

Relevance of Pseudo Cholinesterase Level to Clinical Profile as Prognostic Marker on Organophosphorus Compound Poisoning

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Abstract

Background: Organophosphorus poisoning has a high mortality rate. Various factors decide prognosis of organophosphate poisoning. This study is carried out to analyze the significance of estimation of serum pseudo cholinesterase in assessment of severity as well as prognosis in OP poisoning. **Materials and Methods:** This prospective study was conducted at department of Medicine in McGann teaching hospital attached to Shimoga institute of medical sciences from June 2017 to December 2017. Total of 123 documented OP patients were analyzed. Noting of symptoms, signs, need of oxygen, ventilator support and their assessment with PChE levels carried out. Informed consent was taken from each study participant. Ethical committee approval was obtained to carry out the study. Suitable statistical methods applied to assess correlation and variables. **Results:** Among 123 patients, majority were male (64.2%), belonged to 21-30 age group (34.1%), were from rural areas (91%) and commonest compound ingested is chlorpyrifos (60.9%). Patients needing ventilator support were 3, 13 and 43 in patients of moderate poisoning, severe poisoning and very severe poisoning respectively, where as it was none in patients with mild poisoning and normal PChE levels. There were 21 deaths in very severe poisoning patients where as it was 4 and 1 in severe and moderate poisoning patients respectively and none in mild poisoning patients and in patients with normal PChE levels. **Conclusions:** Significant correlation (p value <0.001) was observed between PChE levels with clinical manifestations, need of mechanical ventilation and in hospital outcome. These findings can enforce the evaluation of patient's prognosis, complications and treatment plan.

Keywords: Organophosphorus Poisoning; Pseudo Cholinesterase; Ventilator Support.

Introduction

Poisoning has become a significant cause of death especially in the developing nations and is the most frequently used method of suicide [1].

The WHO estimates that approximately 3 million pesticide poisonings occur annually worldwide and cause more than 220,000 deaths. Developing countries like India and Srilanka report alarming rates of toxicity and death [2]. Amongst these, insecticides constitute

an important group, and organophosphorus (OP) compounds are possibly the insecticides most widely used in the world. Organophosphates (OP) inhibit acetylcholinesterase and cause excessive acetylcholine accumulation, which affects muscarinic and nicotinic receptors at synapses within the peripheral and central nervous systems [3].

Organophosphorus compounds were first used as an agricultural insecticide and later as potential chemical warfare agents [4]. Its widespread use and easy availability has increased the likelihood of

poisoning with these compounds. Organophosphorus compound poisoning is the most common medico toxic emergency in India. Acute Organophosphorus compound poisoning is an important indication for emergency admission in most hospitals throughout India [4].

OPpoisoning causes neurotoxic sequela and has a high mortalityrate [5,6]. Respiratory failure is the most common complication of OP poisoning leading to death. Early recognition and prompt ventilator support may improve survival. Owing to limited availability of resources, all OP poisoning patients are not managed in ICUs in Indian setup. It is therefore important that clinical features and criteria to predict the need for ventilator support and complications be identified at initial examination.

The anti-cholinesterase effects can be evidenced biochemically by suppressed levels of Pseudo cholinesterase (PChE) and red cell cholinesterase. Serum cholinesterase levels are easier to estimate and usually depressed after OP poisoning. Measuring serum cholinesterase level in blood is a gold standard for diagnosis of organophosphorus poisoning as its level decreases in OPC poisoning [7].

Factors to assess the severity of organophosphate poisoning and predict outcome have been studied extensively. These include pseudo cholinesterase (PChE), Glasgow coma scale (GCS) score, Acute Physiology and Chronic Health Evaluation (APACHE) II score, and creatine phosphokinase. Of these, PChE remains the main prognosticator. However, while most studies agree that a low PChE level does indicate OP poisoning, they differ in whether it also indicates severity. This study was undertaken to assess the severity of organophosphorus compound poisoning by estimating serum cholinesterase levels and predicting prognosis, outcome using cholinesterase levels.

Objective

To analyze the significance of estimation of serum PChE in assessment of severity as well as prognosis in OP poisoning.

Materials and Methods

This prospective study was conducted at department of Medicine in McGann teaching hospital attached to Shimoga institute of medical sciences from June 2017 to December 2017.

