

Original article

Study of relation of creatine phosphokinase (CPK MB) levels and electrocardiography (ECG) parameters in organophosphorus poisoning patients

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Abstract:

Background: Organophosphorus (OP) poisoning is a common form of chemical poisoning in developing countries, leading to significant morbidity and mortality. The study aimed to determine the clinical and electrocardiographic (ECG) features of OP poisoning and their correlation with serum creatine kinase-MB (CPK-MB) levels.

Methods: A prospective cross-sectional study was conducted on 350 patients with OP poisoning admitted to a tertiary care hospital. The age, gender, CPK-MB levels, and ECG changes were recorded and analyzed using appropriate statistical methods.

Results: The mean age of the patients was 34.91 ± 14.36 years, and 62.6% were male. Most patients were aged between 21 to 40 years, and the male-to-female ratio was 1.7:1. The CPK-MB levels were significantly elevated on the third day of admission compared to baseline and at discharge ($p < 0.05$). The most common ECG changes were prolonged QT interval (21.7%) and T inversion (17%). ST elevation and prolonged QTc were associated with increased mortality (78.3% and 65.2%, respectively).

Conclusion: OP poisoning is a significant public health problem associated with high morbidity and mortality. The study highlights the importance of monitoring serum CPK-MB levels and ECG changes in the management of OP poisoning. The findings suggest that ST elevation and prolonged QTc are associated with increased mortality in OP poisoning. Further research is needed to confirm these findings and identify effective management strategies for OP poisoning.

Keywords: Organophosphorus poisoning, Creatine kinase-MB, Electrocardiography, Mortality, Public health.

Introduction:

Organophosphate compounds (OPCs), which inhibit acetylcholinesterase (AChE), are used as pesticides and have the potential to cause systemic sickness when ingested.^{1,2,3} Due to their easy availability and low cost,

organophosphates are one of the most common global causes of poisoning through agricultural, unintentional, or suicide exposure⁴ The acetylcholinesterase (AChE) enzyme is irreversibly inhibited by these chemicals when they are swallowed, breathed, or absorbed through the skin.^{5,6} A buildup of Ach results in the activation of muscarinic and nicotinic receptors at synapses in the peripheral and central nervous systems.⁷ Early identification and aggressive management are often lifesaving, and hence predictive prognostic features would be useful for the clinicians to stratify the patients according to their risk of deterioration.⁸ Also, Cardiac complications that often accompany poisoning with these compounds may be serious and are often fatal. Since early recognition of abnormal rhythm in OP poisoning protects the patients against acquiring life-threatening arrhythmias, which would identify the severity of poisoning and timely intervention / treatment done so as to prevent early mortality and morbidity of the patient.

Material and methods:

In this prospective cross sectional study done at tertiary care hospital, 350 patients of organophosphorus poisoning who were brought to Hospital were included and following are the observations. The mean age of study subjects was found to be 34.91±14.36 years. Of the 350 patients with OP poisoning, majority of them (32.3%) were in the age category of 21-30 years, followed by 86 (24.6%) in the age group of 31 to 40 years. There were 55 (15.7%) patients observed in the age category of 41-50 years and 50 were from above 50 years. Among total patients, 46 (13.1%) found below ≤20years. Of the 350 patients 62.6% were male and 37.4% were female giving Male to Female ratio of 1.7:1.

Table 1: Distribution of study subjects as per CPK-MB level

CK-MB Positivity(>24 U/L)	No.	Percent
Day 1	26	7.4
Day 3	179	51.1
Discharge	15	4.2

In the study, only 26 (7.4%) patients shows raised enzyme on presentation while on day 3 of admission, 51.1% showed the evidence of raised enzymes.

Table 2: Comparison of baseline CPK-MB, on 3rd day and at discharge

Variable	Mean±SD	F statistics	p value
Baseline CPK-MB (mg/dl)	18.63 ±3.58	24792.244	0.000
CPK-MB on day 3 (mg/dl)	25.65 ±4.20		
CPK-MB at discharge (mg/dl)	18.39 ±7.13		

The difference between the means is statistically significant (p <0.005)

Table No 2 shows Comparison of baseline CPK-MB, on 3rd day and at discharge. Mean value of baseline CPK-MB, on 3rd day and at discharge was observed to be 18.63 ±3.58, 25.65±4.20 and 18.39±7.13 respectively. Serum level of CPK-MB was significantly elevated in OP poisoning on 3rd day of admission as

compared to CPK-MB level at presentation and at discharge (p value <0.05).

