

Assessment of Serum cholinesterase and Serum Creatinine Phosphokinase Levels in Organophosphorus Poisoning Patients at a Tertiary Care Centre of Northern India

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Abstract

Introduction: Poisoning with Organophosphorus compounds is an important global health problem, possibly the most common acute poisoning in developing countries. This study was done to correlate the severity of acute organophosphorus poisoning with serum cholinesterase and serum creatine phosphokinase level.

Materials and Methods: A Prospective observational clinical study was done on 42 patients suspected of Organophosphorus poisoning of age >15 years admitted to the emergency unit at a tertiary healthcare center in northern India. Serum cholinesterase levels and serum Creatinine phosphokinase levels were estimated at the time of admission in all patients and the severity of Organophosphorus poisoning was assessed according to Peradeniya Organophosphorous Poisoning (POP) Scale.

Results: In this study, among 42 patients of acute organophosphorus poisoning 32(76.2%) were males and 10(23.8%) were females. Our study authors observed a significant correlation between the severity of poisoning categorized by the POP scale and the serum cholinesterase and Serum CPK level at the time of the patients' initial presentation. Also found that there was a significant correlation between serum cholinesterase and serum CPK with the outcome of the patients.

Conclusion: In our study severity as well as outcomes of OP poisoning was directly correlated with serum cholinesterase level and serum Creatinine phosphokinase.

Keywords: organophosphorus, poisoning, serum cholinesterase, serum Creatinine phosphokinase, severity, correlation.

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Introduction

Poisoning with organophosphorus (OP) compounds is a worldwide problem. Organophosphorus poisoning occurs due to exposure to organophosphorus which results in the accumulation of acetylcholine (ACh) in the body, as acetylcholinesterase (AChE) gets inhibited. Organophosphorus poisoning most commonly results from exposure to insecticides or nerve agents. The World Health Organization estimates that one million serious unintentional poisonings occur every year in addition to two million cases of suicide attempts, with pesticides.¹

India is a predominantly agrarian country where pesticides are routinely used for farming. These are the third most common agents implicated in suicidal poisonings after household agents and drugs, according to the National Poison Information Centre, India². Erythrocyte cholinesterase (EchE) and plasma cholinesterase (PchE) are reduced in OP poisoning, but their estimation is costly and not regularly performed. There are emerging options for new cheaper biochemical markers for OP poisoning. The serum level of creatine phosphokinase (CPK) is often found to be elevated in OP poisoning.

To present study correlate serum cholinesterase and serum creatinine phosphokinase level with the clinical criteria score described by the POP scale at initial presentation and the severity of organophosphorus poisoning. The correlation may help in predicting the clinical outcome and in making timely decisions regarding transferring the patients for intensive care management.

Peradeniya Organophosphorus Poisoning (POP Scale)

Parameter	Criteria	Scale
Pupil Size	≥2 mm	0
	<2 mm	1
	Pinpoint	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

Materials and Methods

A Prospective observational study was done on 42 patients, in the medicine department of King George medical university Lucknow for 1 year.

A purposive sample technique was used. All cases of OP poisoning meeting the selection criteria that applied to the study center (METC) during the period August 2020 to July 2021 were included in the study. A detailed case history is taken and relevant investigation such as Serum Cholinesterase level, Serum Creatinine Phosphokinase level, complete blood count, renal function test, liver function test, Serum electrolyte sent at the time of admission and repeat after 1 week.

Clinical severity was assessed and categorized according to Peradeniya organophosphorus poisoning scale (POP scale). The score was obtained at initial presentation before any medical intervention and it represented the muscarinic, nicotinic, and central effects of the acute cholinergic manifestations of OP poisoning. A score of 0 to 3 is considered mild poisoning, 4 to 7 moderate poisoning, and 8 to 11 as severe poisoning.

Measurement of SChe and SCPK level:

Serum ChE was measured by the Butyrylthiocholine potassium hexacyanoferrate (III) method (Kinetic test) with Biological ref. range 4850-12000 IU/L.

