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Study to evaluate the correlation of serum cholinesterase levels, peradeniya clinical score at presentation and severity of organophosphorus poisoning

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Abstract

Background: The incidence of OP poisoning in India is among the highest in the world. The Peradeniya Organophosphorus Poisoning scale assesses the severity of poisoning based on the symptoms at presentation and is simple to use. We planned this study to evaluate the correlation of serum cholinesterase levels, Peradeniya clinical score at presentation and severity of organophosphorus poisoning.

Methodology: A prospective observational study was conducted on 140 adult patients with history of acute OP poisoning. The diagnosis was made based on history or evidence of exposure to OP compound within 24 hours, assessment was also done based on the POP scaling system. A score of 0 to 3 is considered as mild poisoning, 4 to 7 as moderate poisoning and 8 to 11 as severe poisoning. Pseudocholinesterase were measure to assess the severity of poisoning as per Proud foot classification. Correlation between serum cholinesterase level and POP was assessed.

Results: Majority of the patients (32.14%) belongs to age group between 31-40. Mean age of patients were 40.41 ± 9.55 years. Male (69.28%) and rural (91.42%) patients were more common. Most of the patients had suicidal poisoning (87.85%). More than 50% of the poisoning cases were caused by Monocrotofos, Chlorpyrifos and Profenophos. Nausea, vomiting and sweating were more common symptoms and present in more than 60% of the patients. The most frequent sign was miosis (55.71%) patients, tachypnea (42.14% patients) and fasciculation (34.28% patients). 32.85% patients had moderate and 7.85% patients had severe poisoning according to their POP score. All the patients with severe POP score needed the ventilator support, positive correlation between the POP score and the need for ventilator support. Overall mortality was (8.57%). Patients with low Pseudocholinesterase level had higher incidence of need for ventilator support. The relation between POP score and the Sr. Pseudocholinesterase levels was statistically significant. As the severity of poisoning increases the average dose of Atropine needed to treat the patients also increases. As the severity of the poisoning increases, the dose of Pralidoxime needed to treat patients also increases.

Conclusion: Patients with low POP score and high level of Sr. Pseudocholinesterase level needed less ventilator support as compared to patients with high POP score and low Sr. Pseudocholinesterase level. Mortality is more in patients with high POP score and low Sr. Pseudocholinesterase. There is significant correlation between POP score, Sr. Pseudocholinesterase level and need of mechanical ventilation and final prognosis in patients with acute organo-phosphorous poisoning and can be used as a prognostic marker indicating severity of the poisoning.

Keywords: Organophosphorus poisoning, serum cholinesterase levels, peradeniya score, correlation, ventilator requirement

Introduction

Organophosphorus (OP) compounds are one of the most commonly used pesticides worldwide and poisoning due to these compounds had become the major public health problem specially in developing countries [1]. The incidence of OP poisoning in India is among the highest in the world [2, 3]. Recent data from National Crime Bureau shows that suicide by consuming pesticides account for approximately 19% of all cases of poisoning related deaths in India and various reports suggested that the rate of suicidal poisoning with OP compounds ranges from 10 to 43% [4, 5].

These OP compounds possess anticholinesterase activity.

The initial effects predominate in the parasympathetic nervous system producing a range of clinical features known as the “acute cholinergic crisis”. It consists of muscarinic, nicotinic and central nervous system (CNS) features of anticholinesterase poisoning. Cardiovascular effects include bradycardia or tachycardia, hypotension or hypertension, ventricular arrhythmias, and cardiac arrest. Gastrointestinal tract (GIT) effects include vomiting and diarrhoea [6]. Diagnosis is made based on clinical suspicion, the characteristic clinical signs, smell of pesticides or solvents, and reduced butyrylcholinesterase or acetylcholinesterase activity in the blood [7].

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 Senayake *et al*, patients with the high score on the POP scale had a high rate of morbidity and mortality [8]. The patients were monitored regularly till the final outcome. A score of 0 to 3 is considered as mild poisoning, 4 to 7 as moderate poisoning and 8 to 11 as severe poisoning [9].

Early diagnosis is a key to cure. 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 [10]. We planned this study to evaluate the correlation of serum cholinesterase levels, Peradeniya clinical score at presentation and severity of organophosphorus poisoning.

