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Original Research Article

A study on serum cholinesterase level in organophosphorus poisoning and its correlation with severity of organophosphorus poisoning

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ABSTRACT

Background: There has been a steady increase in the use of organophosphates (OPs) as pesticides in most of the developing countries including India for more than 50 years. OPs tend to be the commonest cause of poisoning worldwide and are persistently and deliberately used in suicides in Agrarian areas. As stated by WHO, 3 million cases of pesticide poisoning occur every year, of these about 1 million are accidental and 2 million are suicidal poisonings, resulting in more than 0.25 million deaths per year. As there is limited availability of facilities and resources in developing countries, all OP poisoning patients are not managed in intensive care units. Hence it is important to understand the clinical features and other factors that indicate severity of poisoning which should be identified in the initial examination.
Methods: It was a hospital based prospective study of 100 OP poisoning patients that were attending to casualty of BIMS Hospital and Medical College Belagavi, India. Over a period, patients fulfilling inclusion criteria were included and patients were categorized according to Peradeniya Organophosphorus Poisoning (POP) scale. Serum cholinesterase level measured at the time of admission.
Results: The patients were in the age group of 18 to 70 years. Majority of the patients were in the age group of 21-30 years (51%). Sixty nine percent of the patients were from rural areas and 38% of them were farmers. Sixty nine percent of patients were from low socioeconomic stratum. Major route of intake of poison was ingestion. Eighty four percent of patients consumed poison with a suicidal intent. In this study, authors observed that there is a significant correlation between the severity of poisoning categorized by the POP scale and the serum cholinesterase at the time of initial presentation of the patients ($P<0.001$).
Conclusions: Present study concluded that significant correlation between the degree of derangement in serum cholinesterase level and severity of poisoning at the initial presentation. Higher the score on the POP scale, the greater was the degree of derangement in the serum cholinesterase level.

Keywords: Cholinesterase level, Organophosphorus poison, POP scale

INTRODUCTION

OP poisoning occurs due to exposure to OPs which results in the accumulation of acetylcholine (ACh) in the body, as acetyl cholinesterase (AChE) gets inhibited. OP poisoning most commonly results from exposure to insecticides or nerve agents. OP's tend to be the commonest cause of poisoning worldwide, and are persistently and deliberately used in suicides in Agrarian areas.[1] As stated by WHO 3 million cases of pesticide poisoning occurs every year, out of which, about 1 million are accidental and 2 million are suicidal poisonings, resulting in more than 0.25 million deaths per year.[2,3]

OP pesticide exposure occurs via inhalation, ingestion and dermal contact. Because OP pesticide disintegrates quickly in air and light, they have been observed to be relatively safe to consumers. However, OP remnants persist on fruits and vegetables.[4] Certain OP pesticides have been banned for being utilized on certain crops, for example. Methyl parathion is banned from use on some crops while permitted on others. OP pesticide available as

- Insecticides including malathion, parathion, diazinon, fenthion, dichlorvos, chlorpyrifos, ethion, trichlorfon.
- Nerve gasses including soman, sarin, tabun, VX
- Herbicides including tribufos [DEF], merphos are tricresyl phosphate containing industrial chemicals.[5]

OP poisoning occurs as organophosphates inhibit AChE by phosphorylating the serine hydroxyl residues on AChE that inactivates AChE. AChE is found in the synapse between nerve cells and muscle cells and is critical for nerve function but causes ACh accumulation resulting in muscle overstimulation. This causes disruption at cholinergic synapses and can only be reactivated very slowly. Paraoxonase1(PON1) was first discovered through its ability to hydrolyse and therefore detoxify organophosphorus compounds which are widely used as pesticides and nerve gases. Despite decades of research it is only now becoming clear that PON1 protects humans from the acute and chronic harmful effects of these compounds.[6,7] Low PON1 activity found in children may increase their susceptibility to organophosphates, which is critical in determining an organism`s sensitivity to OP exposure. The cause of death in OP poisoning may be either one or combination of the above. Early diagnosis is a key to cure. Any type of delay in the commencement of treatments will not only limit the outcome but also the opportunity to use pralidoxime which prevents aging of the enzyme.[8]

As there is limited availability of facilities and resources in developing countries all OP poisoning patients are not managed in intensive care units. Hence it important to know the clinical features and other factors that indicate the severity of poisoning and criteria to speculate the need for ventilator support which should be identified in the initial examination.[9]