Serum creatine phosphokinase measured by Liquid stable optimized UV method with Biological ref. range 24-195 IU/L with CK(NAC act) KIT with cat no. 110206021.

Parameter	Criteria	Scale
Fasciculation	None	0
	Present, generalized / continuous	1
	Both generalized and continuous	2
Level of consciousness	Conscious and rationale	0
	Impaired response to verbal command	1
	No response to verbal command	2
Seizures	Absent	0
	Present	1
0-3: Mild Poisoning, 4-7: Moderate Poisoning, 8-11: Severe Poisoning		

Statistical Analysis: The results were analyzed using descriptive statistics and making comparisons among various groups. Categorical data were summarized as proportions and percentages (%) while discrete (quantitative) as mean (SD). All the associations were tested by using the chi-square test. An unpaired t-test was used to compare the means between two categories. One-way analysis of variance (ANOVA) was performed for comparing means of continuous variables among various outcome categories. Statistical analyses were performed using SPSS version 23.0 (SPSS Inc., Chicago, IL, USA). A value of $p < 0.05$ was considered statistically significant

Observation and Results

A total 42 of patients were taken for the study. Among them maximum cases of poisoning belonged to the age group 20-30 yr (52.4%), most of them were males (76.2%) and farming was the most frequent occupation (54.8%) followed by the students (26.2%). Most of them were belonging to the lower socioeconomic status (88.1%) Table 1. A suicidal attempt was the most common reason for poison ingestion as seen in 90.5% of Table 2. The mild, moderate, and severe POP grading was found in 47.6%, 31.0%, and 21.4% cases respectively. The proportion of death was increased with severity as 0.0%, 15.4%, and 77.8% of deaths was found in mild, moderate in severe cases respectively Table 3. A significant association was found between outcome and severity according to POP grading ($p < 0.001$). On comparing the mean S.CHOLINESTREASE at admission among various severity levels, the mean S.CHOLINESTREASE was maximum in mild cases

and minimum in severe cases, and the difference was found to be highly significant ($p < 0.001$) Table 4. On comparing the mean S.CPK level at admission among various severity levels, the mean S.CPK level was maximum in severe cases and minimum in mild cases, and the difference was found to be highly significant ($p < 0.001$) Table 5.

Table 1: Distribution of Cases according to Socio-Demographic Profile

Variable		Total	
		No.	%
Age	< 20 Yr	10	23.8%
	20 - 30 Yr	22	52.4%
	> 30 Yr	10	23.8%
SEX	Male	32	76.2%
	Female	10	23.8%
Occupation	Farmer	23	54.8%
	House Wife	7	16.7%
	Labourer	1	2.4%
	Student	11	26.2%
Socioeconomic Status	Lower	37	88.1%
	Middle	5	11.9%

Table 2: Distribution of Cases according to Type of Ingestion

Variable		Total	
		No.	%
Type of Ingestion	Accidental	3	7.1%
	Homicidal	1	2.4%
	Sucidal	38	90.5%

Table 3: Distribution of Final Outcome with POP Grading

Variable		Death		Survived		chi sq	p-value
		No.	%	No.	%		
POP Grading	Mild	0	0.0%	20	100.0%	22.71	<0.001
	Moderate	2	15.4%	11	84.6%		
	Severe	7	77.8%	2	22.2%		

Table 4: Comparison of S.CHOLINESTREASE (ADMISSION) with Severity

Severity	S. Cholinestrase (Admission)		Anova	
	Mean	SD	F-value	p-value
Mild	3077.80	560.60	98.88	<0.001
Moderate	1623.15	473.18		
Severe	434.56	275.37		
Total	2061.14	1171.22		

Table 5: Comparison of S.CPK LEVEL (ADMISSION) with Severity

Severity	S.CPK LEVEL (ADMISSION)		ANOVA	
	Mean	SD	F-value	p-value
Mild	165.15	37.16	15.76	<0.001
Moderate	194.23	53.70		
Severe	498.00	326.22		
Total	245.48	200.57		

Discussion

In this study, among 42 patients of acute organophosphorus poisoning 32(76.2%) were males and 10(23.8%) were females and as in most other studies, male-dominated females (M:F ratio 3.2:1). Mutalik GS, et al;

Young age group between 20-30 yr (52.4%), most of them were males (76.2%) and >30 years consisted of 10(23.8%) were the most sufferer. This indicates that there is an increased incidence of organophosphorus compound poisoning among young people. Various studies had shown the same result^{3,4}. This age group is the most active one, physically, mentally, and socially and so, it was more prone to stress during life.

