Section: General Medicine

Original Research Article

THE DIAGNOSTIC AND PROGNOSTIC SIGNIFICANCE OF CREATINE PHOSPHOKINASE, LIVER ENZYMES AND PANCREATIC ENZYMES IN COMPARISON WITH PSEUDOCHOLINESTERASE IN ORGANOPHOSPHORUS COMPOUND POISONING

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Received *: 10/04/2025*
Received in revised form *: 03/06/2025*
Accepted *: 25/06/2025*

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DOI: 10.70034/ijmedph.2025.3.62

Source of Support: Nil,
Conflict of Interest: None declared

Int J Med Pub Health
2025; 15 (3); 343-348

ABSTRACT

Background: Organophosphates are commonly used for suicide by poisoning in India. Early recognition of the diagnosis and its severity will help in achieving a better outcome. Currently, Pseudocholinesterase are widely accepted as biochemical marker to estimate OP poisoning severity, which is sensitivity, but not specificity and costly investigation. Since Organophosphates effect multiple organs, this study aimed to find out that the possibility of using a wide array of alternate, cheap and easily available markers like serum creatine phosphokinase (CPK), pancreatic enzymes (serum amylase and lipase), liver enzymes (AST, ALT, ALP) in comparison with pseudocholinesterase in diagnosis and prognosis of oragnophosphorus compound poisoning. The objective is to estimate the serum levels of Creatine phosphokinase, Liver enzymes (AST, ALT, ALP), Pancreatic enzymes (serum amylase and lipase), and Pseudocholinesterase in patients with Organophosphorus compound poisoning. to correlate all investigations with Pseudocholinesterase in diagnosis and prognosis of OP poisoning.

Materials and Methods: This Correlative study included 100 in patients with Organophosphates poisoning Admitted in K. R. HOSPITAL, MMC&RI, MYSORE during Study period of April 2023 to September 2024. Clinical manifestations including myopathy / muscle injury, acute pancreatitis, liver dysfunction were assessed. Biochemical markers (serum creatine phosphokinase, serum amylase and lipase, AST, ALT, ALP) were measured. Statistical analyses were performed to evaluate the association between these parameters.

Results: The study population was predominantly female (58%) with a mean age of 38.5 years. majority of patient (70%) had myopathy or muscle injury with elevated CPK (r = -0.573,p = 0.000), 62 % of study subjects had acute pancreatitis with elevated serum amylase (r = -0.454, p = 0.000): and serum lipase (r = -0.446, p = 0.000), while 56 % patients had hepatic dysfunction with elevated serum AST(r = -0.455, p = 0.000), serum ALT (r = -0.450, p= 0.000), serum ALP (r = -0.361, p = 0.000).All these various biochemical markers showed a perfect negative correlation with Pseudocholinesterase with significant p valve.

Conclusion: This study proves that, there is a significant derangement of various biochemical markers like creatine phosphokinase (CPK), serum amylase, serum lipase, serum Aspartate Aminotransferase (AST), Serum Alanine Aminotransferase (ALT) and Serum Alkaline Phosphatase (ALP) in acute OP compound poisoning patients. Hence these various biochemical markers which are cheaper, and easily available can be used as potential biochemical markers for diagnosis and assessing the severity of organophosphate poisoning.

