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RESEARCH ARTICLE
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CORRELATION BETWEEN SERUM AMYLASE AND CHOLINESTERASE IN OP POISONING

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ABSTRACT:
Introduction: Organophosphorus compounds constitute a varied category of chemicals employed as pesticides. Poisoning due to OP compounds is often reported, usually either intentional or accidental ingestion. In the past, cholinesterase levels served as the main indicator for assessing the severity of OP poisoning; however, serum amylase is currently being taken into account as well. **Aim:** To investigate the levels of plasma cholinesterase and serum amylase in instances of acute organophosphorus poisoning, and to establish a correlation between serum amylase levels and plasma cholinesterase levels. **Materials and methods:** A total of 120 patients with OP poisoning admitted in Sri Venkateswara medical college& hospital were included in the study within 24 hours following the incident. Blood samples were collected from each patient upon admission, on the 3rd day, and on the 5th day, and sent to the laboratory for the assessment of cholinesterase and serum amylase levels. **Results:** The majority of patients (42.5%) were in the age range of 21-30 years, with a higher incidence among males (57.5%). There were 47 (39.1%) farmers, 39 (32.5%) students, and 34 (28.3%) housewives. Upon admission, the average plasma concentration of cholinesterase was 3661 U/L, while serum amylase averaged 191.2 U/L. Compared to baseline values, a significant increase in mean plasma cholinesterase and a decrease in mean serum amylase were observed on both the 3rd and 5th days of treatment. This trend of increasing plasma cholinesterase and decreasing serum amylase was statistically significant ($p<0.05$). A significant negative correlation was observed between plasma cholinesterase and serum amylase levels. **Conclusion:** The current research concludes that the average plasma cholinesterase levels decline while serum amylase levels rise in cases of OP poisoning. As treatment progresses and the severity diminish, there is a reversal of the trend, leading to an increase in plasma cholinesterase levels and a decrease in serum amylase levels.

Keywords: Serum Amylase, Plasma Cholinesterase, Organophosphorus Compounds.

INTRODUCTION

Organophosphorus (OP) compounds serve as insecticides widely utilized in agriculture for the management of weeds, pests, and plant diseases. Their targeted action makes these OP compounds

valuable for crop protection and enhancing productivity. In India, OP poisoning represents a significant category of poisoning incidents.[1] Over the last forty years, more than 50,000 organophosphorous compounds have been developed and evaluated for their insecticidal properties, yet the actual number in use today likely does not surpass thirty.[2] The extensive application and easy accessibility of these compounds have heightened the risk of poisoning in developing nations such as India.[3] The critical role of pesticides in India is underscored by the fact that agriculture constitutes a vital part of the Indian economy.

The frequency of pesticide-related poisoning and subsequent hospital admissions has raised in recent years.[4] OP compounds are the leading agents responsible for acute pesticide poisoning. The reasons for poisoning include suicidal, accidental, and homicidal incidents.[4] Among these, suicidal poisoning is the most prevalent in developing countries due to the low cost and easy market availability of these substances. Factors such as accessibility and socio-cultural influences significantly affect the selection of an Organophosphorus compound for self-poisoning.[5] OP compounds function by inhibiting the enzyme acetyl cholinesterase, resulting in the buildup of acetyl choline, which interacts with muscarinic and nicotinic receptors throughout the nervous system. The signs and symptoms associated with OP poisoning arise from the sustained hyperstimulation of acetylcholine at muscarinic and nicotinic receptor sites.[6]

OP compounds attach to the serine residue at the enzyme's active site, leading to the phosphorylation of the enzyme. This phosphorylated enzyme becomes inactive yet stable, degrading over a period of days to weeks.[4] The symptoms of poisoning primarily stem from the overstimulation of muscarinic, nicotinic, and central nervous system receptors. These effects typically manifest only after more than 50% of serum cholinesterase activity has been inhibited.
In cases of mild poisoning, the cholinesterase level drops to 20-50%; in moderate poisoning, it falls to 10-20%; and in severe poisoning, it decreases to below 10%.[7] Serum amylase may serve as a significant prognostic marker for OP poisoning. In the past, plasma cholinesterase levels were utilized to evaluate the severity of poisoning. Currently, serum amylase is being suggested as a more effective measure of severity.[8] Neurological, cardiac and respiratory complications are the primary contributors to morbidity and mortality among these patients. While involvement of other systems can occur, it is quite rare.[9] The primary objective of the current research is to assess plasma cholinesterase and serum amylase levels in cases of acute organophosphate poisoning, and secondary objective is to establish a correlation between serum amylase levels and cholinesterase.