Objectives

1. To evaluate the correlation between serum cholinesterase level and the Peradeniya organophosphorous poisoning scale at initial presentation and the severity of poisoning.
2. To estimate serum cholinesterase levels in patients with organo-phosphorous compound poisoning.

Materials and Methods

A prospective observational study was conducted on 140 adult patients with history of acute organophosphorus poisoning present to emergency ward and admitted in medicine ward, Tertiary health care center between 1 Dec 2020 to 30 Nov 2022). Patients with burns or with history of acute alcohol intoxication were excluded. Study was started after approval from Institutional Ethical Committee (IEC), and informed consent regulations. After fulfilment of inclusion criteria, the enrolment of patient was started. Demographic details were collected and entered in pre structured case record form. Immediately after the arrival of the patients, history was taken to confirm the diagnosis and type of OP compound consumed and the interval between the consumption of poison and arrival at the hospital. Informed written consent of the patient and/or guardian was taken.

The diagnosis was made based on history or evidence of exposure to OP compound within 24 hours, characteristic manifestations of OP poisoning include, miosis, fasciculation, excessive salivation, improvement of signs and symptoms with administration of atropine and odour of gastric aspirates. Apart from the routine and detailed clinical examination, assessment was also done based on the POP scaling system, which included pupil size, respiratory rate, pulse rate, level of consciousness of the patient and the presence or absence of convulsion and fasciculation. Based on this assessment, a score was given to the patients. The

POP 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.

Pseudocholinesterase were measure to assess the severity of poisoning as per “Proud foot classification” [11]. In Mild poisoning, pseudocholinesterase levels are 20-50% of the normal range that is >2001 U/L. In moderate poisoning, pseudocholinesterase levels are 10-20% of the normal that is it ranges 1001-2000 U/L and in severe poisoning, pseudocholinesterase levels are <10% of the normal that is <1000 U/L.

Data entry and statistical analysis

Data was recorded in pre structure case record form. From this CRF, data was entered in MS Excel and appropriate software and test was applied to find the statistically significant difference. P value <0.05 was considered as statistically significant. For the comparison of qualitative data, Chi-square or Fishers exact test was used.

Observations and results

Table 1: Baseline Characteristics of the patients in years

Baseline Characteristics	Total Numbers	Percentage	
Age of patients in years	>12 - 30	34	24.28
	31-40	45	32.14
	41-50	33	23.57
	51-60	20	14.28
	More than 60	08	5.71
Gender	Male	97	69.28
	Female	43	30.71
Residence	Urban	12	8.57
	Rural	128	91.42
Occupation	Farmer	54	38.57
	Labourer	38	27.14
	House Keeping	22	15.71
	Student	11	7.85
	Unemployed	15	10.71
Intent of Poisoning	Accidental	15	10.71
	Homicidal	02	1.42
	Suicidal	123	87.85

In the present study maximum number (32.14%) of patients belongs to age group between 31-40 years followed by age less than 30 years (24.28%). Least number of patients (5.71) had age more than 60 years. Mean age of patients were 40.41 years with standard deviation of 9.55 years and median age of the patients were 42 years. Youngest patient was 15 years old while oldest was 92 years old. Male patients (69.28%) were more common than female patients (30.71%). Rural patients (91.42%) were more than urban (8.57%).

Maximum number of patients were farmer (38.57%) followed by labourer (27.14%). Others were house keeping (15.71%), students (7.85%), unemployed (10.71%). Most (87.85%) of the patients had suicidal poisoning followed by accidental poisoning (10.71%). 1.42% patients had homicidal poisoning.

Frequency distribution of Organophosphate compound in patients: More than 50% of the poisoning cases are caused by Monocrotofos, Chlorpyrifos and Profenophos.

The most common agent being Monocrotofos (24.28%) followed by Chlorpyrifos (21.42%) and Profenophos (17.85%). Other agents were Dichlorfos (8.57%), Metapar (17.85%),

(4.28%), Dimethoate (5.0%), Malathion (7.14%), Fenetrothion (4.28%), Parathion (3.57%) and Quinalfos (2.85%).

