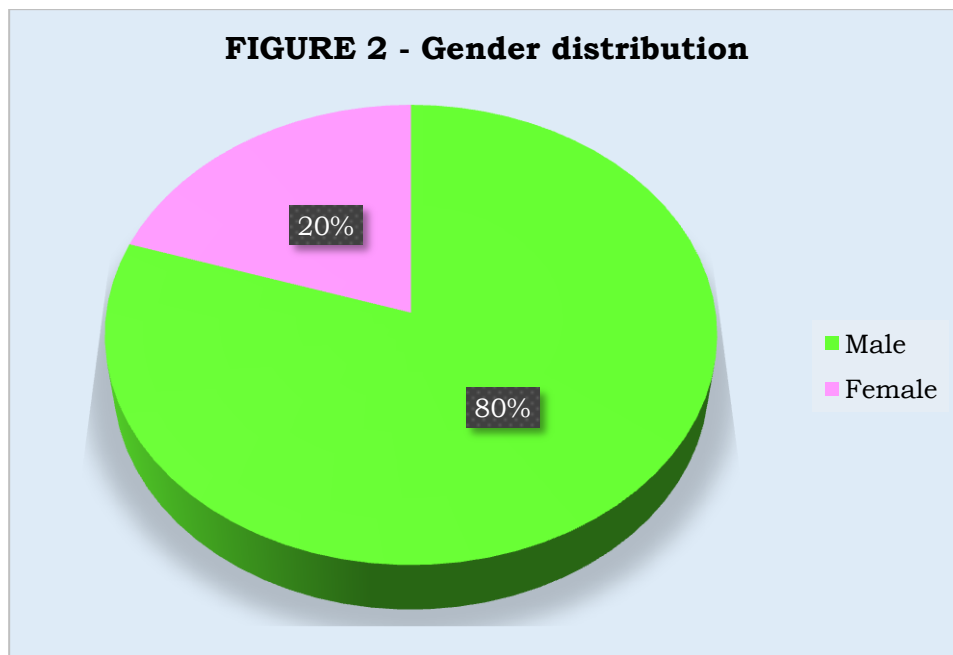
**Table 1** The Peradeniya OPC Poisoning scale

Parameters	Criteria	Score
Pupil size	> 2 mm	0
	< 2 mm	1
	Pin point	2
Respiratory rate	< 20/ min	0
	> 20/ min	1
	> 20/ min with central cyanosis	2
Heart rate	> 60/ min	0
	41 – 60 min	1
	< 40/ min	2
Fasciculation	None	0
	Present, generalized/ continuous	1
	Both generalized and continuous	2
Level of consciousness	Conscious and rationale	0
	Impaired response to verbal commands	1
	No response to verbal commands	2
Seizures	Absent	0
	Present	1