MATERIALS & METHODS

A prospective observational study was carried out in the General Medicine department in collaboration with the Forensic Medicine and Biochemistry departments at Sri Venkateswara medical college& Hospital, Tirupati, Andhrapradesh, from June 2019 to June 2020. A total of 120 patients who were admitted due to OP poisoning in the casualty and intensive care unit were included in this study. Approval from the institutional ethical committee was secured prior to the start of the study, and informed consent was obtained from each patient or their attendant. A pre-designed proforma was utilized to gather the demographic and clinical information of the patients. Patients were recruited based on the following criteria.

Exclusion Criteria:

- Patients with chronic alcoholism
- History of pancreatitis
- Disease of salivary glands
- Cardiac, renal, hepatic diseases
- Diabetes and Hypertension.
- Neuromuscular diseases

- Women on oral contraceptives and pregnant women
- History of consumption of OP poison mixed with any other poison

Sample Collection:
From the selected patients, approximately 3 ml of venous blood was drawn on three separate occasions: initially at the time of admission (within 24 hours post-poison consumption), then on the 3rd day, and subsequently on the 5th day. The blood sample underwent centrifugation at 3000 rpm for 15 minutes, after which serum was separated for the assessment of serum amylase.

The leftover blood sample was utilized for the evaluation of plasma cholinesterase. Plasma cholinesterase levels were determined using the new Deutsche Gesellschaft für Klinische Chemie (DGKC) method, known for its high linearity and sensitivity. Serum amylase was measured using the 2-Chloro-4-Nitrophenyl-α-Maltotrioside (CNPG3) method. Furthermore, additional tests were conducted, including random blood glucose, serum electrolytes (sodium and potassium), blood urea, serum creatinine, complete blood count, chest radiograph, electrocardiogram, HIV, HBs Ag, liver function tests, and arterial blood gas (ABG) analysis if required. Clinical observations included pupil size, pulse rate, blood pressure, respiratory rate, and secretions.

Statistical Analysis:
Data was gathered and input into MS Excel. The collected data were analyzed using the unpaired test and the chi-square test. The relationship between Plasma Cholinesterase and Serum amylase was assessed through Pearson's correlation analysis utilizing SPSS software version 23.0. Results were presented as Mean±SD. A P-value of <0.05 was deemed statistically significant.

RESULTS

Table -1: Demographic pattern of the study group

Variables		No. of Patients	Percentage
Age	21-30 years	51	42.5%
	31-40 years	35	29.1%
	41-50 years	27	22.5&
	51-60 years	6	5%
	Above 60 years	1	0.83%
Gender	Males	69	57.5%
	Females	51	42.5%
Occupation	Farmer	42	35%
	Housewife's	23	19.16%
	Students	30	25%
	Employee	6	5%
	Others	19	15.8%
Route of poisoning	Oral	116	96.6%
	Inhalational	4	3.3%
Mode of contact	Accidental	3	2.5%
	Suicidal	117	97.5%
Marital status	Married	87	72.5%
	Unmarried	33	27.5%
Time elapsed between consumption to presentation to hospital	Less than 1 hour	70	58.3%
	2-4 hours	43	35.8%
	More than 4 hours	7	5.8%

