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STUDY OF SERUM CREATINE PHOSPHOKINASE LEVELS AS A PROGNOSTIC BIOMARKER AMONG CASES OF ORGANOPHOSPHATE POISONING IN A TERTIARY HEALTH CARE CENTER

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ABSTRACT

Background: OPCs constitute a heterogeneous category of chemicals specifically designed for the control of pests, weeds or crop diseases. The clinical features of organophosphate poisoning are a combination of effect of acetylcholine stimulation on various kinds of acetylcholine receptors such as muscarinic and nicotinic receptors. Estimation of serum or RBC cholinesterase level and electrodiagnostic tests is helpful in confirming the diagnosis. The purpose of present study was to study epidemiology, clinical features of OPP cases; various clinical grades were evaluated and compared with outcomes of OPP. Hence an attempt was made to study clinical significance of various laboratory parameters in prediction of prognosis in OPP such as serum ChE and Serum CPK, which might help in early recognition, prognostication and optimal utilisation of resources. **Materials and methods:** The present Prospective, Observational, Cross Sectional Study was conducted among 130 cases of Organophosphate poisoning admitted to department of General Medicine within 12 hours of consumption of poison and of age >18 years, at a tertiary care centre. **Results**: In this study 83.07 % cases consumed OPPs with suicidal intention whereas 22 cases (16.92 %) of poisoning were accidental in nature. Chlorpyrifos (62 cases) and Dichlorvos (54 cases) were the most commonly consumed organophosphate poisoning compounds. The mean Cholinesterase level was found to be 2969.26 IU/L with standard deviation of 1521.51 IU/L, whereas mean Creatine Phosphokinase level was 359.33 IU/L with standard deviation of 169.4 IU/L. **Conclusions:** The crux of the present study is that prognostic marker in cases of OP poisoning should be sensitive, reliable, accessible at peripheral healthcare facilities and affordable to general population at cheaper expenses. Instead of using serum Cholinesterase as a prognostic marker in OPP cases

KEYWORDS: Organophosphate poisoning, Organophosphate compounds, poisoning, creatine phosphokinase, serum cholinesterase, POP score.

INTRODUCTION

India consisting of 16% of world's population sustains only on 2.4% of land resource. Organophosphorus compounds [OPC] have been widely used for a few decades in agriculture for crop protection and pest control.[1] OPCs constitute a heterogeneous category of chemicals specifically designed for the control of pests, weeds or crop diseases. The commonly encountered OP compounds comprise insecticides (including Malathion, parathion, diazinon, fenthion, dichlorvos, chlorpyrifos, and ethion); also some organophosphate esters are used to treat glaucoma (Echothiophate). Pesticides are toxic chemicals by design and their ingestion is a common cause of self-poisoning in the developing world. Since organophosphorus compounds are widely used and they are known to pose risks of acute and chronic toxicity to both humans and wildlife, it is important to monitor the exposure to them.[2,3]

Hence it is essential to have detailed study report on the effects [both long term and short term] of organophosphate compounds exposure in humans.[2] It is also important as well to study clinical significance of various laboratory parameters in prediction of prognosis in Organophosphate poisoning, which might help in early recognition, prognostication and optimal utilisation of resources.

Today agriculture sector experiences one of the highest numbers of suicides than any other industry.[4] According to WHO estimates, more than 90% of fatal poisoning cases are seen in middle and low income countries i.e. the developing countries in general and agricultural countries in particular.[4] In India, Farmers' suicides are reported commonly from Maharashtra, Punjab, Uttar Pradesh, Kerala, and Karnataka.[1] The estimated mortality rates with OPP in India are around 7-12 %.[4]

Most of the OP poisoning and subsequent death occur in developing countries following a deliberate self-ingestion particularly in young, productive age group as highly toxic pesticides are readily available at the moment of stress; due to family problem, failure in love and exam phobia, etc.[5,4]

The clinical features of organophosphate poisoning are a combination of effect of acetylcholine stimulation on various kinds of acetylcholine receptors such as muscarinic and nicotinic receptors. Patients who develop respiratory failure have less favourable prognosis and worse outcome. Many factors are responsible for respiratory failure such as respiratory muscle weakness, bronchospasm with bronchorrhea, and respiratory tract infection. Regarding muscle weakness, two kinds of clinical features during acute organophosphate poisoning are described. Fasciculations and weakness from direct stimulation of nicotinic cholinergic receptor is well known.[6] Morbidity and mortality are due to insufficient respiratory management, delayed intubation, cardiac complications, aspiration pneumonia, weakness and neuropathy.[7] The cardiac complications/ electrocardiographical (ECG) changes that often accompany poisoning with these compounds may be serious and are often fatal. These changes are potentially preventable if they are recognized early and treated adequately.[7]