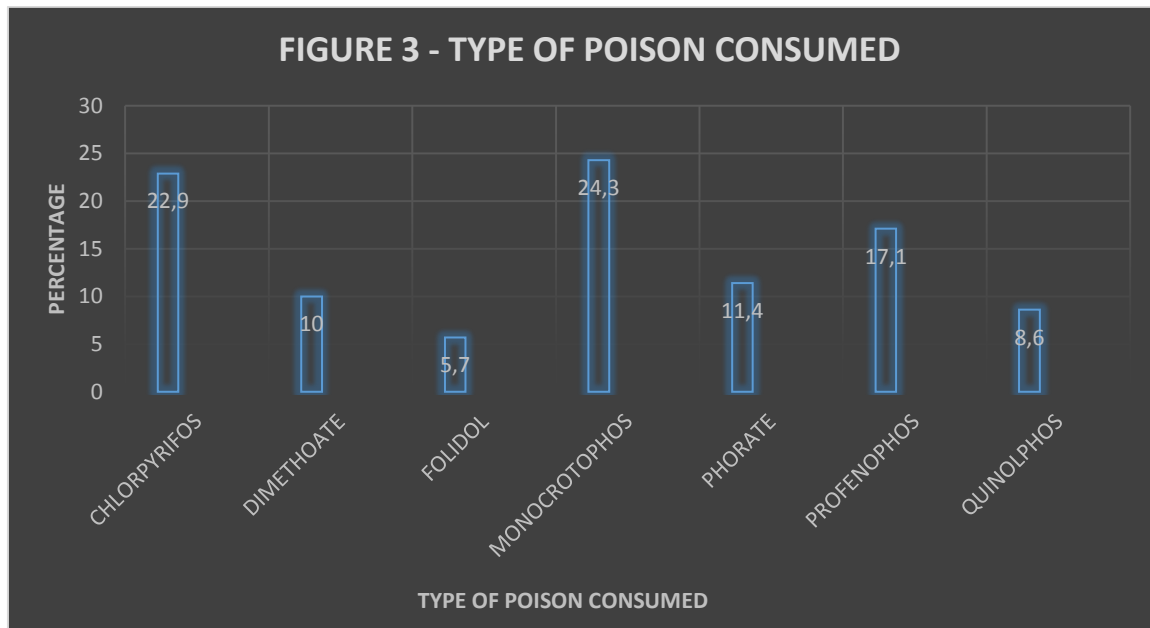
Results



The total number of participants in the study are 70 patients. Of them, the majority (24 patients; 34.3%) belong to 18 to 30 years age group.

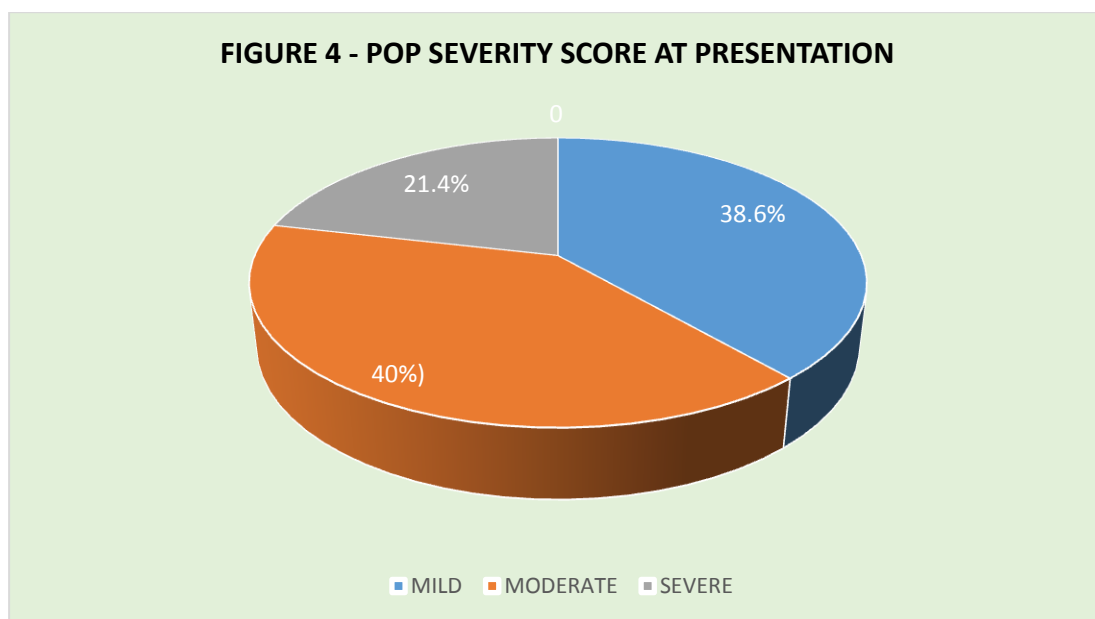


In this study, with a total participant of 70 patients, 56 are male (80%) and 14 are female (20%) with a male to female ratio of 4:1



The commonest compound ingested in the study population is MONOCROTOPHOS 24.3% (17 patients), followed by CHLORPYRIFOS 22.9%

(16 patients), PROFENOPHOS 17.1% (12 patients), and PHORATE 11.4% (8 patients).