Initial diagnosis were established in all cases based on history, the odor of OP in the gastric contents, cholinergic clinical features, and other circumstantial evidence such as the poison or a label of an OP-containing product found by relatives. All patients were given the standard treatment regime for OP poisoning.

Inclusion Criteria

Patients of documented OP poisoning hospitalized were included.

Exclusion Criteria

Patients poisoned with multiple insecticides, other drugs, associated chronic medical illness and partially treated at different hospital. Patients with pregnancy were also excluded from the study.

In all selected patients detailed history was taken and through clinical examination is performed based on Proudfoot classification for assessment of severity of poisoning. In all documented OP cases, apart from routine blood investigations and arterial blood gas analysis, estimation of serum cholinesterase on day of admission is carried out and its values are analyzed with severity and outcome.

The normal range for PChE was taken as 4850-12000 U/L, with levels 4365-4850 U/L (<10% reduction) as mild poisoning, 2425-4365 U/L (10-50% reduction) as moderate poisoning, 1213-2425 U/L (50-75% reduction) as severe poisoning and <1213 (>75% reduction) as very severe poisoning.

After informed consent initial details of poisoning with clinical findings were obtained as per proforma. Care was also taken to ensure privacy and confidentiality of the interview as part of the study. The Ethical committee approval was obtained to carry out the study of OP poisoning patients admitted in medicine department in McGann teaching hospital Shimoga.

Statistical Analysis

Data were presented as percentage or as standard deviation. A factor influencing outcome of interest was considered significant if its p value is <0.05 and considered highly significant if its p value is <0.001. All statistical analysis was performed using The Statistical software SPSS 21.0.

Results

From table 1, it is observed that, the total number of participants include 123 patients. Age group ranged from 16 to 80 years, majority of the patients were in the age group of 21-30 which comprised 34.1% of the study population and least in 71 to 80 years age group with 2.4% of study population (Figure 1). Majority of patients were males (64.2%). Majority were from rural areas (91%).

As in table 2 and figure 2, the commonest compound ingested was chlorpyrifos (75 patients, 60.9%), followed by Thimet (20 patients, 16.2%), Quinalphos (16 patients, 13%), Malathion (7 patients, 5.7%), Monocrotophos (3 patients, 2.4%) and dimethoate (2 patients, 1.6%). With respect of amount of poison consumption, in 37 patients (30.1%) it was 31-50ml and in 43 patients (34.9%) of <30 and >50ml respectively. Majority (93.5%) of patients consumed OP compounds orally with the intention of self-poisoning.

From table 3 it is observed that, 73.9% subjects were having low PChE levels and remaining 26% poisoning patients with normal PChE. Among 73.9% subjects (91 patients), 4.4% patients had PChE level with <10% reduction, 17.6% with 10-50%

reduction, 6.4% with 50-75% reduction and 51.6% more than 75% reduction according to Proudfoot classification.

As shown in table 4, clinical presentations included emesis, increased secretions, bradycardia, cyanosis, fasciculation's, convulsions and coma in 56%, 84.5%, 69.1%, 43.1%, 31.7%, 13% and 26.8% of poisoning patients respectively. Mentioned presentations were more commonly noted in severe poisoning patients when compared to patients with normal PChE levels and was statistically significant (p value <0.05). Patients needing ventilator support were 3 in moderate poisoning (10-50% reduction of PChE), 13 in severe poisoning (50-75% reduction of PChE) and 43 in very severe poisoning (>75% reduction of PChE) where as it was none in patients with mild poisoning and in patients with normal PChE levels.

This was also statistically significant (p value <0.001). There were 21 deaths in very severe poisoning patients where as it was 4 and 1 in severe and moderate poisoning patients respectively and none in mild poisoning patients & patients with normal PChE levels. With regards to in hospital outcome, lower levels of PChE levels was associated with increased mortality and was statistically significant (p value <0.005)

Table 1: Sociodemographic characteristics of study population

Age in Years	Frequency
10-20	24(19.5%)
21-30	42(34.1%)
31-40	20(16.2%)
41-50	18(14.6%)
51-60	09(7.3%)
61-70	07(5.7%)
71-80	03(2.4%)
Sex	
Male	79(64.2%)
Female	44(35.7%)
Residence	
Rural	112(91%)
Urban	11(8.9%)