ECG changes among OP poisoning patients. In our study, most frequent ECG change was prolonged QT interval (21.7%). Other ECG changes were T inversion (17%), sinus tachycardia [14.3% (>100 bpm)], bradycardia [11.7% (2 mm above the isoelectric line)], ST elevation (10.8%) and extrasystole (7.4%).

Table 3 :CPK-MB levels in specific ECG parameter in discharged and dead patients

Sr. No	ECG changes	Deaths (n=46)	Survived (n=304)
		CPK-MB level	
1	Prolonged QTc	31.97±4.52	24.89±2.62
2	Extrasystole	35.63±5.45	25.00±2.49
3	ST elevation	33.55±4.83	24.49±2.74
4	T inversion	33.21±4.55	24.61±2.80
5	ST depression	34.10±5.11	24.76±2.77
6	Polymorphic ventricular tachycardia	33.38±4.92	24.39±4.47
7	Sinus bradycardia	31.85±4.26	23.29±2.52
8	Sinus tachycardia	34.32±4.87	24.64±3.63
8	Low voltage	31.65±5.11	23.76±0.81

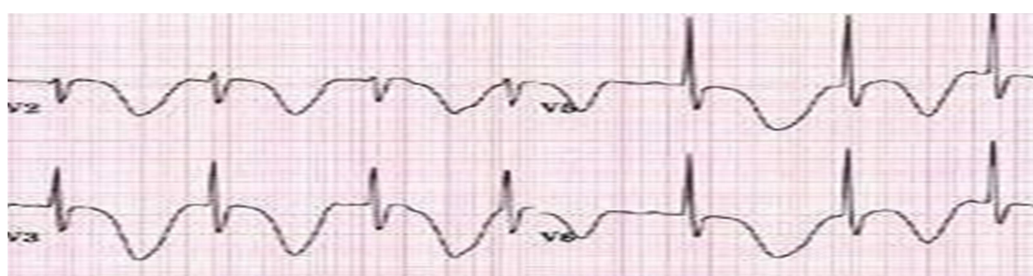
Average CPK-MB level were found to be relatively high in deceased patients as compared to survived which is statistically significant ($p < 0.005$).

In the present study, ST elevation and prolonged QTc is considered a typical ECG abnormality observed among deceased patients which 78.3% and 65.2% mortality in all deaths. The difference between ECG changes among deceased patients and survived individuals was found to be statistically significant ($p < 0.005$)

INTERESTING ECGS OBSERVED DURING THE STUDY



ECG of a severe grade poison case with low voltage complexes



A case of QT prolongation with giant T inversion



A case developing torsades de pointes following QT prolongation who survived with defibrillation

Discussion:

In developing countries like India which largely depends on agriculture, poisoning with pesticides like organophosphates are common. Due to widespread use and lack of strict legislations for use it stands as the most commonly encountered poison, being considered as the king of pesticides due to their extensive use in agriculture.^{9,10} The present study aimed to investigate the clinical and electrocardiographic (ECG) characteristics of patients with organophosphorus (OP) poisoning. A total of 350 patients were included in the study, with a male to female ratio of 1.7:1. The majority of patients were between 21-40 years of age, and 13.1% were below the age of 20 years. The mean age of the study subjects was found to be 34.91 ± 14.36 years.

In this study, 7.4% of patients showed elevated CPK-MB levels on presentation, which increased to 51.1% on day 3 of admission. The mean value of CPK-MB levels was significantly higher on day 3 of admission compared to levels at presentation and discharge. The ECG changes observed in the patients included prolonged QT interval, T inversion, sinus tachycardia, bradycardia, ST elevation, and extrasystole. Prolonged QT interval was the most frequent ECG abnormality observed (21.7%), followed by T inversion (17%), sinus tachycardia (14.3%), bradycardia (11.7%), ST elevation (10.8%), and extrasystole (7.4%). The present study also evaluated the relationship between ECG changes and CPK-MB levels in discharged and deceased patients. The average CPK-MB level was found to be significantly higher in deceased patients compared to survived patients. ST elevation and prolonged QTc were the typical ECG abnormalities observed among deceased patients, with 78.3% and 65.2% mortality, respectively.