Farmers (54.8%) were the most sufferers in this study, Similar observations were also made by Joshi S C et al and Shakuntala et al who showed 51.07% and 70.07% were farmers respectively.^{5,6}

Acute pesticide exposure can be accident or

suicide, occupational, bystander exposure, or exposure because of consumption of food items containing pesticide residues. The commonest incidence of OP poisoning was a suicidal attempt as in this study^{3,7}

In this study out of 42 patients, 20 were classified as mild poisoning, 13 as moderate poisoning, and 9 as severe as per the POP scale. In mild OP poisoning mean serum ChE level was 3077.80±560.60, in moderate poisoning level was 1623.15±473.18 and in severe poisoning, it was 434.56±275.37. Our study observed a significant correlation between the degree of derangement in serum ChE level and severity of OP poisoning, p-value <0.001. The higher the score on the POP scale, the higher the degree of derangement in the serum ChE level. Similar observations were made by Rehman S et al which showed in mild (n=35) op poisoning mean S. ChE level was 2647.7 ±391, in moderate (n=13) serum ChE level was 200.2 ±39 and in severe (n=2) op poisoning this was 124.5

± 39.5 , $P < 0.001$.⁸

When we correlated Serum CPK levels in our patients, their mean value was 165 ± 37 in mild cases, in moderate OP poisoning this was 194 ± 53.0 and in severe cases, it was 498 ± 326 . We found that there statistically significant correlation between the serum CPK levels and the severity of acute OP poisoning, $p < 0.001$. The mean S.CPK Level at admission among dead cases was more than the survived cases, and the difference was found to be significant ($p < 0.001$). A similar study by D. Markandeyulu et al showed mean S. CPK level in mild op poisoning patients $291 (\pm 78.16)$, in moderate $532.82 (\pm 105.3)$, and severe $1124.78 (\pm 349.32)$. They found the presence of a high degree of correlation between initial CPK value and severity of acute OP poisoning, P -value < 0.001 .⁹

Nermeen A. M. Hassan et al also showed that there was a high degree of correlation between the initial serum CPK levels and the severity of acute OP poisoning; as illustrated by the positive correlation of initial serum CPK level with the POP scale. These correlations were found to be statistically highly significant ($P < 0.001$)¹⁰. These results are in agreement with Bhattacharyya et al¹¹ who confirmed the presence of a high degree of correlation between initial CPK value and POP scale, serum EChE levels, arterial pH values, and total dose of atropine in acute OP poisoning.

In our study, the decreased levels of SChE had a significant correlation with mortality ($p < 0.005$), also evidenced in studies by Eddleston et al¹². Lower ChE level was also directly correlated to death outcome ($P < 0.001$). These findings were consistent with studies by Rehman Set al.⁸

In the present study serum, CPK level was also correlated with the outcome of the patients and it was statistically significant $p < 0.001$. Also evidenced Sam KG et al showed CPK level for a poisoned patient as an acceptable predictor for the outcome in poisoned patients.¹³ Further studies are still needed.

Conclusion

In this study, the severity of poisoning was directly correlated with serum cholinesterase and serum CPK level. There was a significant correlation

between serum cholinesterase, CPK, and the outcome of the patient. However, more research is required with an increased sample size.

Ethical clearance- Taken from Institutional Ethics Committee KGMU Lucknow, Ref code-104 ECM IIB- Thesis/P15

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Conflict of Interest - Nil

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