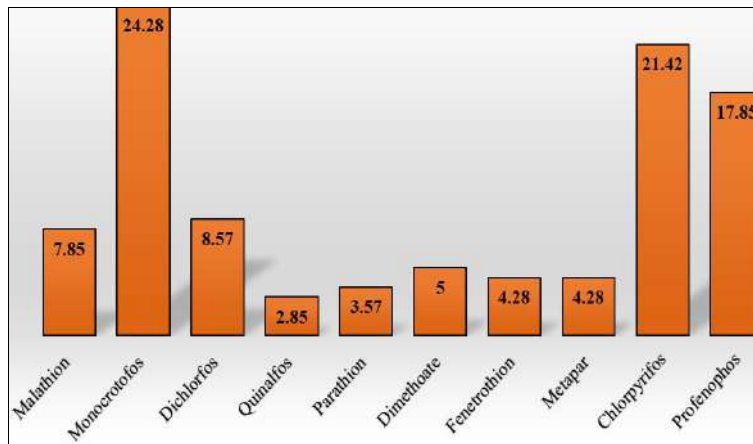


Fig 1: Frequency distribution of Organophosphate compound in patients

In the present study nausea and sweating were present in more than 60% of the patients. Other common symptoms were excessive salivation (49.28), vomiting (42.85%), bronchorrhea (40%), breathlessness (37.14%) lacrimation (36.42%) and loose stool in (35%).

seen in 55.71% patients. The second most common sign was tachypnoea, observed in 42.14% patients followed by fasciculation present in 34.28% patients. Other important signs were bradycardia (30%), altered sensorium (24.28%) and seizure (10%).

In our study most frequent sign in the patients was miosis,

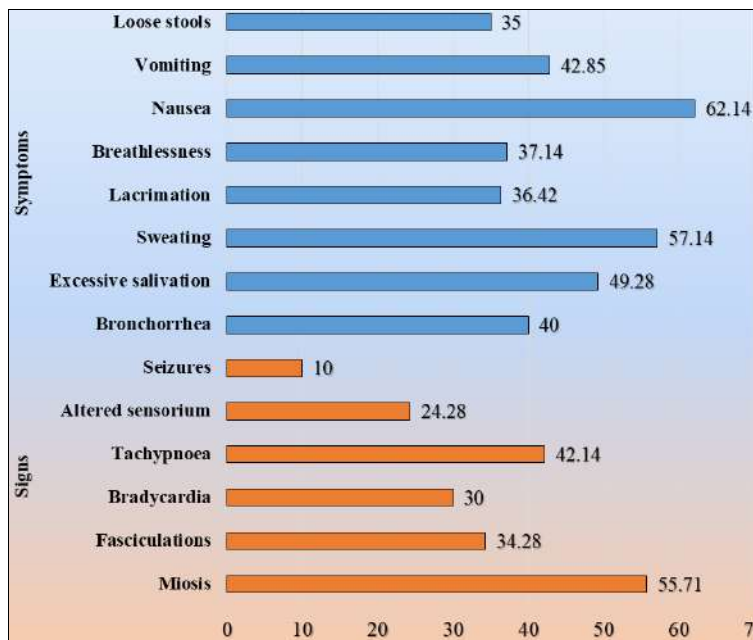


Fig 2: Percentage of Symptoms and signs in patients at presentation

Table 2: Distribution of patients depending on Severity of POP score and Serum pseudo-cholinesterase level

Pop score and Serum Cholinesterase level		Total Numbers	Percentage
Pop score	Mild {POP score 0-3}	83	59.28
	Moderate {POP score 4-7}	46	32.85
	Severe {POP score 8-11}	11	7.85
Serum Pseudo-cholinesterase levels	Normal (4501-11000)	25	17.85%
	>50% (2251-4500)	51	36.42%
	20-50% (901-2250)	55	39.28%
	<20% (<900)	9	6.42%
Total		140	100%

In the present study majority (59.28%) of the patients had mild OP poisoning at the time of presentation denoted by their POP score which was ranges from 0-3. 32.85% patients had moderate and 7.85% patients had severe poisoning according to their POP score.

In present study, we observed that 39.28% patients had Pseudocholinesterase level between 20-50%, followed by 36.42% having Pseudocholinesterase level >50%.

Outcome of patients

In present study majority (91.43) of the patients survived the OP poisoning and 8.57% patients were died because of it.