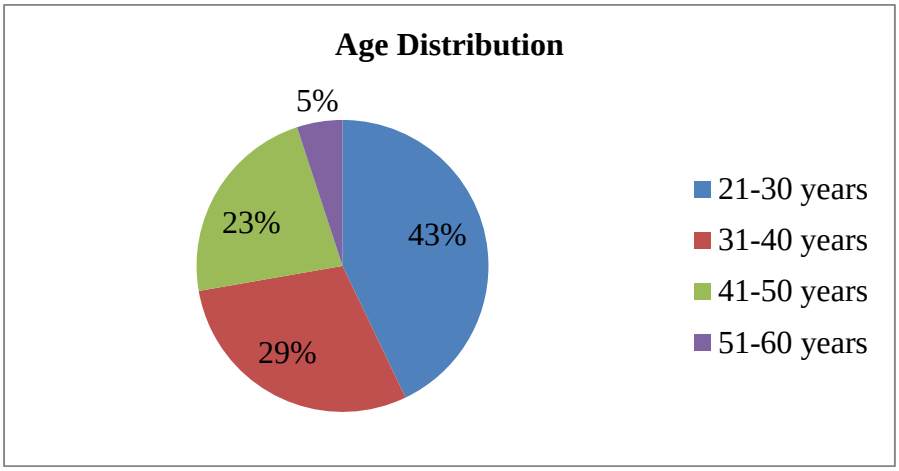

Image-1: Distribution of Age

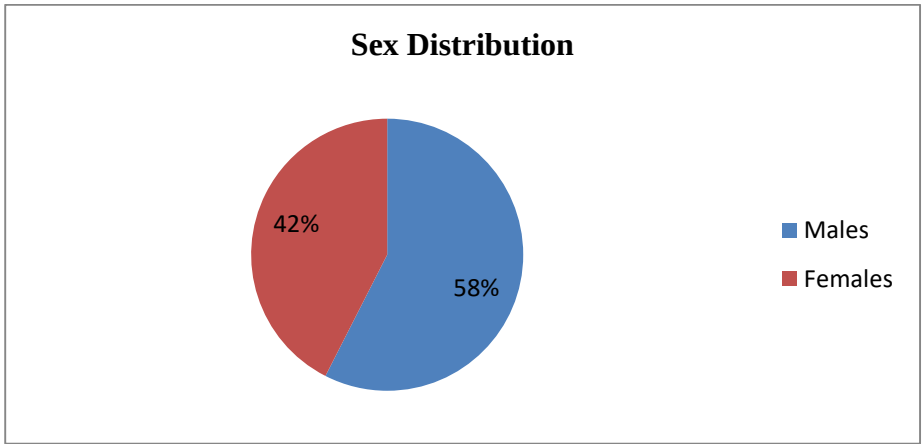

Image-2: Distribution of sex

Table -2: Comparison of Plasma Cholinesterase and Serum Amylase Level by Days

	Baseline	**3rd day**	**5th day**	**ANOVA P value**
Plasma Cholinesterase Mean ± SD U/L	3661 ± 24.21	3972.3±33.2	5451.6 ±35.3	0.001
Serum amylase Mean ± SD U/L	191.2 ±25.36	162.4±25.12	101.2±23.4	P<0.003

