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A study of serum cholinesterase activity in acute Organophosphorous poisoning with clinical correlation

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Abstract
Aim: To evaluate relationship between consumption of organophosphorous compounds and alteration in levels of serum acetylcholinesterase enzyme.
Material and Method: Patients with respiratory failure were given ventilator support. Pupillary dilatation and drying up of secretions were taken as the sign of atropinization and the heart rate was maintained at 120 beats / minute. Atropine was given to all patients and the dose depended on the severity of the poisoning. In some cases it was given as an infusion. Pralidoxime was given to patients who had taken organophosphorous compounds and was not given in cases of organocarbamate compound.
Patient received pralidoxime (Inj. P2AM) as 2 gms IV stat and 2.5/5 gms in each 5% Dextrose Normal Saline (DNS) pint (5 pints in 24 hours),0 each pint over 5 hours, total dose of P2AM given in 24 hours via continuous IV drip was 12.5/25 gms. The atropine used contained 1mg of the compound /ml and the same was also available as a drip of 100ml bottles which were used in some cases.
Results: It was also found that the serum acetylcholinesterase values correlated with the clinical symptoms suggestive of severe poisoning in most of the cases. However despite initiating treatment significant elevation of the values were not observed in the initial few days. On the contrary there seemed to be a further fall in the values in the initial few days following admission. In some cases even at discharge the serum AChE values were at around 30-40% of the normal.
Conclusion: The on admission serum AChE level is a good tool to predict the prognosis of the patient. Low levels of serum AChE are associated with bad prognosis and lower the serum AChE levels higher are the chances of mortality.

Keywords: organophosphorous compounds, serum acetylcholinesterase enzyme

Introduction
Pesticides are the leading cause of fatality from acute poisoning worldwide [1, 2]. In 1990 World Health Organization (WHO) estimated that 3 million severe pesticide poisonings occur annually and are associated with upto 200,000 deaths [3]. Pesticides are a diverse group of chemicals designed to kill and control various insects, animals, fungi or plants. Organophosphorous compounds are the most commonly used insecticides worldwide and account for most human poisonings and death annually than any other pesticides class [4]. In 2004, there were 10,994 organophosphorous and carbonate exposures reported to United States (US) poison centers; 70 (0.6%) resulted in major toxicity and 3 (0.3%) in death [5].
The first organophosphate, tetraethyl pyrophosphate (TEPP), was synthesized in 1854, but the class was not actively used commercially until World War II when the German used TEPP as a substitute for the scarce botanic insecticide nicotine. The human toxicity of organophosphates (OPs) was exploited by the Germans at the end of World War II with the development of the nerve agents tabus, sarin and soman (GA, GB, GD).This study helps to evaluate relationship between consumption of organophosphorous compounds and alteration in levels of serum acetylcholinesterase enzyme.

Material and Methods
100 cases of organophosphorous compound poisoning were taken from among the cases of poisoning admitted in this hospital during the period May 2008 to May 2010. The cases were diagnosed from the typical history, clinical findings, the serum AChE values on admission and compound brought by patients relatives.

Depending on the symptoms these cases were classified into 4 grades of severity according to the classification by Namba *et al*. 27 On admission the serum AChE was estimated. A verbal consent to include them in the study was obtained from the immediate relative, and a thorough stomach wash was given on admission, the bladder was catheterized, clothing of the patient was removed and the body was cleaned to avoid any possible absorption from the skin. These cases were treated with atropine, pralidoxime and supportive care. Patients with respiratory failure were given ventilator support. Pupillary dilatation and drying up of secretions were taken as the sign of atropinization and the heart rate was maintained at 120 beats / minute.

Atropine was given to all patients and the dose depended on the severity of the poisoning. In some cases it was given as an infusion. Pralidoxime was given to patients who had taken organophosphorous compounds and was not given in cases of organocarbamate compound.

Patient received pralidoxime (Inj. P2AM) as 2 gms IV stat and 2.5/5 gms in each 5% Dextrose Normal Saline (DNS) pint (5 pints in 24 hours),0 each pint over 5 hours, total dose of P2AM given in 24 hours via continuous IV drip was 12.5/25 gms. The atropine used contained 1mg of the compound /ml and the same was also available as a drip of 100ml bottles which were used in some cases.

Wherever large doses of atropine was required to maintain atropinization it was given in the form of a continuous infusion at a rate which was maintained at a constant value by means of infusion pump. Hence it was possible to calculate the total amount of atropine given in each 24 hours. Apart from atropine in some cases it was also necessary to give diazepam intravenously to prevent extreme restlessness. Majority of the cases were also given a broad spectrum antibiotic in view of possibility of aspiration pneumonia due to excessive retching and vomiting.

Apart from the diagnostic investigations done for the purpose of the study, at the time of admission the few investigations such as Complete blood count, Renal function tests – Urea, Creatinine, Liver function tests-AST, ALT, Bilirubin, ALP, Electrolytes, Chest X-Ray, Electrocardiogram and Arterial blood gases, Urine-Routine & Microscopy, were also performed.

The value of estimation of serum acetylcholinesterase in cases of organophosphorous poisoning and their relation to clinical improvement and outcome was studied.