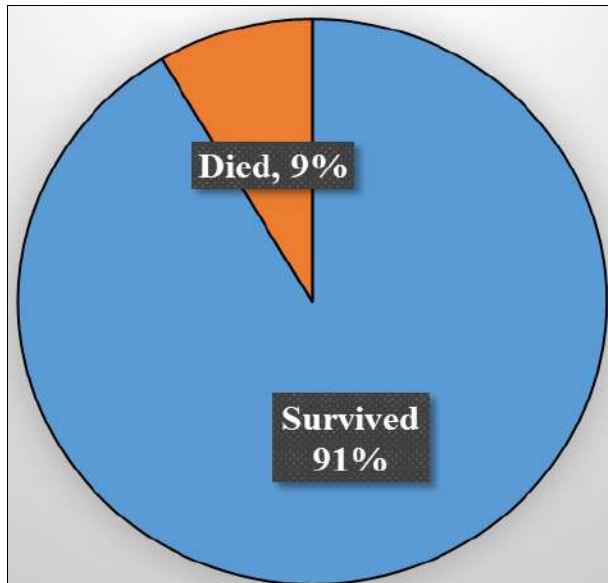


Fig 3: Outcome of patients

Distribution of patients depending on need of ventilator support

In the present study 20% patients needed ventilator support and 80% patients did not need any ventilator support.

Table 3: Relation of POP grading and Pseudo-cholinesterase levels with need for Ventilator support

Severity of POP score and Pseudo-cholinesterase levels		Need of ventilator support		Total	P value
		Yes	No		
Severity of POP score	Mild	02(2.4%)	81(97.6%)	83	<0.001
	Moderate	15(32.6%)	31(67.4%)	46	
	Severe	11(100%)	00(0%)	11	
Pseudo-cholinesterase levels	Normal	00(0%)	25(100%)	25	<0.001
	Mild Poisoning	04(7.8%)	47(92.2%)	51	
	Moderate Poisoning	15(27.3%)	40(72.7%)	55	
	Severe poisoning	09(100%)	0(0%)	09	
Total		28(20%)	112(80%)	140	

In our study most (97.60%) of the patient who had mild POP score not required the ventilator support. In patients with moderate POP score, 32.60% patients required ventilator support. All the patients with severe POP score needed the ventilator support. We found positive correlation between the POP score and the need for ventilator support. ($P < 0.0001$). Also, serum Pseudocholinesterase levels had an association with the need for ventilator support. Patients with low Pseudocholinesterase level had higher incidence of need for ventilator support.

Table 4: Relation of POP grading and Pseudo-cholinesterase levels with outcomes of the patients:

Severity of POP score and Pseudo-cholinesterase levels		Outcome		Total	P value
		Discharged	Expired		
Severity of POP score	Mild	83	0	83	0.012
	Moderate	41	5	46	
	Severe	4	7	11	
Pseudo-cholinesterase levels	Normal	25	0	25	<0.001
	Mild Poisoning	50	1	51	
	Moderate Poisoning	50	5	55	
	Severe poisoning	3	6	9	
Total		128(%)	12(%)	140	

Majority of patients who had Sr. cholinesterase >50% or within normal range had mild POP score and better prognosis. Patients who had Sr. cholinesterase <50% had high POP score, had higher requirement of ventilatory support and had poorer prognosis.

In this study observed significant correlation between the

degree of derangement in serum cholinesterase level and severity of poisoning at the initial presentation. The higher the score on the POP scale, the higher was the degree of derangement in the serum cholinesterase level, higher need of ventilatory support and mortality of patients.

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

Severity of patients as per POP grading	Serum pseudo-cholinesterase				Total	P value
	<20%	20-50%	>50%	Normal		
Mild {POP score 0-3}	0	20	40	23	83	0.0012
Moderate {POP score 4-7}	1	32	11	2	46	
Severe {POP score 8-11}	8	3	0	0	11	
Total	9	55	51	25	140	

Table 6: Frequency distribution of symptoms in patients at presentation

Sr. No	Symptoms	Total Numbers	Percentage
1.	Bronchorrhea	56	40
2.	Excessive salivation	69	49.28
3.	Sweating	80	57.14
4.	Lacrimation	51	36.42
5.	Breathlessness	52	37.14
6.	Nausea	87	62.14
7.	Vomiting	60	42.85
8.	Loose stools	49	35