Table 2: Poisoning characteristics of study population

OP compound	Frequency
Chlorpyrifos	75(60.9%)
Thimet	20(16.2%)
Quinalphos	16(13%)
Malathion	07(5.7%)
Monocrotophos	03(2.4%)
Dimethoate	02(1.6%)
Amount of poison ingested in ml	
<30	43(34.9%)
31-50	37(30.1%)
>50	43(34.9%)
Mode of poisoning	
Accidental	8(6.5%)
Suicidal	115(93.5%)

Table 3: Severity of OP poisoning based on Proudfoot classification

Percentage of PChE reduction	Severity	Range of PChE(U/L)	Frequency
<10%	Mild	4365-4850	04(4.4%)
10-50%	Moderate	2425-4365	16(17.6%)
50-75%	Severe	1213-2425	24(26.4%)
>75%	Very severe	<1213	47(51.6%)
Total			91(73.9%)

Note- Normal range of PChE (Pseudo cholinesterase) levels is 4850 to 12000U/L.

Table 4: Clinical profile, Mechanical ventilation requirement and outcome (mortality/survival) to different grades of OP poisoning

Percentage of PCHE Reduction	Normal PChE	<10%	10-50%	50-75%	>75%	Total	P value
Frequency	32 (26%)	4 (3.2%)	16 (13%)	24 (19.5%)	47 (38.2%)	123	
Miosis	12 (17.3%)	03 (4.3%)	12 (17.3%)	20 (28.9%)	42 (60.8%)	69 (56%)	<0.001
Increased secretions	20 (19.2%)	04 (3.8%)	14 (13.4%)	22 (21.1%)	44 (42.3%)	104 (84.5%)	0.005
Bradycardia	11 (12.9%)	03 (3.5%)	10 (11.7%)	22 (25.8%)	39 (45.8%)	85 (69.1%)	<0.001
Cyanosis	0	0	02 (3.7%)	08 (15.1%)	43 (81.1%)	53 (43.1%)	<0.001
Fasciculations	02 (5.1%)	03 (7.7%)	08 (20.5%)	12 (30.7%)	14 (35.9%)	39 (31.7%)	<0.001
Convulsions	0	0	01 (6.2%)	03 (18.7%)	12 (75%)	16 (13%)	0.009
Coma	0	0	0	08 (24.2%)	25 (75.7%)	33 (26.8%)	<0.001
Oxygen therapy	05 (6.3%)	01 (1.3%)	07 (8.9%)	19 (24.1%)	47 (59.5%)	79 (64.2%)	<0.001
Ventilator support	0	0	03 (5.1%)	13 (22%)	43 (7.8%)	59 (47.9%)	<0.001
Number of deaths	0	0	01 (3.8%)	04 (15.3%)	21 (80.7%)	26 (21.1%)	<0.001