Keywords: Organophosphate poisoning, CPK, AST, ALT, ALP

INTRODUCTION

Organophosphorus compounds are a diverse group of chemicals that contain carbon–phosphorus bonds including pesticides like malathion, parathion, diazinon, fenthion, dichlorvos, chlorpyrifos, and ethion, as well as nerve agents like soman, sarin, tabun.[1] Organophosphorus agents (OP) are widely used as pesticides due to their cost effectiveness, they present a significant public health risk owing to their high toxicity, especially in cases of occupational exposure in agriculture, during suicide attempts using pesticides, and as nerve agents in warfare, OP agents vigorous permeability through inhalation, ingestion, and dermal exposure and results in a high number of reported OP poisoning cases and alarming mortality rates.[2] India being an agriculture-based country, OP pesticide remains the main agent for crop protection and pest control, it is therefore likely to have adverse effects on farmers who are accidentally over exposed while handling these pesticides,however, because of low cost and easy availability, it has also become an agent of choice for self poisoning.[3] Available organophosphates can be divided into diethyl compounds such as chlorpyrifos, diazinon, parathion and phorate and dimethyl compounds like dimethoate, dichlorvos, malathion and fenthion.[3] OP insecticides are irreversible inhibitors of carboxylic ester hydrolases, including acetylcholinesterase (AChE), plasma or butyrylcholinesterase (BChE) and other nonspecificproteases, The primary toxicity of OP compounds is derived from excessive stimulation of muscarinic and nicotinic cholinergic receptors by the accumulated acetylcholine in the central and autonomic nervous systems as well as at skeletal neuromuscular junctions.[4]

MATERIALS AND METHODS

This Correlative study included 100 in patients with Organophosphates poisoning Admitted in K. R. HOSPITAL, MMC&RI, MYSORE during Study period of April 2023 to September 2024.

Inclusion Criteria

- Patients who have consumed and / or exposure of op compound.
- Patients who are more than 18 years old

Exclusion Criteria

- Patients mixed with other poison.
- Chronic alcoholics
- Patients with known medical illness such as chronic liver diseases, pancreatitis, malignancy, myopathy, renal failure, autoimmune diseases.
- Pregnant patients were excluded.
- Patients who were on chronic drug usage with Statins, Fibrates Steroids.

Sample size Calculation

Formula: The formula for sample size calculation in correlation studies is:

$$n = \left(\frac{Z_\alpha + Z_\beta}{0.5 \, . In \left(\frac{1+r}{1-r} \right)} \right)^2 + 3$$

Where

n = Required sample s

r = 0.34: Expected c

Z_α = 2.58: Z= score for the significance level (α= 0.01, two sided)

Z_β = 0.84: Z- score for power (β = 0.20, corresponding to 80% power)

The required sample size is 97. However, the present study considered a sample size of 100.

Study Procedure: Patients with organophosphate poisoning and passing selection criteria was taken into study, clinical examination was done in all of the study subjects. Blood sample was taken from each of theses individuals and following investigations were done like creatine phosphokinase (CPK), serum amylase, serum lipase, serum Aspartate Aminotransferase (AST), Serum Alanine Aminotransferase (ALT) and Serum Alkaline Phosphatase (ALP) were measured. The information was tallied and examination using the relevant statistical approach.

SPSS (Statistical Package For Social Sciences) version 21. STATISTICAL ANALYSIS are done with the help of SPSS for WINDOWS VERSION 28. Dermographic and clinical parameters will be analysed using descriptive statistics: mean, standard deviations, frequencies and percentages.

RESULTS

[Table 1] presents the age distribution of 100 subjects, ranging from 20 to 80 years old, with a mean age of 38.5 years and a standard deviation of 1.3 years.

Table 1: Mean age distribution of the subjects

	N	Minimum	Maximum	Mean	S.D
Male	42	22.00	80.00	39.5000	13.63326
Female	58	20.00	69.00	37.7931	1.69761
Total	100	20.00	80.00	38.5100	1.31882

Table 2: Distribution of the subjects based on age groups

Age groups	Frequency	Percent
<30 years	38	38.0
31 – 40 years	26	26.0
41 – 50 years	20	20.0
51 – 60 years	9	9.0

>60 years	7	7.0
Total	100	100.0

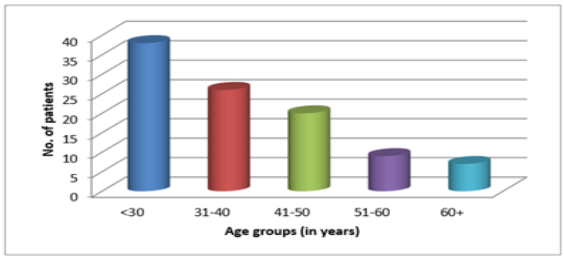

Figure 1: Distribution of the subjects based on age groups

[Table 2] illustrates the distribution of 100 subjects across different age groups. The largest age group was <30 years, comprising 38% of the sample, followed closely by the 31 to 40 years group at 26%. The least represented groups were those aged 60 years and above, constituting 7% of the sample, and those aged 41 to 50 years, making up 20% and 51 to 60 years constituting 9%.