Out of 70 patients, 28 patients (40%) presented with moderate severity. 27 (38.6%) patients presented with mild and remaining 15 (21.4%)

patients presented with severe grade according to Peradeniya OP poisoning scale.

**Table 2 - Electrolyte Derangement**

	FREQUENCY	PERCENT
Hyponatremia (<135)	6	8.6
Hypokalemia (<3.5)	18	25.7
Hypochloremia (<98)	4	5.7

Out of 70 patients in the study, the frequency of hyponatremia, hypokalemia and hypochloremia were 6 (8.6%), 18 (25.7%) and 4 (5.7%) respectively.

**Table 3** Association of Potassium Derangement with Ventilator Requirement

			MV		TOTAL	STATISTICAL INFERENCE
			YES	NO		
POTASSIUM DERANGEMENT	YES	COUNT	15	3	18	P<0.001 Significant
		PERCENTAGE	83.3%	16.7%	100.0%	
	NO	COUNT	2	50	52	
		PERCENTAGE	3.8%	96.2%	100.0%	
TOTAL		COUNT	17	53	70	
		PERCENTAGE	24.3%	75.7%	100.0%	

Potassium derangement was present in 15 ventilated and 3 non ventilated patients and this difference was statistically significant.

**Table 4** Association of Chloride Derangement with Ventilator Requirement

			MV		TOTAL	STATISTICAL INFERENCE
			YES	NO		
CHLORIDE DERANGEMENT	YES	COUNT	0	4	4	P = 0.243 Not significant
		PERCENTAGE	0.0%	100.0%	100.0%	
	NO	COUNT	17	49	66	
		PERCENTAGE	25.8%	74.2%	100.0%	
TOTAL		COUNT	17	53	70	
		PERCENTAGE	24.3%	75.7%	100.0%	

Chloride derangement was observed in 4 non ventilated patients and not present in ventilated patients and this difference was not statistically significant.

**Table 5** Association of Sodium Derangement with Ventilator Requirement

			MV		TOTAL	STATISTICAL INFERENCE
			YES	NO		
SODIUM DERANGEMENT	YES	COUNT	1	5	6	P = 0.649 Not significant
		PERCENTAGE	16.7%	83.3%	100.0%	
	NO	COUNT	16	48	64	
		PERCENTAGE	25.0%	75.0%	100.0%	
TOTAL		COUNT	17	53	70	
		PERCENTAGE	24.3%	75.7%	100.0%	

Sodium derangement was present in 5 non ventilated and 1 ventilated patients and this difference was not statistically significant.

**Table 6** Association of Potassium Derangement with Outcome

			OUTCOME		TOTAL	STATISTICAL INFERENCE
			SURVIVED	DEATH		
POTASSIUM DERANGEMENT	YES	COUNT	9	9	18	P < 0.001 Significant
		PERCENTAGE	50.0%	50.0%	100.0%	
	NO	COUNT	50	2	52	
		PERCENTAGE	96.2%	3.8%	100.0%	
TOTAL		COUNT	59	11	70	
		PERCENTAGE	84.3%	15.7%	100.0%	

Potassium derangement was present in 9 expired and 9 survived patients and this difference was statistically significant.

**Table 7** Association of Chloride Derangement with Outcome

			OUTCOME		TOTAL	STATISTICAL INFERENCE
			SURVIVED	DEATH		
CHLORIDE DERANGEMENT	YES	COUNT	4	0	4	P = 0.374 Not significant
		PERCENTAGE	100.0%	0.0%	100.0%	
	NO	COUNT	55	11	66	
		PERCENTAGE	83.3%	16.7%	100.0%	
TOTAL		COUNT	59	11	70	
		PERCENTAGE	84.3%	15.7%	100.0%	

Chloride derangement was present in 4 survived patients and not present in expired patients and this difference was not statistically significant

**Table 8** Association of Sodium Derangement with Outcome

			OUTCOME		TOTAL	STATISTICAL INFERENCE
			SURVIVED	DEATH		
SODIUM DERANGEMENT	YES	COUNT	5	1	6	P = 0.947 Not significant
		PERCENTAGE	83.3%	16.7%	100.0%	
	NO	COUNT	54	10	64	
		PERCENTAGE	84.4%	15.6%	100.0%	
TOTAL		COUNT	59	11	70	
		PERCENTAGE	84.3%	15.7%	100.0%	

Sodium derangement was present in 5 survived and 1 expired patients and this difference was not statistically significant.