Diagnosis of OP poisoning is based on characteristic clinical features, [miosis is considered to be a very strong indicator of organophosphate poisoning] and history of exposure to a known OP compound. Estimation of serum or RBC cholinesterase level and electrodiagnostic tests is helpful in confirming the diagnosis. Clinical features of OP poisoning appear when RBC cholinesterase activity is <75% of normal and in clinical overt poisoning it is usually <10%. In general, however, serial studies have failed to document a strict relationship between the severity of clinical manifestations and prognosis.[2]

There are several systems of grading of severity in acute Organophosphate poisoning. Senanayake et al proposed Peradeniya Organophosphorus Poisoning (POP) scale for grading the severity, which is based on five cardinal manifestations of Organophosphate poisoning namely pupillary constriction, fasciculations, heart rate, respiratory rate and level of consciousness. Each sign is given a score according to the severity and all are added up to assess the severity on a 1 to 11scale. A score of 0-3 is graded as mild, 4-7 is graded as moderate and 8-11 is graded as severe poisoning.[8]

The purpose of present study was to study epidemiology, clinical features of OPP cases; various clinical grades were evaluated and compared with outcomes of OPP. Hence an attempt was made to study clinical significance of various laboratory parameters in prediction of prognosis in OPP such as serum ChE and Serum CPK, which might help in early recognition, prognostication and optimal utilisation of resources.

MATERIAL AND METHODS

The present Prospective, Observational, Cross Sectional Study was conducted among 130 cases of Organophosphate poisoning admitted to department of General Medicine within 12 hours of consumption of poison and of age >18 years, at a tertiary care centre. Type of poisoning was ascertained by objectively looking at the packet/ container. Data is collected using a preformed proforma from each patient. Patients were treated according to standard treatment protocol of our hospital with atropine 3–5 ml (0.6 mg/ml) bolus followed by continuous infusion with titration based on clinical assessment, and pralidoxime 2 g bolus over 30 min followed by 1 g/h for 48 hours.

Serum CPK level was measured by using Mod IFCC method, by using CK (NAC act.) kit which uses the conversion of creatine phosphate to creatine and ATP. Their reference values were taken as 24 – 195 U/L for males and 24 – 170 U/L for females. Serum ChE level was measured by using new DGKC method, with the help of LiquiCHEK (Coral) kit, which uses butyrylthiocholine as a substrate. Their reference values are ~ 4000-11000 IU/L.

Patients with other co-existing illnesses like myopathy, chronic renal disease, epilepsy, myocardial infarction, myocarditis, autoimmune diseases or malignancy, patients who had trauma or received intramuscular injection, cardiopulmonary resuscitation; recently and patients who are on prior medications like statins, fibrates, aspirin, anticoagulants, furosemide, and dexamethasone were excluded from the study.

The diagnosis of organophosphate poisoning is based on history, clinical examination and laboratory investigations. The routine biochemical investigations including creatine phosphokinase and serum cholinesterase were obtained. Both internal and external quality control was done during the assay process. The severity of poisoning at admission was assessed using Peradeniya Organophosphorus Poisoning (POP) scale (Table 1).

The data was collected using pre-designed and validated case record forms. The data was entered using Microsoft Excel software and statistical analysis was done using SPSS software. Graphical presentation is done wherever applicable using bar diagrams, pie charts and scatter plots. The significance was tested using Chi-Square test for categorical variables. Quantitative variables and categorical variables were tested using Spearman's correlation techniques, whereas Pearson's correlation was used to test significance between two quantitative variables. The patient's outcome of interest was calculated with 95% confidence limits. P value of <0.05 was considered as significant.