[Table 3] presents the gender distribution of 100 subjects, with 42% identified as males and 58% as females.

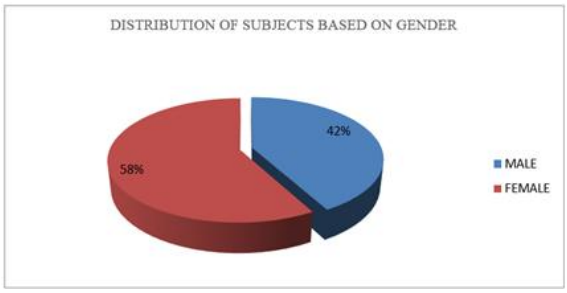

Figure 2: Distribution of the subjects based on gender.

Table 3: Distribution of the subjects based on gender

Gender	Frequency	Percent
Male	42	42.0
Female	58	58.0
Total	100	100.0

Table 4: Descriptive statistics of biochemical parameters

	N	Minimum	Maximum	Mean	Std. Deviation
Serum Pseudocholinesterase	100	695.00	14000.00	3224.3300	2646.03945
Serum creatine phophokinase	100	25.00	2496.00	711.7000	525.67739
Serum amylase	100	20.00	761.00	202.4200	162.47444
Serum lipase	100	12.00	705.00	174.8600	149.52558
Aspartate aminotransferase	100	16.00	647.00	155.8300	125.65200
Alanine transaminase	100	10.00	626.00	138.4000	117.83176
Alkaline phosphatase	100	37.00	1196.00	328.8600	321.98827

The [Table 4] provides statistical summaries for various serum biochemical parameters measured in a sample of 100 individuals.

Table 5: Correlation of serum CPK levels with s. Pseudocholinesterase

	N	Pearson correlation	p- value
S. PSEUDOCHOLINESTERASE	100	1	0.000
S. CREATINE PHOPHOKINASE	100	-.573**	0.000

**. Correlation is significant at the 0.01 level (2-tailed).

[Table 5] Above table represents the correlation between Serum Creatine Phosphokinase (CPK) levels and Serum Pseudocholinesterase levels. The study includes a sample size (N) of 100 individuals. A p-value of 0.000 (typically interpreted as $p < 0.001$) indicates a highly significant association, suggesting a strong relationship between Serum CPK and Serum Pseudocholinesterase levels.

[Figure 3] A scatter plot visually represents the relationship between two numerical variables, helping to identify trends, correlations, and patterns. Above is a general description of a scatter plot for Serum Creatine Phosphokinase (CPK) levels vs. Serum Pseudocholinesterase levels. X-Axis: Serum Pseudocholinesterase levels, Y-Axis: Serum Creatine Phosphokinase (CPK) levels.This scatter plot shows downward pattern, it suggests a negative correlation.

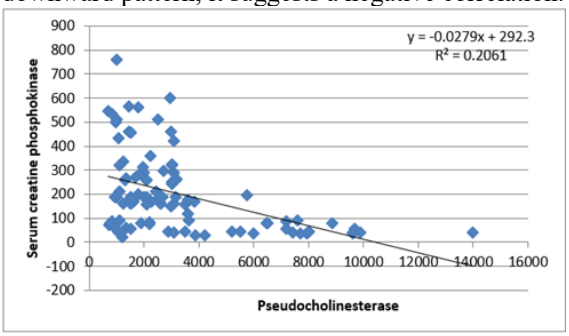

Figure 3: Scatter plot showing correlation of serum cpk levels with s. Pseudocholinesterase