According to the study at Senayeke et al, serum cholinesterase level is depressed after OP poisoning.[10] Serum cholinesterase level can be routinely estimated locally. The Peradeniya Organophosphorus Poisoning scale assesses the severity of poisoning based on the symptoms at presentation and is simple to use. In a study by Senayeke et al, patients with the high score on the POP scale had a high rate of morbidity and mortality. Noiura S et al concluded that serum cholinesterase levels have no prognostic value in acute OP poisoning.[11]

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

The objectives were to estimate serum cholinesterase levels in Organophosphorus compound poisoning patients and to correlate serum cholinesterase level and the clinical criteria score described by the Peradeniya Organophosphorus Poisoning scale at initial presentation and the severity of poisoning.

METHODS

The study was conducted at the Department of Medicine, BIMS Belagavi from January 2017 to December 2017. It was a hospital based prospective study of 100 patients with OP poisoning attending to the casualty of BIMS Hospital and Medical College, Belagavi. The approval from the institutional ethical committee was taken. All the procedures were followed in accordance with Helsinki declaration 1975 which was revised in 2013.

Consent of the patient and/or Guardian was taken before including in the study. Patients with H/O exposure to OP poison presenting within 24 hours were included in the study. Patients with age <18years, patient with indication of exposure to an entirely different poison other than OP poison, patients with OP poisoning and mixed with any other poison, patients who were treated elsewhere, patients who had been administered any blood products or derivatives were excluded from the study

All the cases satisfying inclusion and exclusion criteria were included. A detailed case history was taken as per the proforma, general physical examination and systemic examination was done soon after admission. Laboratory investigation such as Complete Blood Count, Random Blood Sugar, Renal Function Test, Liver Function Test, Serum cholinesterase level was sent at the time of admission. The patients were monitored regularly till the final outcome.

The diagnosis was made based on history or evidence of exposure to OP compound within 24 hours; characteristic manifestations of OP poisoning include, miosis, fasciculations, excessive salivation, improvement of signs and symptoms with administration of atropine, corroborative evidence like empty containers and odor of gastric aspirates. Clinical severity was assessed and categorized according to 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 as mild poisoning, 4 to 7 as moderate poisoning and 8 to 11 as severe poisoning.

Statistical method

All the collected data of 100 patients were analysed using appropriate statistical test. For the description of data, mean values, percentages and standard deviations were used. Pearson's Chi- square test and correlation coefficient was used to calculate test of significance.

RESULTS

Table 1: Age distribution.

Age group	No. of cases	Percentage
<20	13	13
20-30	51	51
30-40	24	24
40-50	08	08
>50	04	04
Total	100	100

Age group ranged from 18 years to 66 years. Majority of the patients were in the age group of 20-30 years which comprised 51% of the study patients.

Table 2: Gender distribution of cases.

Gender	No. of cases	Percentage
Male	60	60
Female	40	40
Total	100	100

Table 3: Occupation of patients.

Occupation	No. of cases	Percentage
Farmer	38	38
Labour	17	17
House keeping	25	25
Student	10	10
Businessmen	05	05
Unemployed	05	05
Total	100	100

Out of 100 cases, 60 were males and 40 were females. Male to female ratio was 1.5:1. In this study, there was male predominance. In present study, 73% of patients were married 27% were unmarried. More than half of present study subjects (69%) were from rural area. In this study, 69 % of patients were from the lower socioeconomic group in contrast to 3% from the upper class.

Thirty-eight percentage of patients in present study were farmers. Next major group was constituted by housekeeping 25% which included housewives and unmarried females. Most patients (84%) had consumed poison with a suicidal intent. In present study, 16% patient had accidental poisoning that were mainly farmers.

Table 4: Severity according to Peradeniya OP poisoning scale.

Severity scale	No. of cases	Percentage
Mild (<4)	55	55
Moderate (4-7)	33	33
Severe (>7)	12	12
Total	100	100

Fifty five percent of patients in present study belonged to a mild grade of poisoning with a POP score less than 4, 12% patients had a score more than 7 and severe poisoning.