RESULTS

The present study was conducted in a tertiary health care institute among 130 confirmed cases of Organophosphate poisoning admitted under department of general medicine. Detailed history was taken, general examination and detailed systemic examination was carried out. Necessary laboratory investigations were done apart from routine investigations. After collection of relevant data from all of the 130 OPP cases, it was entered and analysed. When we assessed their demographic characteristics, we found that 94 cases (72.30%) were males, whereas 36 cases (27.69%) were females and majority of cases (66.15%) were between 21 to 40 years of age group (Table 2). Majority of cases belonged to upper lower class-IV (44.61%), followed by lower socio-economic class (35.38%). Most of the study subjects were young and students 54 (41.5%), followed by farmers (23.8%) and household workers & agriculture labourers (Table 2). In the present study, we found that 108 cases (83.07 %) had suicidal intention whereas 22 cases (16.92 %) of poisoning were accidental in nature (Table 2. Figure 1 shows that Chlorpyrifos (62 cases) and Dichlorvos (54 cases) were the most commonly consumed organophosphate poisoning compounds, whereas 2% methyl parathion, dimethoate and quinolphos were among the less commonly consumed ones.

Among 130 organophosphate poisoning cases, after extensive clinical management using standard management protocols, 101 (77.69%) cases improved clinically and declared as improved whereas 19 (14.61%) cases did not show any improvement in their clinical status. In 10 cases (7.69%), condition worsened to death (Table 3). According to POP scoring system we observed that 36 (27.69%) cases were of mild severity, 82 (63.07%) cases i.e. maximum cases which belonged to moderate severity, whereas 12 (9.2%) cases were severe (Table 3). We found that severity of Organophosphate poisoning cases was found highly significant with outcome of the patients. (Pearson Chi-Square value: 21.461 and P-value: < 0.001) (Table 3). In the present study, it can be seen that maximum cases of intermediate syndrome were confined to moderate severity of Organophosphate poisoning, but when we tested these differences using Chi-square test, it was not found statistically significant. (Pearson Chi-Square: 3.424, P-value: 0.181) (Table 10). The need for intubation was seen to be significantly associated with Moderate severity of Organophosphate poisoning (POP scale) (Table 3).

The mean Cholinesterase level was found to be 2969.26 IU/L with standard deviation of 1521.51 IU/L, whereas mean Creatine Phosphokinase level was 359.33 IU/L with standard deviation of 169.4 IU/L. The Cholinesterase values were maximum for 0-3 POP score and minimum for 8-11 POP score whereas serum Creatine Phosphokinase values were maximum for 8-11 POP score and minimum for 0-3 POP score, hence Cholinesterase values showed inverse relationship with POP scores (Table 4). When we evaluated correlation between Serum Cholinesterase levels and Serum Creatine Phosphokinase levels among 130 Organophosphate poisoning cases from our study; we found highly negative correlation between Serum Cholinesterase and Creatine Phosphokinase. It indicates that there is an inverse relationship between serum Cholinesterase and serum Creatine Phosphokinase values. (Pearson's correlation coefficient: -0.587 and P-value: < 0.001) (Table 5).

When we tried to correlate various laboratory parameters with severity of Organophosphate poisoning, we used statistical correlation techniques (Spearman's or Pearson's correlation). In correlation between serum Creatine Phosphokinase and Cholinesterase, we found strongly negative correlation with Spearman's correlation coefficient: - 0.587 and Pearson's correlation coefficient: - 0.679 with highly significant difference (p-value: < 0.001). In correlation between POP scores and serum Cholinesterase, we found strongly negative correlation with Spearman's correlation coefficient: -0.567 and Pearson's correlation coefficient: -0.482 with highly significant difference (p-value: < 0.001). We also assessed correlation between POP score and serum Creatine Phosphokinase values, we found strong positive correlation between them with Spearman's correlation coefficient: 0.697 and Pearson's correlation coefficient: 0.681 with highly significant difference (p-value: < 0.001) (Table 5) (Figure 3 and 4).

We plotted receiver operating characteristic (ROC) curve between POP score and serum CPK levels of 130 OPP cases in order to predict better prognostic indicator for OPP cases. We observed that the area under the curve was fairly good. Hence we can say that estimation of serum CPK can be better prognostic indicator for prediction of OPP outcomes in future (Figure 5). This shows that estimation serum CPK can be better alternative to predict prognosis of OPP cases with fairly good sensitivity and specificity.

Table 1: Peradeniya Organophosphorus Poisoning (POP) scale.

Parameter	Criteria	Score
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
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
0-3: mild poisoning; 4-7: moderate poisoning; 8-11: severe poisoning. (POP: Peradeniya Organophosphorus Poisoning)		

Table 2: Distribution of cases according to their demographic characteristics.