Table 4: Correlation of serum amylase levels with s. Pseudocholinesterase

	N	Pearson correlation	p- value
S. PSEUDOCHOLINESTERASE	100	1	0.000
S. AMYLASE	100	-.454**	0.000

**. Correlation is significant at the 0.01 level (2-tailed).

[Table 4] Above table represents the Pearson correlation coefficients and p-values for the relationship between Serum Amylase Levels and Serum Pseudocholinesterase Levels in a sample of 100 individuals. Pearson correlation measures the strength and direction of a linear relationship between these variables. Serum Amylase (r = -0.454, p = 0.000): A moderate negative correlation suggests that as Serum Pseudocholinesterase levels decrease, Serum Amylase levels tend to increase. Since the p-value is 0.000 (p < 0.01), this relationship is statistically significant.

[Figure 4] This is a scatter plot depicting the relationship between serum amylase (y-axis) and pseudocholinesterase (x-axis). The trend line (regression line) has a negative slope, indicating an inverse relationship between Serum Pseudocholinesterase and Serum Amylase levels.

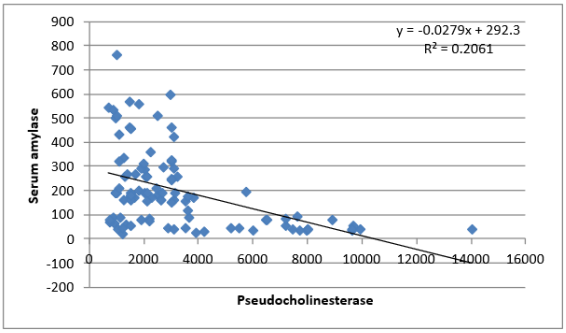

Figure 4: Scatter plot showing correlation of serum amylase levels with s. Pseudocholinesterase

Table 5: Correlation of serum lipase levels with s. Pseudocholinesterase

	N	Pearson correlation	p- value
S. PSEUDOCHOLINESTERASE	100	1	0.000
S. LIPASE	100	-.446**	0.000

**. Correlation is significant at the 0.01 level (2-tailed).

[Table 9] Above table represents the Pearson correlation coefficients and p-values for the relationship between Serum Lipase Levels and Serum Pseudocholinesterase Levels in a sample of 100 individuals. Serum Lipase (r = -0.446, p = 0.000):** A moderate negative correlation suggests that as Serum Pseudocholinesterase levels decrease, Serum Lipase levels tend to increase. Since the p-value is **0.000 (p < 0.01)**, this relationship is statistically significant.

[Figure 5] The scatter plot illustrates the relationship between Serum Lipase levels and Serum Pseudocholinesterase levels. The x-axis represents Pseudocholinesterase levels, while the y-axis represents Serum Lipase levels. The trend line (regression line) has a negative slope (-0.0252), indicating an inverse relationship between Serum Pseudocholinesterase and Serum Lipase levels.

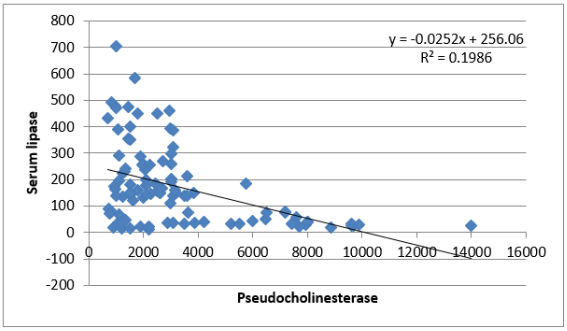

Figure 5: Scatter plot showing correlation of serum lipase levels with s. Pseudocholinesterase

Table 6: Correlation of serum aspartate aminotransferase levels with s. Pseudocholinesterase

	N	Pearson correlation	p- value
S. PSEUDOCHOLINESTERASE	100	1	0.000
S. ASPARTATE AMINOTRANSFERASE	100	-.455**	0.000

**. Correlation is significant at the 0.01 level (2-tailed)

[Table 6] Above table represents the Pearson correlation coefficients and p-values for the relationship between Serum Aspartate Aminotransferase (AST) Levels and Serum Pseudocholinesterase Levels in a sample of 100 individuals. Serum AST (r = -0.455, p = 0.000): A moderate negative correlation suggests that as Serum Pseudocholinesterase levels decrease, Serum AST levels tend to increase. Since the p-value is 0.000 (p < 0.01), this relationship is statistically significant.

