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Original Research Article

The Function of Plasma Cholinesterase Levels in Determining the Severity and Prognosis of Organophosphorus Poisoning

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Abstract

Background: If not identified and treated promptly, organophosphorus poisoning is linked to a high death rate. Therefore, determining the importance of cholinesterase activity in determining the severity and forecasting the course of organophosphorus poisoning is the goal of the current investigation.

Methods: The present study was carried out over the course of a year, from July 2024 to June 2025, at the Department of Forensic Medicine at Radha Devi Jageshwari Memorial Medical College and Hospital in Turki, Muzaffarpur, and Bihar. Following the application of inclusion and exclusion criteria, 160 patients in total were enrolled. For every study participant, the Peradeniya Organophosphorus Poisoning Scale was used.

Result: Majority of patients were married (70%) and male (64%). About 42% of cases belong to the age group 21-30 years. About 1/3rd of the cases had low socioeconomic status and about 1/3rd cases were farmers by occupation. On applying Peradeniya Organophosphorus Poisoning (POP) Scale, about one third of patients had tachypnoea, followed by impaired consciousness (29%). Serum/ plasma cholinesterase level showed higher mortality in patients having suppressed cholinesterase activity (< 4000 IU/L).

Conclusion: Organophosphorus poisoning diagnosed at early stages of poisoning determining pseudocholinesterase activity form a reliable diagnostic test for management and can serve as lives saving tool.

Keywords: Organophosphorus poisoning, Plasma cholinesterase, Pseudocholinesterase, Tachypnoea.

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Introduction

A worldwide issue, organophosphorus compound (OPC) poisoning has a significant fatality rate if it is not identified and treated promptly [1]

In developing nations like India, organophosphorus chemicals are widely utilized as pesticides to boost agricultural commodity production. As a result, OPC poisoning mortality and toxicity rates are worrying in developing nations like India [2].

Every year, about 2,20,000 people die from pesticide poisoning, and there are about 3 million cases worldwide. In their chemical examination of viscera, Soni et al. also found that the most prevalent toxin was an organophosphorus molecule [3]. Monocrotophos, dimethoate, parathion, Malathion, diazinon, etc. are most commonly used OPCs. These compounds can be absorbed by various routes like inhalation, ingestion, dermal absorption etc. Diagnosis of OPCs poisoning is made on the basis of history, clinical examinations and biochemical investigations. Treatment of OPCs is done with antidotes particularly atropine, oximes, benzodiazepines and selective determination [4].

OPCs are not only powerful inhibitors of cholinesterase but also act directly on cholinergic nerve endings [2]. These compounds inhibit the enzyme acetylcholinesterase leading to accumulation of acetylcholine, which binds to muscarinic and nicotinic receptors throughout nervous system.

Signs and symptoms of poisoning are due to persistent acetylcholine hyperstimulation at muscarinic and nicotinic receptors sites.[4] The

major forms of cholinesterase exist in vertebrates which can hydrolyze acetylcholine are plasma cholinesterase (Pseudo- or Butyrl or Serum Cholinesterase) and RBC cholinesterase (True, Specific Cholinesterase). Both these types of enzymes are inhibited by OPCs poisoning.

Therefore the aim of present study is to evaluate the significance of cholinesterase activity in assessing severity and to predict the outcome of Organophosphorus poisoning.

Material and Methods

The present study was carried out over the course of a year, from July 2024 to June 2025, at the Department of Forensic Medicine in collaboration with the emergency department of Radha Devi Jageshwari Memorial Medical College and Hospital in Turki, Muzaffarpur, Bihar.

There were 240 patients of OP poisoning who were admitted through OPD and emergency during the study period. Among them, 160 patients were enrolled after applying inclusion and exclusion criteria.

A known case of organophosphorus poisoning, patient with clinical signs and symptoms suggestive of organophosphorus poisoning, patient showing evidence of organophosphorus poisoning on evaluation were included in this study.

Patient brought dead or unknown poisoning, patient on Ventilator, patient with multiple poisoning with drugs such as opioids, diazepam, barbiturates etc. and patients who received partial treatment outside and referred to our hospital were excluded. A detailed history, clinical examination and relevant biochemical investigations were performed. A thorough clinical examination was carried out with particular reference to vital parameters, pupil size, assessment of central nervous system, respiratory system, cardiovascular system. This examination took place during initial resuscitation and treatment of the patient. Peradeniya Organophosphorus Poisoning Scale was applied to all study subjects and severity of OP poisoning was graded as mild, moderate and severe.

In all study subjects, 3 ml, of blood was collected on admission before administration of atropine and plasma cholinesterase was estimated. Plasma cholinesterase was estimated by colorimetric method using a kit provided by "Raichem of USA". The instrument used was RA – 50.

3 ml of plain blood was drawn and 5 uml of blood was centrifuged at 3000 rpm for 5 minutes. The serum of the patient was taken and added to the tube containing 1.55 ml of the reagent. Required information is collected on open ended semi-structural scheduled and compiled analysis with the help of MS Excel software.

Result

Out of 160 patients, 84 (54%) patients had PChe levels more than 50% within normal range. Only 11 patients (7%) had severe poisoning with PChe levels less than 10% (Table 1).