Demographic variables		Number of cases	Percentage
Gender	Males	94	72.30%
	Females	36	27.69%
Age group	Less than or equal to 20	25	19.23%
	21- 40	86	66.15%
	41 - 60	14	10.76%
	Above 60	5	3.84%
Religion	Hindu	94	72.3 %
	Muslim	22	16.92 %
	Buddhist	8	6.15 %
	Others	6	4.61 %
Socio-economic classification	Upper (I)	0	0
	Upper Middle (II)	3	2.3 %
	Lower Middle (III)	23	17.69 %
	Upper Lower (IV)	58	44.61 %
	Lower (V)	46	35.38 %
Occupation	Farmers	31	23.8 %
	Students	54	41.5 %
	Household workers	23	17.7 %
	Labourer	22	16.92 %
Intention of poisoning	Suicidal	108	83.07 %
	Accidental	22	16.92 %

Table 3: Distribution of cases according to clinical variables and comparison between them.

Clinical variables		POP severity				Level of significance
		Mild	Moderate	Severe	Total	
Intermediate Syndrome	No	35	71	10	116	Pearson Chi-Square: 3.424 P-value: 0.181
	Yes	1	11	2	14	
Outcome	Improved	34 (26.15 %)	61 (46.92%)	4 (3.07%)	99	Pearson Chi-Square: 21.461 p-value: < 0.001
	No Improvement	1 (0.76%)	6 (4.61%)	4 (3.07%)	11	
	Death	1 (0.76%)	15 (11.53%)	4 (3.07%)	20	
Intubation Needed	No	35 (33.98%)	62 (60.19%)	6 (5.8%)	103	Pearson Chi-Square: 13.966 P-value:0.001
	Yes	1 (3.7%)	20 (74.07%)	6 (22.22)	27	

Table 4: POP scale and its relation with mean Serum Cholinesterase and Creatine Phosphokinase at the time of admission and correlation between them.

POP score	No. of patients	Mean Serum cholinesterase	Mean Serum Creatine Phosphokinase
0 – 3	36	4186.9	199.86
4 – 7	82	2545.3	400.43
8 – 11	12	2213.3	556.83
Total	130	2969.26	359.33
Level of significance	**Pearson's correlation coefficient: -0.587, P-value: < 0.001**		

Table 5: Correlation between Serum Cholinesterase, Serum Creatine Phosphokinase levels and POP score.

Variables	Spearman's or Pearson's correlation co-efficient	p-value	Comments
Serum Creatine Phosphokinase & Cholinesterase	Pearson's correlation co-efficient: -0.679	< 0.001	Moderately strong Negative Correlation
POP Score & Cholinesterase	Spearman's correlation co-efficient: -0.567	< 0.001	Moderately strong Negative Correlation
POP score & Creatine Phosphokinase	Spearman's correlation co-efficient: 0.697	< 0.001	Moderately strong Positive Correlation

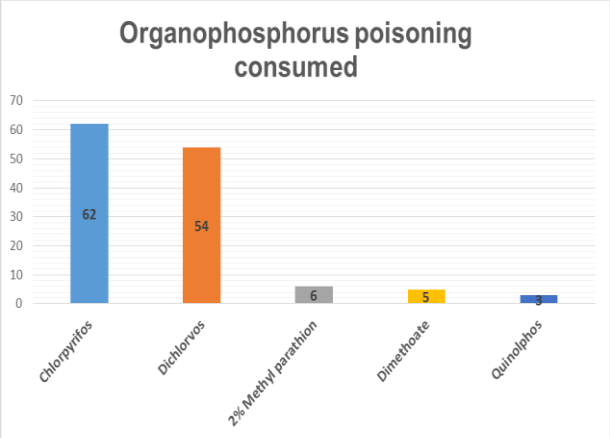

Figure 1: Distribution of cases according to types of organophosphate compound consumed.

