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ROLE OF SERUM CHOLINESTERASE IN ACUTE ORGANOPHOSPHORUS POISONING: A HOSPITAL BASED CROSS SECTIONAL STUDY

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ABSTRACT: BACKGROUND: Pesticide poisoning is a public health problem in developing countries. The anticholinesterase effect of OP compound is observed by decrease in serum pseudo cholinesterase level. The present study was designed to evaluate the relationship between the serum cholinesterase level and mortality following OP compound poisoning since it is not conclusive in previous studies. **MATERIAL AND METHODS:** Estimation of serum cholinesterase was done in 82 patients admitted from Jan 2014 to Dec 2014. Patients were divided into 3 groups. Group I- S cholinesterase more 4500 IU/Lt, Group II- 2500-4500 IU/Lt, Group III- Less than 2500 IU/Lt. These 3 groups were compared with respect to age, sex, outcome, and amount of atropine used. **RESULTS:** Total of 82 patients were studied. 51 patients in group I, 7 in group II and 24 in group III. An average day of hospital stay was more in group III patients. Total amount of Atropine required to treat group III patients was significantly higher than group I and group II patients. Mortality rate was significantly higher in group III patients (25%) as compared to group I patients (7.84%). **CONCLUSION:** Estimation of serum cholinesterase is an useful tool to diagnose OP compound poisoning and predictor of severity of illness.

KEYWORDS: Pseudo cholinesterase, Organophosphorus, Atropine, Poisoning, Mortality.

INTRODUCTION: Pesticide poisoning is a public health problem in developing countries.^{1,2} A world Health Organization (WHO) report says that yearly about three million cases of pesticide poisoning occur worldwide and about 50% of them are due to organo phosphorous (OP) compound poisoning.³ WHO has estimated that about 0.3 million people die every year due to poisoning. OP compound poisoning is one of the most common poisoning in India and other parts of the world. Due to lack of proper reporting, the exact number of cases and deaths to OP compound poisoning is not known.⁴ Mortality rate reported due to OP compound poisoning vary from 20% to 70%.⁵ It is more in developing countries due to limited facilities for investigation and treatment.

Acetyl cholinesterase is found in skeletal muscles, nervous system and erythrocytes. Pseudo cholinesterase is found in heart, Pancreas, liver and plasma. OP compounds exert their toxicity by inhibiting cholinesterase enzyme, thereby accumulation of acetylcholine at central and peripheral nervous system receptors.

Over action of acetylcholine is responsible for toxic effects of OP compounds. The anticholinesterase effect of OP compound is observed by decrease in serum pseudo cholinesterase and red cell cholinesterase.¹

The significance of estimation of serum cholinesterase activity to assess the severity of illness and prognosis in patients with OP compound poisoning is not conclusive in previous studies.^{6,7} The

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present study was designed to evaluate the relationship between the serum cholinesterase level and mortality in following OP compound poisoning.

MATERIALS & METHODS: This is a prospective cross sectional study, conducted at a tertiary care hospital, of north Karnataka. This study was done between Jan-2014 to Dec-2014. Adult patients, more than 18 years, who were admitted to medical ward with definite diagnosis of OP compound poisoning were assessed.

5 ml venous blood was collected from the patients for estimation of serum cholinesterase immediately after admission. A total of 83 patients were enrolled for study. The patients who had liver dysfunction, preexisting renal failure, malnutrition and pregnancy were excluded from study.

On admission, all patients were evaluated by history, detailed clinical examination and routine blood investigation and serum cholinesterase levels. These patients were given stomach wash and body wash on admission. All these patients were treated by 5-10 mg of intravenous atropine bolus followed by atropine infusion. They also received P2 AM 1gm injection 8th hourly. Patients with impending respiratory failure were admitted to medical ICU and treated by oxygen by mask and mechanical ventilation whenever necessary.

The normal values of serum cholinesterase range from 5100 to 11700 IU/L as per Nemours and company Inc. USA.^{7,8} Mild poisoning is defined as less than 10% reduction in serum cholinesterase, moderate toxicity is 10-50% reduction and severe toxicity is more than 50% reduction. Accordingly patients were grouped into 3 groups:

Group 1: Serum cholinesterase more than 4500 IU/lit – mild poisoning.

Group 2: Serum cholinesterase between 2500 - 4500 IU/lit – moderate poisoning.

Group 3: Serum cholinesterase less than 2500 IU/lit - severe poisoning.

These 3 groups were compared with respect to age, sex, amount of atropine used in these patients, no of days of hospital stay, mortality etc.

STATISTICAL ANALYSIS: Basic data is presented in percentages. Chi-square test is applied to find the association between the different groups and mortality. It is also applied to find the association between the different groups and dose of Atropine required to treat these patients.

OBSERVATIONS: In this study a total of 82 patients were enrolled for the study. Out of which 51 patients (62.20%) were admitted with mild poisoning, 7 patients were (8.54%) were admitted with moderate poisoning and 24 patients (29.27%) were admitted with severe poisoning. Out of 82 patients 63(77%) were male and 19(23%) were female patients. Majority of patients were in the age group of 20 to 40 years (49 out of 82) range from 18 years to 64 years.