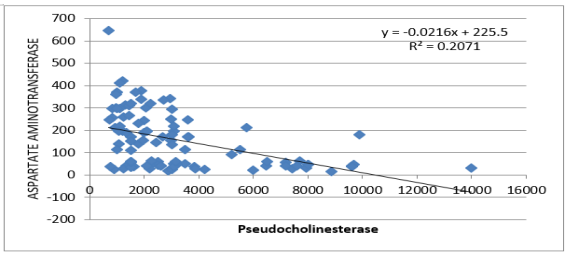

Figure 6: Scatter plot showing correlation of serum aspartate aminotransferase levels with s. Pseudocholinesterase.

[Figure 6] The scatter plot illustrates the relationship between Serum Aspartate Aminotransferase (AST) levels and Serum Pseudocholinesterase levels. The x-axis represents Pseudocholinesterase levels, while

the y-axis represents AST levels.The trend line (regression line) has a negative slope (-0.0216), indicating an inverse relationship between Serum Pseudocholinesterase and Serum AST levels.

Table 7: Correlation of serum alanine aminotransferase levels with s. Pseudocholinesterase

	N	Pearson correlation	p- value
S. PSEUDOCHOLINESTERASE	100	1	0.000
S. ALANINE AMINOTRANSFERASE	100	-.450**	0.000

**. Correlation is significant at the 0.01 level (2-tailed)

[Table 7] Above table represents the Pearson correlation coefficients and p-values for the relationship between Serum Alanine Aminotransferase (ALT) Levels and Serum Pseudocholinesterase Levels in a sample of 100 individuals.

Serum ALT ($r = -0.450$, $p = 0.000$): A moderate negative correlation suggests that as Serum Pseudocholinesterase levels decrease, Serum ALT levels tend to increase. Since the p-value is 0.000 ($p < 0.01$), this relationship is statistically significant.

[Figure 7] The scatter plot represents the relationship between Serum Alanine Aminotransferase (ALT) levels and Serum Pseudocholinesterase levels. The x-axis corresponds to Pseudocholinesterase levels, while the y-axis represents ALT levels. This trend line (regression line) has a negative slope (-0.0201), indicating an inverse relationship between Serum Pseudocholinesterase and Serum ALT levels.

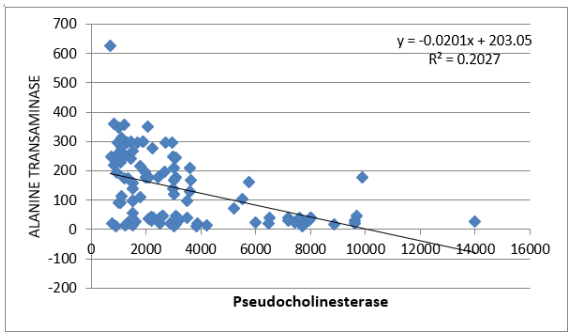

Figure 7: Scatter plot showing correlation of serum alanine aminotransferase levels with s. Pseudocholinesterase

Table 8: Correlation of serum alkaline phosphatase levels with s. Pseudocholinesterase

	N	Pearson correlation	p- value
S. PSEUDOCHOLINESTERASE	100	1	0.000
S. ALKALINE PHOSPHATASE	100	-.361**	0.000

**. Correlation is significant at the 0.01 level (2-tailed)

[Table 8] Above table represents the Pearson correlation coefficients and p-values for the relationship between Serum Alkaline Phosphatase (ALP) Levels and Serum Pseudocholinesterase Levels in a sample of 100 individuals. Serum ALP ($r = -0.361$, $p = 0.000$): A moderate negative correlation suggests that as Serum Pseudocholinesterase levels decrease, Serum ALP levels tend to increase. Since the p-value is 0.000 ($p < 0.01$), this relationship is statistically significant.