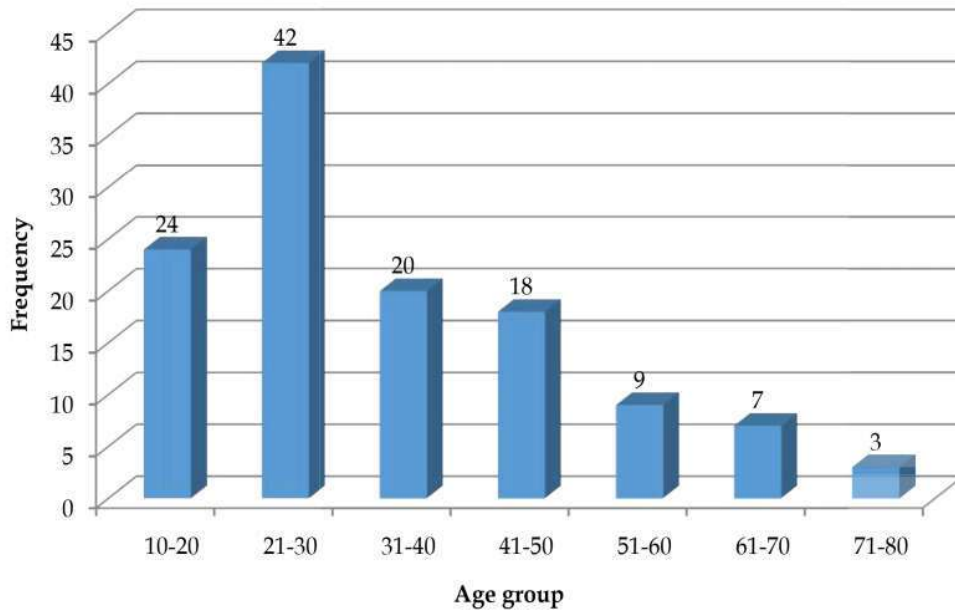


Fig. 1: Age characteristics of study population

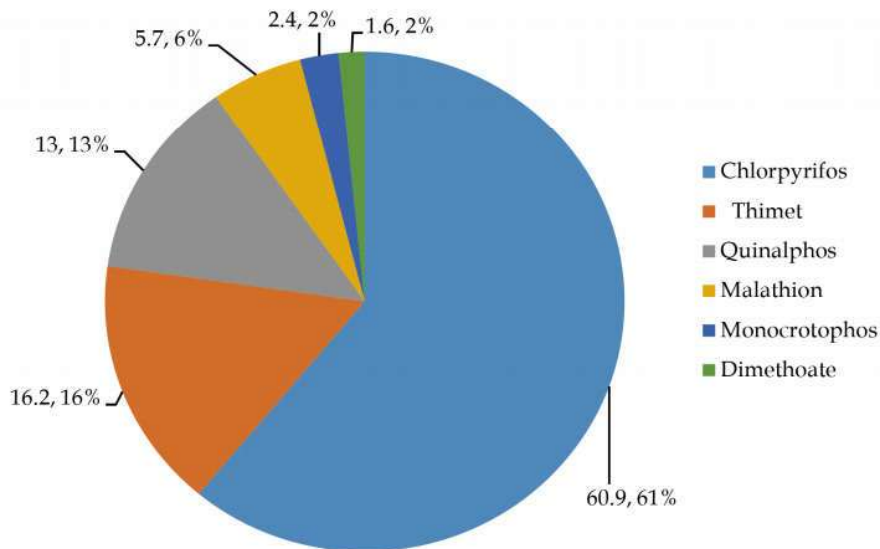


Fig. 2: Particulars of OP compound of study population

Discussion

In present study, majority of patients were in 21 to 30 years of age group and belonged to male sex. Most of the patients were from rural areas and reason for OP consumption is suicidal intention. Same sociodemographic factors were reported in other studies also Rehiman S et al. [8] Paudyal BP et al. [9] and Jha S et al. [10] Most of the patients had consumed chlorpyrifos, thimet and quinalphos.

This may be because of wide use of these compounds for agricultural purposes. Studies done in India and outside of our country where agriculture is a main occupation has highlighted this fact [8,9,11,12]. Present study clinical profile was also similarly noted in OPP studies done by Zawar S D et al. [13], Rehiman S et al. [8], Arup K K et al. [14].

Present study showed significant correlation between the degree of reduction in serum pseudo cholinesterase level and severity of poisoning at the initial presentation. Lower the PChE level, there is increased morbidity (in terms of need for ventilator support and hospital stay) and mortality and was significantly correlated (p value <0.001). These findings are consistent with studies done by Rehiman et al. [8], Zawar S D et al. [13], Jha S et al. [10], Goel et al. [15], Sam KG et al. [16], Aygun et al. [17].

In present study 17.6% patients with moderate poisoning needed ventilator support, whereas it was 78% for severe poisoning patients. Percentage of patients needing ventilator support is lower in our study when compared to study by Subhash et al. [18], where need for ventilator support was 62.5% for patients with moderate poisoning and 100% for patients with severe poisoning (according to POP scale).

Respiratory failure was common feature in severe grade of poisoning. This may be due to use of different parameters (Proudfoot classification and POP scale) for assessing severity of poisoning. In present study 21% of patients had died which is double of other similar studies [15,19,20]. In all the patients who were died had low serum pseudo cholinesterase level at time of initial presentation. Death is usually a result of respiratory paralysis.

A relative relationship between lower PChE level with clinical manifestations and outcomes was found. These findings can assist health professionals to better evaluate patient's prognosis and improve their treatment plan.

Conclusion

Most of the patients having lower PChE level had a negative outcome and those who had < 10% reduction or normal PChE levels had a successful outcome and it was statistically significant. Thus Cholinesterase levels can be used as a predictor of severity of OP poisoning and in hospital outcome.

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