Average days of hospital stay by the patients is more in group III patients. In group I patients it was 6 days and in group III it was 7 days. When we separate expired patients from group III (most of them died within a period of 3 days from admission) then the average hospital stay by group III patients went up from 7 to 9.4 days.

When we compared average dose of Atropine used for each patient, it was 119.37 ampoules for group I and 165.86 ampoules for group II patients and 201.38 ampoules for group III patients.

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This shows that the dose of Atropine required increased with severity of poisoning. Total dose of Atropine required is inversely proportional to serum cholinesterase level on admission.

As the pseudocholinesterase level decreased from group I (>4500) to group III (<2500) the dose of Atropine injection required increased from 119.37 ampules per patient to 201.38 ampules per patient. This association between the level of pseudocholinesterase and dose of Atropine injection required is found to be statistically highly significant ($p < 0.001$) (Table no. 4).

When we compared the mortality in different groups, we observed that only 7.84% patients expired in group I, 14.29% patients died in group II and 25% patients died in group III. This shows that the mortality is inversely proportional to serum cholinesterase level. Low serum cholinesterase level on admission is a predictor of high mortality.

As the pseudocholinesterase level decreased from group I (>4500) to group III (<2500), the percentage of mortality increased from 7.84% to 25%. This association between level of pseudocholinesterase and mortality is found to be statistically significant ($p < 0.01$) (Table no.5).

DISCUSSION: Organophosphorous compound poisoning is a major health problem in developing countries. Lakhs of people die every year due to OP compound poisoning. Many of our patients coming from rural area do not have knowledge of poison consumed and do not give details about nature of poisoning⁹. Estimation of plasma pseudo cholinesterase will help medical professionals to accurately diagnose OP compound poisoning and to start immediate treatment and save lives.

Aygun et al showed that plasma cholinesterase is useful for diagnosing OP compound poisoning but not related to morbidity and mortality⁷. But Goswamy et al showed that low plasma cholinesterase level was great predictive value regarding severity of illness⁶. Similarly Chen et al showed that low plasma cholinesterase on admission, which does not rise within 48 hours of admission was associated with higher mortality.¹⁰

In this study we observed that patients, whose serum cholinesterase levels were low on admission, were more serious patients. These patients stayed for longer time in the hospital and most of them were treated in ICU. Those with low serum cholinesterase levels, required significantly higher dose of inj. Atropine compared to patients with high cholinesterase levels.

Devanur R.M.N. Prasad et al. showed in their study that low level of serum cholinesterase on admission, was associated with severity of illness, ventilatory support and mortality.¹¹ Shyam Chand Choudhary et al studied 70 cases and demonstrated that serum cholinesterase is reduced in OP compound poisoning and low level is associated with severity of illness.¹²

In our study, more no of patients whose serum cholinesterase levels were low on admission were serious patients and expired. Low serum cholinesterase level on admission is a strong predictor of mortality and requires intensive care treatment and higher dose of Atropine injection.

Some patients in group III with very low serum cholinesterase levels survived with vigorous, early treatment with higher dose of Atropine. Here we studied only 82 patients, further studies are required with more number of patients to come to a definite conclusion.

CONCLUSION: Estimation of serum cholinesterase level is a useful investigation to diagnose OP compound poisoning when the nature of poison consumed is not known. Patients with low serum cholinesterase level should be treated promptly with higher dose of Atropine injection and they

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should be admitted to medical intensive care unit. Low serum cholinesterase level is correlated with higher morta.

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Pseudocholinesterase Level		
Total Cases 82	No. of Cases	%
Group I : Pseudocholinesterase > 4500	51	62.20%
Group II : Pseudocholinesterase 2500 to 4500	7	8.54%
Group III : Pseudocholinesterase < 2500	24	29.27%

Table 1

Gender	Male	%	Female	%	Chi-Square	P- Value
Group I	37	72.55%	14	27.45%	10.38	<0.01
Group II	6	85.71%	1	14.29%	3.58	>0.05
Group III	20	83.33%	4	16.67%	10.66	<0.01

Table 2

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Age Distribution						
	Gr. I	%	Gr. II	%	Gr. III	%
Age < 20 Yrs	7	13.73%	0	0.00%	1	4.17%
Age 20-29 Yrs	18	35.29%	3	42.86%	7	29.17%
Age 30-39 Yrs	14	27.45%	1	14.29%	6	25.00%
Age 40-49 Yrs	5	9.80%	1	14.29%	5	20.83%
Age > = 50 Yrs	7	13.73%	2	28.57%	5	20.83%

Table 3

No. of Total Atropin Dose (amp)		
	Total Ampules	Average
Group I	6088	119.37
Group II	1161	165.86
Group III	4833	201.38
$\chi^2 = 20.85$, $df = 2$, $p < 0.001$		

Table 4

There is a significant difference between the 3 groups

Mortality				
	Improved	%	Expired	%
Group I	47	92.16%	4	7.84%
Group II	6	85.71%	1	14.29%
Group III	18	75.00%	6	25.00%
$\chi^2 = 9.56$, $df = 2$, $p < 0.01$				

Table 5

Fig. 1

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Fig. 2

Fig. 3

Fig. 4

Fig. 5

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