[Figure 8] The scatter plot illustrates the relationship between Serum Alkaline Phosphatase (ALP) levels and Serum Pseudocholinesterase levels. The trend line has a negative slope (-0.0439), indicating an inverse relationship between Serum Pseudocholinesterase and Serum ALP levels.

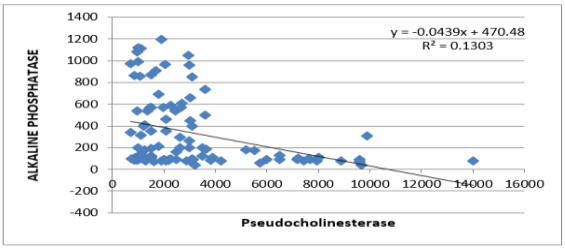

Figure 8: Scatter plot showing correlation of serum alkaline phosphatase levels with s. Pseudocholinesterase

DISCUSSION

This study was conducted to look for the diagnostic and prognostic significance of creatine phosphokinase (CPK), liver enzymes (AST, ALT, ALP) and pancreatic enzymes (serum amylase and lipase) in comparison with pseudocholinesterase in oragnophosphorus compound poisoning. In this study, we found that, there was significant negative correlation between creatine phosphokinase, liver enzymes and pancreatic enzymes with pseudocholinesterase in oragnophosphorus compound poisoning.

In this study, we found that majority of patients (54%) were between 20 to 40yrs of age, it was correlated with study conducted by Bharathisezhian et al., found out that that a significant number of patients poisoned by OP compound were aged between 21 and 40 years (48%).[5]

In our study, we found majority of patient (70%) had myopathy or muscle injury with dearranged serum creatine phosphokinase was correlated with study conducted by Bharathisezhian et al. at Government Mohan Kumaramangalam Medical College Hospital, Tamilnadu it was found that Serum CPK level can be used as an alternative biomarker in diagnosis or stratifying severity of acute OPC poisoning, as it is a cheap and easily available investigation.[5]

In our study, we found 62 % of study subjects had acute pancreatitis with elevated serum amylase and lipase was correlated with study conducted by Aditya Tomar et al., at GSVM medical college, Kanpur,it found that levels of serum amylase & lipase were increased in statistically significant number of cases of acute OP poisoning. These levels can be used as prognostic marker in cases of acute OP poisoning.[6] In our study, we found 56 % of study subjects had hepatic dysfunction with elevated AST, ALT, ALP was correlated with study conducted by Prabodh R et al., at Department Medicine of Dhulikhel Hospital, Nepal, it concluded that this study suggests some level of negative correlation between serum cholinesterase and liver enzymes in OP poisoning.[7] Organophosphates are commonly used for suicide by poisoning in India. Early recognition of the diagnosis and its severity will help in achieving a better outcome. Currently, Pseudocholinesterase are widely accepted as biochemical marker to estimate OP poisoning severity, which is sensitivity, but not specificity and costly investigation. But the possibility of using a wide array of alternate, cheap and easily available markers exists, as evidenced by the studies and using a combination of these markers may be better in terms of early identification of severe poisoning. In peripheral centres without access to costly investigations, these cheap markers may help in guiding an early referral to higher centres for severely poisoned patients.

CONCLUSION

This study proves that, there is a significant derangement of various biochemical markers like creatine phosphokinase(CPK), serum amylase,serum lipase, serum Aspartate Aminotransferase (AST), Serum Alanine Aminotransferase (ALT) and Serum Alkaline Phosphatase (ALP) in acute OP compound poisoning patients. Hence these various biochemical markers which are cheaper, and easily available can be used as potential biochemical markers for diagnosis and assessing the severity of organophosphate poisoning.

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