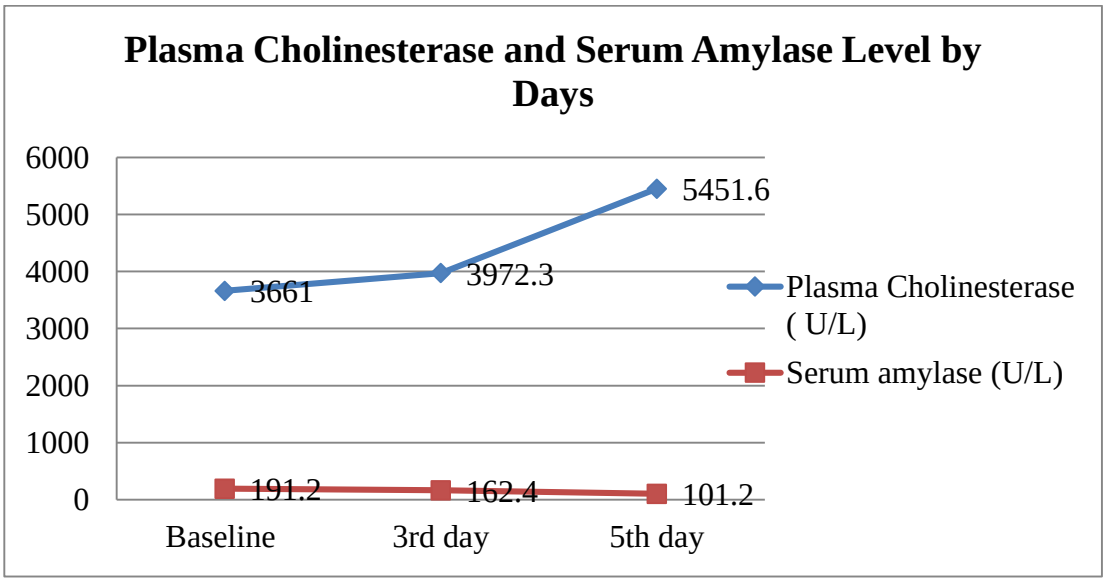

Image-3: Plasma Cholinesterase and Serum Amylase Levels by Days

In this study, a total of 120 patients with organophosphate (OP) poisoning were enrolled. The largest proportion of participants (42.5%) fell within the 21-30 age range, followed by 29.1% in the 31-40 age group. Males accounted for a higher incidence of OP poisonings at 57.5%, with farmers representing 35% and students 25%. Regarding marital status, the majority of patients were married, comprising 72.5%. Additionally, 58.3% of patients arrived at the hospital within one hour of ingesting the poison. A significant 96.6% of the cases involved oral consumption of the poison. Intentional poisoning was reported in 97.5% of the study group, while only 2.5% were accidental cases. The most frequently encountered OP compounds included monocrotophos (51 cases, 42.5%), followed by chlorpyrifos (28 cases, 23.3%). Out of the total, 44 patients required ventilator support; among them, 21 had monocrotophos poisoning, 9 had chlorpyrifos poisoning, 4 were affected by parathion, 4 by cypermethrin, and 1 from another type of poisoning. The remaining 2 patients were unaware of the poison they had ingested.

The mean plasma cholinesterase levels at admission, on the 3rd day, and on the 5th day were recorded at 3661 U/L, 3972.3 U/L, and 5451.6 U/L, respectively, indicating a statistically significant upward trend ($p<0.05$). Conversely, the mean serum amylase levels at admission, on the 3rd day, and on the 5th day were 191.2 U/L, 162.4 U/L, and 101.2 U/L, respectively, demonstrating a statistically significant downward trend over time ($p<0.001$).

Table-3: Correlation between plasma cholinesterase and serum amylase

	r value	**P value**
Day of admission	0.9298	<0.05
3 rd day	0.9550	<0.05
5th day	0.9659	<0.05

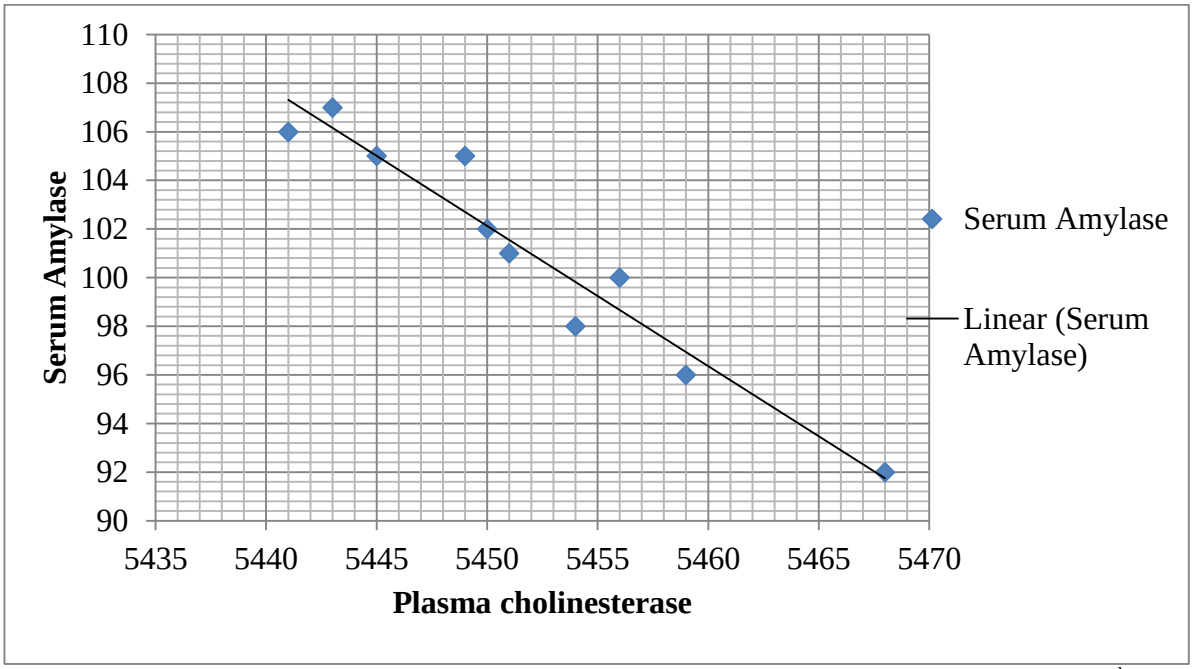

Image-4: Showing correlation between plasma cholinesterase and serum amylase at 5th day

The Pearson's correlation coefficient between the two biochemical indicators plasma cholinesterase and serum amylase shows significant negative correlation (at admission: r-0.9298, 3rd day: 0.9550, 5th day: 0.9659) with p value <0.05.