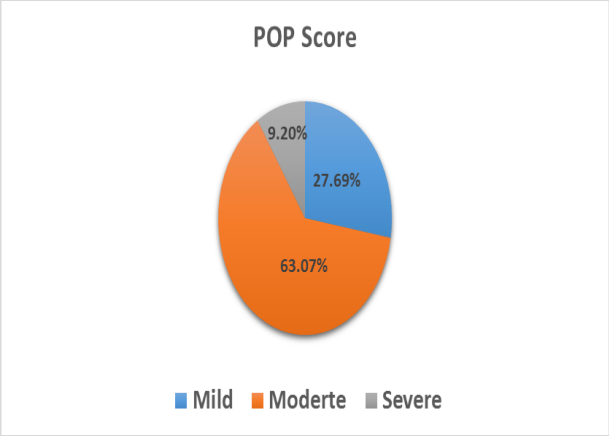

Figure 2: Distribution of cases according to their POP score.

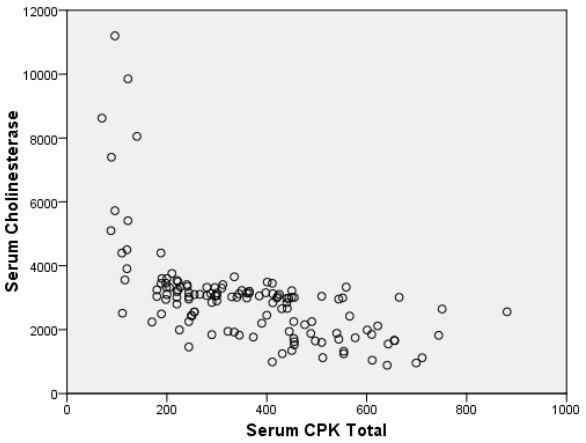

Figure 3: Scatter graph showing correlation between Serum Cholinesterase and Serum Creatine Phosphokinase Total.

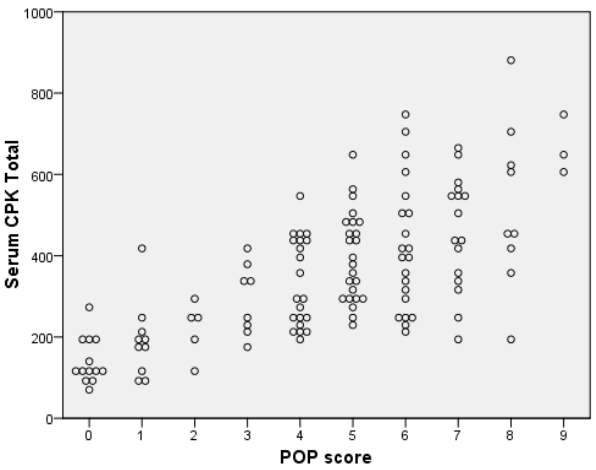

Figure 4: Scatter graph showing relation between POP severity score and Serum Creatine Phosphokinase total.

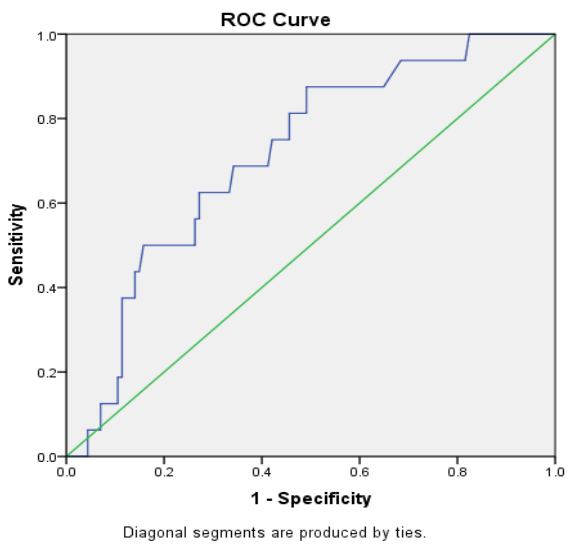

Figure 5: Receiver operating characteristic (ROC) curve showing correlation of serum CPK and POP score.

DISCUSSION

The present study was carried out among 130 cases of OPP admitted in inpatient department of general medicine at a tertiary health care institute in western Maharashtra. The purpose of the present study was to assess epidemiology, clinical presentation of OPP cases and to evaluate prognostic accuracy of serum ChE, serum CPK and hence to assess whether serum CPK estimation as an affordable, reliable, and accessible prognostic biomarker. In the present study, OPP cases were examined, detailed history was taken, clinical status were categorized using POP scoring system into mild, moderate and severe. Serum Cholinesterase and serum CPK were sent at the time of admission to assess and compare prognostic value of these laboratory parameters. Clinical parameters, POP scores and laboratory parameters were compared and statistically analysed using proper statistical methods.