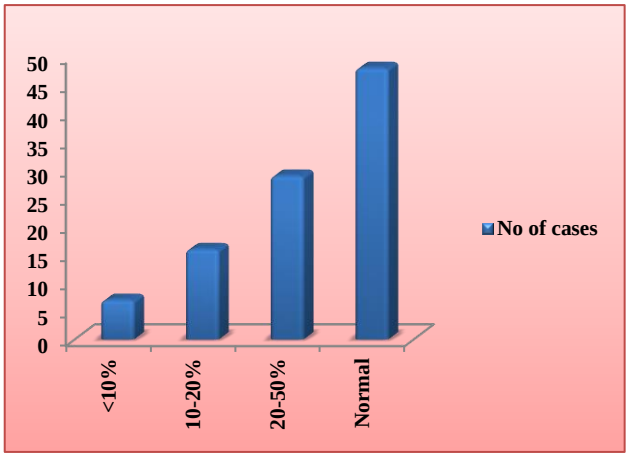

Figure 1: Severity of poisoning according to serum cholinesterase levels.

Table 5: Comparison of severity according to serum cholinesterase levels versus POP scale.

Pop scale	Serum cholinesterase level				Percentage
	<10% (<465 U/L)	10-20% (465-930 U/L)	20-50% (930-2330U/L)	>50% Normal (>2330U/L)	
Mild (<4)	00	00	12	43	55
Moderate (4-7)	00	11	17	05	33
Severe (>7)	07	05	00	00	12
Total	07	16	29	48	100

Normal serum cholinesterase level: 4660-6500 U/L; Pearson correlation coefficient (r): -0.516 (Moderate degree negative correlation); χ^2 value=105.109; P Value is <0.001 (Highly significant).

In this study, 48% of patients had serum ChE levels more than 50%, normal range. Twenty-nine percentage of patients had mild poisoning with serum ChE levels between 20 and 50% and only 7% of cases had severe poisoning <10%.

DISCUSSION

The present study was conducted at the Department of Medicine, BIMS, Belagavi. A total of 100 cases were studied. The clinical and diagnostic findings of this study are compared with studies in the literature.

In present study, the majority of patients were in the age group of 21-30 years (51%) in comparison to studies done by Bhattacharya et al (46%), Kavya et al (65%). Eighty-eight percentage of patients were within 40 years of age. The study by Rehiman et al showed 70% of incident was under 25 years of age.[12]

This study revealed a male preponderance (60%), females accounting for 40% of cases. The male to female ratio in this study is 1.5:1. This corresponds to gender distribution reported by Bhattacharya et al whereas study by Kavya et al was 4.9:1.[13,14]

In present study, married patients were 73% and unmarried patients were 27%. This can be accounted by considering the fact that in India marriages occur at an earlier age. More than half of present study subjects (69%) were from the rural area as the main occupation for many Indians is agriculture and most of the farmers are from rural background.

The POP scale was calculated for all patients at initial presentation. Fifty-five percentage of patients had a mild grade of poisoning and 33% had a moderate grade of poisoning. Twelve percentage patients had severe poisoning with scores more than 8. Serum cholinesterase levels were assessed in all patients at admission to hospital and it was classified according to Proudfoot. A classification of subclinical (normal), mild, moderate and severe poisoning.[15] In present study 48% of patients had subclinical poisoning and 7% had severe poisoning. There was the significant correlation between the severity of poisoning categorized by the POP scale and the serum cholinesterase at the time of initial presentation of the patients ($P<0.001$).

The current study observed the significant correlation between the degree of derangement in serum cholinesterase level and severity of poisoning at the initial presentation. Higher the score on the POP scale, the greater was the degree of derangement in the serum cholinesterase level.

CONCLUSION

Present study concluded that there is a significant correlation between the severity of poisoning and degree of derangement of serum cholinesterase level at the initial presentation. The higher the POP scale, the higher was the degree of derangement in the serum cholinesterase level. Both serum cholinesterase and POP scale are an important tool for the diagnosis of the severity of OP poisoning. The facility of estimation of serum cholinesterase is not available in all centres of India. In that case, POP scale can be used to describe the severity of OP poisoning. Timely administration of an antidote sufficient dose and duration are much more important in the patients with evidence of a moderate and severe degree of OP poisoning. Such patients need to be monitored and observed closely with good supportive care. Larger population-based studies are needed as the study group is just adequate.

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