DISCUSSION

The current research sought to establish a correlation between serum amylase and cholinesterase levels in individuals suffering from organophosphate (OP) poisoning. A total of 120 patients with OP poisoning participated in this study. Among these 120 patients, 42.5% were in the age group of

21-30 years, while 29.1% were aged between 31-40 years. The age group under 30 years is particularly significant, as individuals in this range may struggle to manage psychological stress, potentially leading them to take extreme measures, such as ingesting available poisons, to end their lives. These observations align with findings from earlier studies, which also indicated that a significant proportion of patients fell within the 21 to 30-year age range.[10, 11, 5, 12] In a different study, it was found that most patients were under 20 years old.[13] The occurrence of organophosphorous poisoning was higher in males (57.5%) compared to females (42.5%), which aligns with findings from earlier studies, [12, 14, 15] but contradicts another research.[13]

The gender-based prevalence of poisoning may vary by location, the accessibility of poisons, and various surrounding factors. A significant number of patients (117) did not seek assistance, with 97.5% having ingested poison for suicidal reasons. Rapid urbanization and socio-economic conditions primarily lead to feelings of frustration and depression among individuals. Those who struggle to manage stressful situations are often the primary victims of suicidal poisoning. The majority of participants in the study were farmers (35%), followed by students (25%), with housewives ranking third (19.16%). A significantly higher rate of poisoning was noted among farmers compared to individuals in other professions. The results of this study align with those of earlier research. [12, 16] Previous studies have shown that suicidal and occupational poisoning is more prevalent among agricultural workers in developing nations, while accidental organophosphate poisoning is more frequent in developed countries.[17] In India, farmer suicides represent about 10% of all suicide cases. Factors contributing to these suicides include rising cultivation costs, failure of monsoon rains, climate change, substantial debt, mental health issues, personal challenges, and family-related problems.

The average plasma cholinesterase levels showed a significant increase from the time of admission until the 5th day. This upward trend in plasma cholinesterase was statistically significant ($p<0.05$). Concurrently, the average serum amylase levels decreased from admission to the 5th day, indicating that this downward trend over the same period was also statistically significant ($p<0.001$). The inhibition of plasma cholinesterase in the initial days reflects the severity of organophosphorus poisoning. As treatment continues and the severity diminishes, plasma cholinesterase levels rise. Our observations regarding the decrease in plasma cholinesterase on the day of admission and the severity of OP poisoning align with previous research, which identified a positive correlation between plasma cholinesterase levels and the severity of poisoning as noted in studies.[18, 19]

Serum amylase levels showed a progressive decline from the time of admission to the 5th day; this decrease in serum amylase levels was statistically significant ($p<0.05$). This indicates that in cases of OP poisoning, serum amylase levels rise in accordance with the extent of cholinergic stimulation. Previous studies have also noted a gradual reduction in mean serum amylase levels from admission to hospital discharge.[20] According to one previous study; longer hospital stays and a high risk of complications associated with higher serum amylase levels at admission.[19] Additionally, another study revealed that respiratory failure occurred in 50% of patients who exhibited elevated plasma amylase levels beyond the normal range.[21] In the current research, Pearson's correlation coefficient between the two biochemical markers, namely plasma cholinesterase and serum amylase, demonstrated a significant negative correlation with a p-value of less than 0.05, as illustrated in **Table-3 and Image-4**. A prior study indicated a negative correlation between plasma cholinesterase and serum amylase, and these findings are consistent with the results of the current study.[22]

CONCLUSION

The current research concludes that the average plasma cholinesterase levels decline while serum amylase levels rise in cases of OP poisoning. As treatment progresses and the severity diminish, there is a reversal of the trend, leading to an increase in plasma cholinesterase levels and a decrease in serum amylase levels.

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