Table 1: Distribution of cases according to Pseudo Cholinesterase (PChe) Levels

Plasma cholinesterase level (% of normal)	Number of cases	Percentage
Normal	86	54%
20–50	56	35%
10–20	7	4%
<10	11	7%
Total	160	100%

Table 2 shows correlation between Plasma cholinesterase Levels and outcome. Majority of patients 86 (54%) had subclinical poisoning with their PChe levels being >50%, out of which only 2 (2%) patients expired. Patients with PChe levels <50% had more mortality compared to patients with PChe levels >50%.

Table 2: Correlation between Plasma cholinesterase Levels and Outcome

Plasma cholinesterase levels (% of normal)	Survived (%)	Expired (%)
Normal	84(98%)	2(2%)
20–50	38(68%)	18(32%)
10–20	5(71%)	2(29%)
<10	7(63%)	4(37%)
Total	134(84%)	26(16%)

The reference lab value for serum /plasma cholinesterase in the study: 5100 to 11700 IU. Table 3 shows severity of Organophosphorus poisoning based on cholinesterase levels (SCE) on day one Presentation. 7% cases showed SCE level < 1000 IU/L and classified as severe cases while 4% cases showed SCE level between 1000-2000 IU/L and classified as moderate. Cases showing SCE level > 2000 IU/L are classified as mild cases and majority (89%) cases belong to this category.

Table 3: Severity of Organophosphorus Poisoning based on Cholinesterase Levels (SCE) on Presentation (Day1)

Severity	Range of SCE (IU/L)	Number of cases	Percentage
Severe	<1000	11	7%
Moderate	1000-2000	7	4%
Mild	2001-3000	24	16%
Mild	3001-4000	18	11%
Mild	4001-5000	14	8%
Mild	>5000	86	54%
Total		160	100%

(As per modified Proud foot Classification)

Table 4 shows relation between initial level of serum cholinesterase and mortality. Serum /plasma cholinesterase level shows higher mortality in patients having suppressed cholinesterase activity (< 4000 IU/L). The least rates of mortality were in the >5000 IU/L (2%).

Table 4: Relation between Initial Level of Serum Cholinesterase and Mortality

Severity	Range of SCE (IU/L)	No. of cases (%)	Mortality (%)
Severe	<1000	11(7%)	4(36%)
Moderate	1000-2000	7(4%)	2(29%)
Mild	2001-3000	24(16%)	9(37%)
Mild	3001-4000	18(11%)	7(39%)
Mild	4001-5000	14(8%)	2(14%)
Mild	>5000	86(54%)	2(2%)
Total		160(100%)	26(16%)

(As per modified Proud foot Classification)

Discussion

In the present study, the majority of patients were in the age group of 21-30 years (42%), followed by the age group of 31-40 years (22%). Male to female ratio in present study is 1.75:1 and married to unmarried ratio in present study is 2.33:1. 90 (56%) patients belonged to rural areas and 70 (44%) belonged to urban areas. 58 (37%) patients were from upper lower-socio economic groups, followed by 44(27%) from lower class, in contrast to only 10 (6%) from upper class. On the basis of occupation, 61 (38%) patients were farmers, followed by 35 (22%) housewives and 26 (16%) students.

In the present study, vomiting and salivation was the commonest symptom (94%) followed by sweating (92%) and lacrimation (64%). The characteristic odor was present in 94% of patients. The other common clinical signs were tachypnoea (84%), altered consciousness (72%) and miosis (54%). Results of our study are in accordance with the studies done by Goel et al. [5], Kumar et al. [6] and Ramani et al. [7].

In the present study, 65% patients had mild grade, 32% had moderate grade and 3% patients severe grade of poisoning. The individual components of Peradeniya organophosphorus poisoning (POP) scale namely miosis, fasciculation, respiratory rate, bradycardia and level of consciousness were compared and results are similar with the study done by Goel et al. [5]. Plasma cholinesterase (PChe) levels were classified according to Proud foot classification into subclinical (normal), mild, moderate and severe poisoning. In present study, 11(7%) patients had PChe level less than 10% of normal at admission indicating severe poisoning and 4 (37%) of patients expired. 7 (4%) patients had PChe level between 10-20% indicating moderate poisoning and 2 (29%) of patients were expired. 56 (35%) patients had PChe level between 20-50% indicating mild poisoning and 18 (32%) of patients were expired (Dreisbach's grading). Patients with PChe levels <50% of normal had more mortality compared with PChe levels >50% of normal. Hence it can be inferred that low plasma cholinesterase activity can be taken as a good diagnostic test for OP poisoning.

Recent studies by Ram et al. [8] showed that PChe activity below 10% of normal were associated with poor prognosis. Our findings are consistent with the studies done by various authors (Namba et al. [9]; Wadia et al. [10]; Ramani et al. [7] and Cunha et al. [11] who showed that plasma cholinesterase activity estimation is a reliable diagnostic test in OPCs poisoning and considered it a valid marker between severity of poisoning and prognosis of patients.

Conclusion

One of the leading causes of suicide fatalities in our nation is organophosphorus poisoning. It is possible to diagnose OP poisoning early by estimating pseudocholinesterase activity. It is important to educate farmers and other pesticide sprayers on preventative steps to avoid unintentional organophosphorus poisoning.

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