Statistical significance was present for the association between hypokalemia and outcomes

like ventilator requirement and mortality. Association of other electrolyte derangements (sodium and chloride) with outcomes were not found to be statistically significant.

**Table 9** Association of Potassium Derangement with Pop Scoring

			POP SCORING			TOTAL	STATISTICAL INFERENCE
			MILD	MODERATE	SEVERE		
POTASSIUM DERANGEMENT	YES	COUNT	1	4	13	18	P < 0.001 Significant
		PERCENTAGE	5.6%	22.2%	72.2%	100.0%	
	NO	COUNT	26	24	2	52	
		PERCENTAGE	50.0%	46.2%	3.8%	100.0%	
TOTAL		COUNT	27	28	15	70	
		PERCENTAGE	38.6%	40.0%	21.4%	100.0%	

Of 18 patients with hypokalemia, 13 patients (72.2%) presented with severe grade of poisoning. 4 patients (22.2%) with moderate severity and the remaining 1 patient (5.6%) with mild severity. This difference was statistically significant.

**Discussion**

In this study, the incidence of male to female ratio is 4:1 among patients with OPC poisoning. Likewise, the study by Tanveer Hassan Banday et

al., revealed the ratio to be 3.2:1, showing the trend of increased incidence of OP poisoning in males<sup>(6)</sup>. A similar observation was made in the study conducted by Safdar et al., and Aziza et al<sup>(7,8)</sup>.

In this study, the most common electrolyte abnormality observed was hypokalemia, which was present in 25.7% of total patients. However, Tanveer Hassan Banday et al., and Dandekar et al., showed the incidence of hypokalemia to be

15.03% and 63.3% respectively in their studies<sup>(6,9)</sup>. The incidence of hyponatremia and hypochloremia in this study was 8.6% and 5.7% respectively.

In this study, hypokalemia was present commonly in severe grades (peradeniya OP poisoning scale) of poisoning cases (72.2%) followed by moderate (22.2%) and mild (5.6%) cases. The need for ventilator support has been observed in 83.3% of hypokalemic patients and is also found to be statistically significant, comparing to ventilator requirements in normokalemic patients. Similar findings were reported in Banday et al., and Mahadeshwara Prasad et al., studies<sup>(6,10)</sup>.

Death was reported in 50% of hypokalemic cases, comparing to 3.8% in normokalemic patients. Statistically, this difference was significant. Similar observations were reported in the studies conducted by Mahadeshwara Prasad et al., and Lyzhnikov EA et al.,<sup>(10,11)</sup>. Probable mechanisms by which OPC produces hypokalemia are excessive vomiting, diarrhea, ganglionic stimulation related sympathetic overactivity and hypomagnesemia<sup>(12)</sup>.

The common mechanisms proposed to cause death in OPC poisoning are muscular weakness and respiratory distress. Hypokalemia accentuates both these complications caused by organophosphates, thereby contributing to overall mortality in OP poisoning. Hence, serum potassium levels should be measured for all OPC poisoning cases and hypokalemia, if present, should be corrected aggressively. Hypokalemia can also be proposed as a marker of severity in OP poisoning.

### Conclusion

It was concluded from this study that hypokalemia contributes significantly to the ventilator requirement and outcome of these patients. Routine measurement of serum potassium should be done, as it can be a cost-effective and reliable marker and will be helpful in prognostication and prediction of the outcome in OPC poisoning.

Aggressive management of hypokalemia can be a life saving measure in these patients.

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