In the present study 130 study subjects were enrolled, out of them 72% cases were males while 28% cases were females. Female cases were below the age of 40 years, while majority of male subjects were between 21-40 years. In the age group above 41 years, all the patients were males. This age group (21-40 years) is the most active one physically, mentally and socially and so, it was more prone to stress during life which might be one of the causative factors behind suicidal tendencies among youths.

Out of total study subjects, majority of cases were from Hindu religion followed by Muslim and Buddhist religion and belonged to upper lower followed by lower socioeconomic class according to modified Kuppuswamy classification of socioeconomic classes. This follows the demographic pattern as most of the population in nearby areas consists of farmers and labourer in farms. Most of the study participants were young students followed by agricultural workers and labourers. Presence of young students with suicidal intention critically brings our focus towards this age group, which mandates further qualitative research to study reasons behind suicidal tendencies among students.

Similar findings were observed by **Sangeetha et al,**[9] most of the patients were from rural background, predominantly from lower socioeconomic status according to Modified Kuppuswamy scale. They were mostly farmers, housewives and daily wage labourers. According to the study conducted by **Bhattacharya K et al,**[10] 51 cases (80.95%) came from a rural background, with a predominantly lower and lower middle socioeconomic status according to the Modified Kuppuswamy Scale. They were mostly farmers by occupation; some others were students, housewives, labourers or porters. Their level of education varied from illiterates to graduates. We tried to study intentions behind these OPP cases, we found that intention behind majority of OPP cases was suicidal, which was predominant among young age students, whereas

accidental poisoning was found more common among farmers and labourers, though statistically we did not found it significant. Chlorpyrifos and Dichlorvos were the most commonly consumed OP compounds.

In the present study, majority of OPP patients were improved (77.6%), whereas 14.6% cases showed no improvement with residual morbidities associated with OPP such as ophthalmoparesis, facial weakness, limb weakness, delayed peripheral neuropathy (paresthesia), areflexia, etc. According to POP scoring system majority of cases belonged to moderate grade of severity (63%) followed by mild grade (27.6%).

When outcome of OPP cases was compared with severity of clinical status according to POP score, we found that there was significant difference between clinical status of OPP subject and their outcome. More the POP score, less favourable was the outcome. Outcome was better for the least POP score. We compared and analysed clinical grades of severity (POP score) with occurrence of intermediate syndrome; though there were more cases of intermediate syndrome among those subjects who had more POP score (moderate grade of severity scale), it was not found statistically significant. We also compared severity status (POP score) with need for intubation, we confirmed that more severe the case is, need for intubation was more likely to be. All of the above comparisons of various outcomes with clinical status scales proved its reliability to be associated with outcome.

For early diagnosis and further prognosis, clinical diagnosis should be supported by laboratory parameters. We collected blood samples from study subjects for estimation of serum Cholinesterase and serum CPK along with other routine investigations. We compared these laboratory parameters among each other and with clinical severity of OPP cases and outcomes. We found that mean value of serum Cholinesterase was 4186.9 IU/L in mild grade, 2545.3 IU/L in moderate grade and 2213.3 IU/L in severe grade. Whereas the mean values of serum CPK were 199.86 IU/L in mild grade, 400.43 IU/L in moderate grade and 556.83 IU/L in severe grade. This proves inverse relationship of changes in Cholinesterase and CPK values according to clinical grades of severity. As the outcome of OPP case worsens, serum Cholinesterase values are likely to be reduced while serum CPK values are likely to be elevated. In other words, reduced serum Cholinesterase levels and elevated serum CPK levels shows worse prognosis outcomes while higher Cholinesterase levels and lower CPK levels favors good prognosis among OPP cases. We could be able to prove the differences in above findings statistically significant using appropriate statistical methods mentioned in respective tables.

