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A Study to Determine the Electrocardiographic Changes in Acute Organophosphorus Poisoning

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Abstract **Original Research Article**

Organophosphorus is one of the most common compounds incriminated in poisoning in the world, particularly in the developing world. This is a prospective study to look at the ECG changes in patients with OP poisoning and to determine whether it helps in prognostication of the outcome. We conducted a prospective study to look into the ECG changes in patients who presented with acute organophosphorus poisoning to determine the most common ECG changes stratified as per severity and to study if ECG changes can be used to assess the outcome. A total of 50 study patients with a history of acute organophosphorus poisoning were included and ECG changes were noted on admission. The primary end points being death and respiratory failure and secondary endpoint were the length of ICU stay. The most common ECG abnormality seen was ST elevation (32%) followed by Sinus tachycardia (30%),Q-T prolongation (24%) and sinus bradycardia (20%). 91.66% (p 0.023) of the patients who had QT prolongation developed respiratory failure requiring mechanical ventilation and 5 of 12 (41.6%) p 0.02 patients with QT prolongation died. ST elevation, in spite of being associated with mortality and respiratory failure, was not statistically significant. ECG changes can be used to prognosticate patient with acute OP poisoning. QT prolongation was seen to be associated with increased mortality and severity of OP poisoning. It was also noted to have an association with increased length of ICU stay in this study.

Keywords: Organophosphorus, organophosphate, poisoning, toxin, farmer, OP, EKG changes, QT prolongation.

INTRODUCTION

As Per a study done by UN food and agricultural organization about 40% of the crops are destroyed by pests in the field and 5-6% after harvesting. In India 18% of the GDP [1] is dependent on agriculture and this translates to increased usage of pesticides to protect the crops. One of the drawbacks of excessive usage and easy access to pesticides is the uptrending number of deaths due to poisoning including both accidental and intentional. As per a report by the WHO, in 2012, there were 1,93,460 deaths worldwide due to poisoning[2] and this was predominantly in the low to mid income countries. The best understood pathophysiology leading to death in organophosphorus poisoning (OP) is due to blockage of acetylcholine receptor leading to respiratory failure [3], But there are some reports of the effects of organophosphorus poisoning on the heart, which might be contributing to mortality as noted by the study done by AM saadeh *et al*. [4] who showed cardiac involvement in 67% of the cases. ECG changes was a common occurrence in such poisoning as depicted by a study done by S. Anand [5] *et al*. and recommended continuous cardiac monitoring in these patients. This study aims to assess the ECG changes in organophosphorus poisoning and determine if the changes can be used in the prognostication.

METHODS

This was a prospective study involving patients who were admitted to the emergency room in an urban tertiary care hospital in India. These patients were classified at admission into 3 groups based on the severity by a scoring system called peradeniya organophosphorus poisoning scale [6]. All the patients received care as per the current guidelines and hospital protocols. Informed consent was taken from all the patients or the next of Kin. EKG was obtained on the day of admission. The patients were followed throughout their hospital course for outcome, the primary end points being death and respiratory failure while secondary endpoints being the length of ICU stay. The chi-square test and Fisher's exact test were used to

show the associations between predictor and outcome variables. The level of significance was set at 0.05.

RESULTS

A total of 50 patients were included in the study, which showed an incidence of OP compound poisoning being more common in males than females. Majority of the patients were in the age group of < 30 years with a mean of 33.06 ± 13.41. Most of the patients were classified as mild or moderate poisoning as per Peradeniya organophosphorus poisoning scale while only 3 patients (6%) had severe poisoning. After analyzing the EKG, it was noted that nonspecific ST elevation (32%) was the most common EKG finding followed by QT prolongation (30%). Sinus tachycardia was seen in 12 patients (24%) and sinus bradycardia was noted in 10 patients (20%).

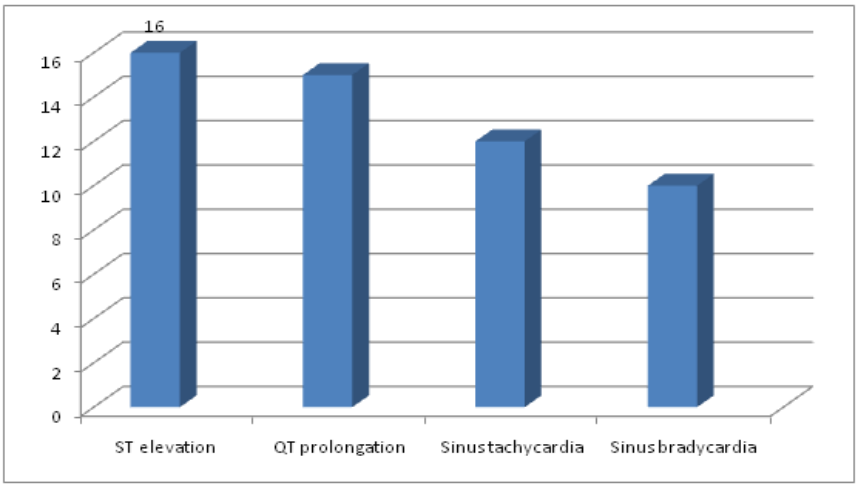

Fig-1: Distribution of patients according to the ECG changes

In the current study there were 7 deaths (14%) and 23 patients (46%) progressed to respiratory failure requiring mechanical ventilation(Table 1).