Results

It was also found that the serum acetylcholinesterase values correlated with the clinical symptoms suggestive of severe poisoning in most of the cases. However despite initiating treatment significant elevation of the values were not observed in the initial few days. On the contrary there seemed to be a further fall in the values in the initial few days following admission. In some cases even at discharge the serum AChE values were at around 30-40% of the normal. However, serial estimation of serum AChE was not a part of my study. It was also seen that all the expired patients had a significantly lower serum AChE levels at admission.

All patients admitted underwent, a thorough stomach wash and were given atropine till signs of atropinization were observed. Patients also received P2AM, however it was seen that 21 out of 100 patients did not require P2AM and atropine and the serum AChE level in 20 out of these 21 patients was normal. Average serum AChE level in these 21 patients was 7162 IU/L.

It was also noticed that in the severe poisoning group 19 out of 37 patients expired which accounted for 51.35% whereas 6 went DAMA and only 12 recovered. The average serum AChE level in this group was very low –521.68 IU/L.

All patients had received pralidoxime. On admission Inj. P2AM 2 gms IV was given stat bolus and 2.5/5 gms were given in 5% DNS pints (5 pints in 24 hours i.e. 12.5/25 gms of Inj. P2AM in 24hours.)

Table 1: Age distribution in males and females

Age group	Gender		Total
	Male	Female	
10-19	6	5	11
20-29	24	15	39
30-39	19	6	25
40-49	7	5	12
50-59	4	1	5
60-69	4	1	5
70-79	2	1	3
Total	66	34	100

Discussion

Organophosphorous compounds were the preferred mode of suicide especially in the lower income group of people and perhaps the two most important factors for this were easy availability and inexpensiveness [10]. Majority of the patients belonged to the lower income group or were uneducated or both [11, 12]. In most instances the precipitating factor was arising from problems of lower income [12,13] group such as unemployment, ill-literacy, decreased threshold of day - to - day problems, for instance emotional disturbances, failure in examinations or marital or familial disputes Regarding sex, males predominated in this study as compared to study by Viswanathan M. and Srinivasan K. in which females had predominated.

In Mutalik and Wadia's study males had predominated. In a study of 41 cases of poisoning with Tik-20 S.C.De and S. C. Chatterjee the sex incidence showed a female preponderance. In a 10 year experience with cases of poisoning S. Singh & B.K. Sharmal [9] had shown a male preponderance and the age group was similar to that in this study.

Correlation between clinical picture and laboratory assessment of serum AChE activity was seen to be fairly accurate in assessing the severity of the poisoning and predicting the outcome [8]. Patients who had history of ingestion but were asymptomatic had an average serum AChE level of 5643.76 IU/L. Patients in severe group had an average serum AChE level of 521.68 IU/L and required treatment in excess of 12 days, in terms of specific antidotes, maintenance of patent airways, endotracheal intubation leading to tracheostomy and scrupulous throat suction [7].

Patients who had enzyme levels less than 1000 IU/L usually had an omnious prognosis and inspite of aggressive therapy and cliical improvement they were prone to sudden death [6], in most cases because of: a) Sudden release of fat soluble organophosphates from adipose depots in large quantums leading to a critical inhibition of enzymatic activity. b) Sudden circulatory collapse and hypotension incompatible with life [13]. Gastrointestinal symptoms were common in most of the earlier studies and observations of this study was also in concordance with them [14]. Other symptoms were fasciculation's and increased secretions. Respiratory failure

was noticed in 39% of the cases. Certain significant observations were made regarding the main aim of this study which shall be discussed now.

Serum Cholinesterase Levels

This study showed that the clinical symptoms after organophosphorous poisoning did have a good correlation with the serum AChE values measured at the time of admission. Serum acetylcholinesterase levels showed marked depression after consumption of organophosphorous compounds to values as low as 89 IU/L.

The average admission values of serum AChE in the expired group was 1448.82 IU/L and that in the recovered group was higher at 5149.68 IU/L. Thus the average admission values of the survivors were higher. The average serum AChE level in the severe group of poisoning (Grade

IV) was 521.68 IU/L and this group had a mortality rate of 51.35% as compared to 0% mortality rate in the latent group of poisoning (Grade I). The average serum AChE level in this group was 5643.76 IU/L.

In some studies the workers have done serial estimation of serum AChE. However it was studied that serial estimation did not show any relation to the clinical picture, often the values were considerably low even when the patient was symptom free and also at the time of discharge from the hospital. In some cases even at discharge a totally asymptomatic patient was found to have a serum AChE value at around 30% of the normal expected. It is questionable as to whether this depression is due to continuing action of the poison. Hence, serial estimation may not be of any value as an indicator of prognosis and was not part of my study. But in circumstances where the initial value is normal and clinical symptoms do not correlate repeated estimation of serum AChE may help in confirming the diagnosis.

Conclusion

A study of 100 cases of organophosphorous compound poisoning was done. The following conclusions were drawn from the study.

1. Organophosphorous significantly depressed the serum acetylcholinesterase activity. The study of serum acetylcholinesterase activity was seen to be useful since it correlated well with the clinical picture and allowed a reasonably accurate assessment of the prognosis.
2. The serum acetylcholinesterase estimation is an important tool to confirm the diagnosis and had correlation with the symptoms at admission.
3. The on admission serum AChE level is a good tool to predict the prognosis of the patient. Low levels of serum AChE are associated with bad prognosis and lower the serum AChE levels higher are the chances of mortality.

Conflict of interest: No conflict of interest

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