The results of the present study were compared with various similar studies conducted by different authors as follows:

Sr. No	Variables	Present study	Other studies
1	Age group (Most common)	21-40 years	**Augun D et al**[12] 34.7 ± 15.94 years **Sangeetha K et al**[9] 20 to 40 years **Nagarajan K et al**[11] 20 – 30 years
2	Commonest intention	Suicidal (83.07%)	**Khan S et al**[13] Suicidal (75%) **Dubey et al**[14] Suicidal 95%
3	Organophosphate compound	Chlorpyrifos (62 cases), Dichlorvos (54 cases)	**Mural et al**[15]**:** Chlorpyrifos (23.4%), Methyl parathion (21.9%), Dichlorvos (18.8%) **Nagarajan et al**[11]**:** chlorpyrifos (41%), Monochrotophos (37,8%)
4	POP score findings	**Mild:** 27.59% **Moderate:** 63% **Severe:** 9.2%	**Sangeetha et al**[9]**:** Mild: 42.5%, Moderate: 37%, Severe: 20.5% **Bhattacharya K et al**[10]**:** Mild: 27%, Moderate: 50.8%, Severe: 22.2%
5	Mean serum Cholinesterase as per POP score	**Mild:** 4186.9 IU/L **Moderate:** 2545.3 IU/L **Severe:** 2213.3 IU/L	**Mural et al**[15]**:** Mild-2389 IU/L, Moderate-1104.4 IU/L, Severe-237.5 IU/L
6	Mean serum CPK as per POP score	**Mild:** 199.86 IU/L **Moderate**:400.43 IU/L **Severe:** 556.83 IU/L	**Mural et al**[15]**:** Mild-183 IU/L, Moderate-490 IU/L, Severe-2140 IU/L

Sangeetha et al[9] also found similar findings like our study. They found lower serum CPK values among mild severity OPP cases and higher serum CPK values among severe OPP cases. Findings from the present study were similar with study conducted by **Nagarajan et al,**[11] **Bhattacharya K et al**[10] and **Khan Set al**[13] etc. All of the above authors found that serum CPK shows good prognosis for lower values than higher values of serum CPK. We also tried to establish relationship between serum Cholinesterase & serum Creatine Phosphokinase, we found inverse relationship between these quantitative parameters using scatter diagram, which is proved using correlation techniques and we found moderately negative correlation between these two parameters. In addition we

also studied relationship between serum CPK and clinical severity of OPP cases graphically using scatter diagram, which is also proved using Spearman's correlation technique and found moderately positive correlation between these two parameters.

The present study proves relationship between clinical grades of severity among OPP cases and outcome of OPP cases, relationships between laboratory parameters (serum Cholinesterase & serum CPK) and clinical status. This study also proves that serum CPK can be used alternatively with serum Cholinesterase as a prognostic indicator to predict outcome of OPP cases.

In addition to above information, it is also well known that in developing countries like India, where we are facing problems of limited resources (money, material & manpower), laboratory investigations such as estimation of serum Cholinesterase at peripheral institutes might be unlikely, since it is costly, so it is less likely to be available at peripheral levels. This study recommends estimation of serum CPK as a better alternative, that can be used to predict outcomes of OPP cases, in addition estimation of serum CPK levels is cheap, requires less expertise, can be done at peripheral level healthcare facilities.

CONCLUSION

Organophosphate compound poisoning is one of the major public health problems, not only in developed countries but also developing countries like India. Chlorpyrifos, Dichlorvos, Malathion, Parathion, are some of the commonest OP compounds which are more readily and easily available in market, and are responsible for most of the OP poisoning cases. OP poisoning is found more among young age individuals, mostly students followed by farmers and agricultural workers. Suicidal intention was found common behind OP poisonings among young peoples. Increasing competition in daily lives, peer pressures, failure in love, relationships or jobs, lack of abilities to handle pressures in life, etc are responsible for increase in suicidal tendencies among youths and adults, whereas accidental OP poisoning is common among farmers and agriculture labourers. Lack of information regarding toxic nature of OPC, its complications and use of personal protective equipment to prevent exposure to OPC may be common reasons behind such accidents.

Early diagnosis and treatment of OPP cases is of paramount importance in developing countries like India, since limited availability of resources. Better diagnostic and prognostic methods should be available, accessible to general population through peripheral public hospitals. The crux of the present study is that prognostic marker in cases of OP poisoning should be sensitive, reliable, accessible at peripheral healthcare facilities and affordable to general population at cheaper expenses. Instead of using serum Cholinesterase as a prognostic marker in OPP cases, which might be beyond the reach of many people due to its cost and availability; newer more reliable, accessible and affordable methods could be developed. Estimation of serum Creatine Phosphokinase level has proved its efficacy as a better alternative which is equally effective to serum ChE as a prognosis marker in OPP cases.

CONFLICT OF INTEREST: None to declare.

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