In addition 30% of the patients had a prolonged ICU stay of >7 days and 70% of them had an ICU stay of <7 days.

Table-1: Distribution of patients according to their outcome

Outcome	No.	Percent
No respiratory failure	25	50.0
Respiratory failure	23	46.0
Death	7	14.0

Analysis

5 out of 12 (41.66%) patients with QT prolongation died as compared to 2 out of 38 (5.2%) patients with no QT prolongation. Thus, with a p value of 0.002 a statistically significant association was noted between QT prolongation and mortality. 3 of the 13 patients with ST elevation died as compared to 4 of 30 patients without ST elevation. Despite being the most common finding, ST elevation did not seem to have a statistically significant association with mortality with a p value of 0.502 (Table-2).

Table-2: Association of EKG changes with Mortality

	No Mortality (n=43)	Mortality (n=7)	P Value
ST Elevation			
Present	13	3	
Absent	30	4	0.507
QT Prolongation			
Present	7	5	
Absent	36	2	0.002

Respiratory failure was seen in 11 of the 12 (91.66%) patients with QT prolongation on ECG, and 12 of the 38 (31.75%) patients without QT prolongation. Thus a statistically significant association was noted between QT prolongation and Respiratory Failure (table 3).

Table-3: Association of EKG changes with Respiratory failure

	No Respiratory Failure (n=27)	Respiratory Failure (n=23)	P Value
ST Elevation			
Present	9	7	
Absent	18	16	0.827
QT Prolongation			
Present	1	11	
Absent	26	12	<0.0001

DISCUSSION

The ECG reflects the widespread cardiotoxicity of organophosphate compounds. Ludromirsky *et al*. [7] had described three phases of cardiotoxicity after organophosphate compound poisoning. Phase 1 – brief period of increased sympathetic tone; faze 2- prolonged period of parasympathetic activity; phase 3 – Q-T prolongation followed by torsade de pointes, ventricular tachycardia and ventricular fibrillation. Both sympathetic and parasympathetic overactivity are known to cause cardiotoxicity.

In the current study abnormal ECG was noted in 22 cases. The most common abnormality found was ST elevation (≥2 mm above the isoelectric line), which was found in 16 patients (32%) followed by sinus tachycardia in 15 patients (30%), Q-T prolongation (Q-Tc ≥ 0.42 secs in males and ≥0.43 secs in females) in 12 patients (24%). Sinus bradycardia was found in 10 cases (20%).This differed from the other studies.

Table-4: Comparison of ECG changes with other studies

ECG changes	Balouch *et al*. [8]	Sadeesh *et al*. [4]	Present study
ST elevation	10.3 %	24 %	32 %
Q-T prolongation	17.2 %	67 %	24 %
Sinus tachycardia	12.6 %	35 %	30 %
Sinus bradycardia	14.9 %	28 %	20 %

In the study done by Balouch *et al*.[8] and Sadeesh *et al*. [4] Q-T prolongation was the most common ECG abnormality, as compared to ST elevation being the most common finding in our study. Q-T prolongation was seen only in 24% of the patients in this study as compared to 67% in study by Sadeesh *et al*. But it was closer to the study done by Balouch *et al*. which showed 46.2% of patients with QT prolongation. ST segment elevation was seen in 32% of the patients, which was similar to the study by Sadeesh *et al*. (24%).The ECG changes like Atrial fibrillation, prolonged P-R interval and ventricular tachycardia found in the study by Sadeesh *et al*. were not found in the present study.

Q-T prolongation was seen in 12 % of patients with mild poisoning, 36 % of the patients with moderate poisoning and 33.33% patients with severe poisoning (P value 0.023) indicating that prolonged Q-T interval may be an indicator of severity. No statistically significant relationship could be found between ST elevation and clinical severity of the patient (p value 0.355).

Q-T interval prolongation was noted in 11 out of the 23 (47 %) patients who developed respiratory failure and needed mechanical ventilator as compared to 1 out of the 26 patients (3.7 %) without respiratory failure (p value <0.0001). Among the 7 patients who died, 5 (71.42 %) had Q-T prolongation; this was higher than 16.27 % as seen in patients who survived (p value 0.002). This suggests that presence of Q-T prolongation is associated with higher incidence of respiratory failure and death, and hence can be used as a prognostic indicator. Unlike Q-T interval, ST segment did not show any statistically significant relationship with the outcome (p value 0.827 for respiratory failure and p value 0.507 for mortality).

CONCLUSION

With increasing incidence of organophosphorus deaths mainly affecting the mid to low income countries, ECG can be used as a simple and effective method in predicting mortality and morbidity. A larger multi-center study will be needed to confirm the findings of this study.

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