Table 7: Frequency distribution of signs in patients at presentation

Sr. No	Symptoms	Total Numbers	Percentage
1.	Miosis	78	55.71
2.	Fasciculations	48	34.28
3.	Bradycardia	42	30
4.	Tachypnoea	59	42.14
5.	Altered sensorium	34	24.28
6.	Seizures	14	10

In the present study patients with high POP score had low Sr. Pseudocholinesterase levels and they needed the ventilator support. Patients with low POP score had normal or high level of Sr. Pseudocholinesterase levels and these patients did not need the ventilator support. The relation between POP score and the Sr. Pseudocholinesterase levels was statistically significant.

Discussion

Acute organo-phosphorous poisoning has become epidemic like condition in developing countries like India, where agriculture is the mainstay of economy. Their easy availability and socio-cultural factors play important role in choice of OP as a self-poison and the incidence is higher among young economically active group with a fatality ratio up to 20%. This results in manifestation of various muscarinic and nicotinic effects. In the present study we used Peradeniya Organo-phosphorous Poisoning (POP) scale and proud foot classification of pseudocholinesterase levels to assess the severity of OP poisoning and its consequences.

Demographic Details

In the present study maximum number (32.14%) of patients belongs to age group between 31-40 years. Mean age of patients were 40.41 years with standard deviation of 9.55 years male patients (69.28%) and rural patients (91.42%) were more. Most (87.85%) of the patients had suicidal poisoning followed by accidental (10.71%). In the study of Honnakatti V *et al.* [12], patients were in the age group of 18 to 70 years. Majority of the patients were in the age group of 21-40 years (51%). Sixty nine percent of the patients were from rural areas and 38% of them were farmers. Major route of intake of poison was ingestion. Eighty four percent of patients consumed poison with a suicidal intent.

In the study of Raveendra KR *et al.* [13], total 100 patients with history of OP compound poisoning were enrolled into the study. The mean age group of our patients was 36.04 years. Most of them were males (72%) when compared to females (28%). 76 patients were from rural background. All 100 patients consumed the poison with suicidal intention. The findings in present study are in accordance with the findings of Honnakatti V *et al.* [12] and Raveendra KR *et al.* [13]. These studies also show the similar results when compared with the findings of our study. OP poisoning commonly seen in economically active age group and suicide is the common mode of poisoning which indicate the financial constrain in the individuals.

Organo-phosphorous compound

In present study most common causative agent was Monocrotofos (24.28%) followed by Chlorpyrifos (21.42%) and Profenophos (17.85%). In the study of Raveendra KR *et al.* [13], dimethoate was the most common OP compound consumed by 54 patients followed by parathion 15,

chlorpyrifos 14, fenthion 12 and 5 had taken mixture of 2 or more OP compounds. In the study of Kothiwale VA *et al.* [14], the most commonly consumed compound was Malathion (24.71%). The choice of insecticides depends on the cost, availability, locality, type of crop and other agricultural factors. So, in various areas depending on these factors different OP insecticides are used. Therefore, this may be the reason of different OP insecticides were found in different studies.

Clinical features

In the present study nausea, vomiting and sweating were present in more than 60% of the patients. Most frequent sign was miosis present in 55.71% patients. The second most common sign was tachypnea (42.14% patients) followed by fasciculation (34.28% patients). Other important signs were bradycardia (30%), altered sensorium (24.28%) and seizure (10%).

In the study of Raveendra KR *et al.* [13], the common presenting features were vomiting (96%), diarrhoea (50%), salivation and lacrimation (50%) and altered sensorium (42%). The common clinical signs on examination were bradycardia (42%), pinpoint pupils (30%) and tachypnea (26%).

In the study of Kothiwale VA *et al.* [14], the most common symptom was vomiting (87.06%). Divekar S. *et al.* [15], studied Clinical profile of patients presenting with organophosphorus poisoning in central India and found that Nausea and vomiting is the most common symptom reported by 60.7% of patients followed by giddiness (41.3%), loose motion (28.2%) and secretions (9.5%). Signs like abnormal pupil size, fasciculations and inability to neck holding were common with 23.55% 19.3% and 21.1% respectively. The observations of these studies are similar to findings of present study. As in our study also nausea and vomiting were the most common symptoms and miosis, tachypnea and fasciculations were the common signs.