The findings of this study suggest that patients with OP poisoning are at risk of developing cardiac complications, as evidenced by the elevated levels of CPK-MB and ECG abnormalities. These findings also highlight the importance of early recognition and management of cardiac complications in patients with OP poisoning. Furthermore, the study indicates that ST elevation and prolonged QTc may serve as prognostic markers for mortality in patients with OP poisoning. However, further studies are needed to confirm these findings and to explore the underlying mechanisms of cardiac complications in OP poisoning. In the present study it was observed that the abnormal ECG parameters were associated with significantly high CPK-MB levels, which were mainly due to skeletal muscle and respiratory muscle involvement. Prolonged QTc interval was the most commonly observed ECG abnormality and the levels of CPK-MB observed were 31.97 ± 5.52 IU. In dead patients and 24.89 ± 2.62 in those who survived.

In study conducted by Shou-Hsuan Liu et al,¹¹ the CPK-MB levels with normal ECG were 11.37 ± 6.75 ng/dl and with prolonged QTc interval the CPK-MB levels were 28.89 ± 60.65 ng/dl.

Considering the outcome in our study population of 350 patients , 304 patients (86.9%) survived, of which 90 (29.6%) required mechanical ventilation as a result of toxicity-induced respiratory failure, and 214 patients. 61.1% had no respiratory failure and 46 died (13.1%). Of which 36 (10.3%) patients died due to respiratory failure and 10 (2.9%) died due to other causes.

Conclusion:

In the study, only 26 (7.4%) patients shows raised CPK-MB enzyme on presentation while on day 3 of admission, 51.1% showed the evidence of raised enzymes. Serum level of CPK-MB was significantly elevated in OP poisoning on 3rd day of admission as compared to CPK-MB level at presentation and at discharge (p value <0.05). In conclusion, this study on organophosphorus poisoning provides valuable insights into the clinical presentation, laboratory findings, and ECG changes associated with this condition.

References

1. Karunaratne A, Gunnell D, Konradsen F, Eddleston M. How many premature deaths from pesticide suicide have occurred since the agricultural green revolution? *Clin Toxicol.* 2020;58(4):227–32.
2. Jeyaratnam J. Acute pesticide poisoning: a major global health problem. *World Health Stat Q.* 1990;43:139–44
3. Gupta P. Pesticide exposure—Indian scene. *Toxicology.* 2004;198(1– 3):83–90.
4. Dandona R, Kumar GA, Dhaliwal R, Naghavi M, Vos T, Shukla D, et al. Gender differentials and state variations in suicide deaths in India: the global burden of disease study 1990–2016. *Lancet Public Health.* 2018;3(10):e478– 89.
5. Patel V, Ramasundarhettige C, Vijayakumar L, Thakur J, Gajalakshmi V, Gururaj G, et al. Suicide mortality in India: a nationally representative survey. *Lancet.* 2012;379(9834):2343–51.
6. Anon. Poisoning in India. *Br Med J.* 1892;2(1655):641–2.
7. Eddleston M. Patterns and problems of deliberate self-poisoning in the developing world. *Qjm.* 2000;93(11):715–31.
8. Jones CM, Mack KA, Paulozzi LJ. Pharmaceutical overdose deaths, United States, 2010. *JAMA.* 2013;309(7):657–9.
9. van Amsterdam J, van den Brink W. The misuse of prescription opioids: a threat for Europe? *Curr Drug Abuse Rev.* 2015;8(1):3–14.
10. Anthony L, Kulkarni C. Patterns of poisoning and drug overdosage and their outcome among in-patients admitted to the emergency medicine.
11. Shou-Hsuan Liu. Study of clinical and biochemical parameters in predicting the need for ventilator support in organophosphorus compound poisoning. *J Evol Med Dent Sci* 2013;12:9555-70.