POP Scale

In the present study majority (59.28%) of the patients had mild OP poisoning at the time of presentation denoted by their POP score which was ranges from 0-3. 32.85% patients had moderate and 7.85% patients had severe poisoning according to their POP score. In the study of Honnakatti V *et al.* [12] the POP scale was calculated for all patients at initial presentation. 55% of patients had a mild grade of poisoning and 33% had a moderate grade of poisoning. 12% patients had severe poisoning with scores >8.

Pop scale, sr. psuedocholinesterase, need of mechanical ventilation and prognosis

Most (97.60%) of the patient who had mild POP score not required the ventilator support. In patients with moderate POP score, 32.60% patients required ventilator support. All

the patients with severe POP score needed the ventilator support. We found positive correlation between the POP score and the need for ventilator support. ($P < 0.0001$). Patients with high POP score had low Sr. Pseudocholinesterase levels and they needed the ventilator support. The relation between POP score and the Sr. Pseudocholinesterase levels was statistically significant. In the study of Raveendra KR *et al.* [13] 100 patients with OP poisoning were categorized according to POP score. 58% of them were categorized under mild category, 32% under moderate category and 10%, under severe category. 43 patients required ventilator support and were shifted to ICU for the same and mortality was seen in 16% patients.

In the study conducted by J V Peter *et al.* [16], where 65.7% of patients required mechanical ventilation and had a mortality of 13.1%. Tripathi S. *et al.* [17] conducted a prospective cross-sectional study at tertiary health centre Nagpur from October 2011 to September 2013. The study was done to correlate the prognostic value of POP and serum acetylcholinesterase levels in acute OP poisoning. Mortality was seen in 17.5% of patients and mortality was found to be higher in patients with severe grade of POP score. Intubation rates were significantly higher in patients with moderate and severe grades where mortality rates were higher in patients with severe grades of POP score.

In their study many of the cases (61%) with mild to moderate OP poisoning had serum AChE level less than 3167 IU/L. They found that POP score of 3 or less (mild poisoning) patients with serum AChE level ≤ 2221 IU/L usually survived. Patients with POP score of ≥ 4 (moderate and severe poisoning) and serum AChE level ≤ 588 IU/L on admission usually had bad prognosis in terms of mechanical ventilation or death. In the study of Honnakatti V *et al.* [12], they 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.

These findings in the present study are in accordance with the observations of previous studies. Vasava JF *et al.* [18] performed a study for a period of two year 150 patients were included and patients were categorized according to Peradeniya organophosphorus poisoning (POP) scale. According to POP scale 24% cases had mild poisoning and 69% cases had moderate while 07% patient were severely poisoned. According to their study, correlation of POP score and Plasma Cholinesterase level with ventilator support requirements and mortality was determined statistically significant. Mevada B *et al.* [19] conducted a hospital based cross sectional observational study from October 2017 to October 2019 at tertiary care hospital, Ahmedabad. Total of 75 patients were evaluated for POP scale and serum cholinesterase levels for assessment of severity of poisoning. Respiratory failure was more common in moderate and severe OP poisoning, 68.42% and 100% respectively. 100% mortality was noted in severe group, 47.36% was noted in moderate group.

Need of atropine and pralidoxime

In present study we found that as the severity of poisoning increases the average dose of Atropine needed to treat the patients also increases. Serum Pseudocholinesterase levels had an association with the need for ventilator support. Maximum doses are required to treat the severe cases. Chaudhary R *et al.* [20] concluded that the higher degree of

POP score correlated to higher degree of serum acetylcholinesterase derangement, need for atropine, PAM and length of hospital stay. Thus, it enhances in the prediction of outcome among patients with acute organophosphate poisoning.

Conclusion

Patients with low POP score and high level of Sr. Pseudocholinesterase level needed less ventilator support as compared to patients with high POP score and low Sr. Pseudocholinesterase level. Mortality is more in patients with high POP score and low Sr. Pseudocholinesterase. There is significant correlation between POP score, Sr. Pseudocholinesterase level and need of mechanical ventilation and final prognosis in patients with acute organo-phosphorous poisoning and can be used as a prognostic marker indicating severity of the poisoning.

Conflict of Interest

Not available

Financial Support

Not available

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