

Original Research Article


# A study of the ECG changes associated with Organophosphorous compound poisoning

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## Abstract

**Introduction:** Estimates from the World Health Organisation (WHO) indicate that 1 million accidental poisoning and 2 million suicide attempts involving pesticides occur the world over. Large proportion present to the ICU with an acute suicidal attempt with male predominance. The case mortality in the developing world is more than 20%. The cardiac manifestations are hypotension, bradycardia, and varied Electrocardiogram (ECG) changes manifested by prolonged QTc interval, inverted T waves, prolonged PR interval, and ST-segment elevation. There is also a high incidence of respiratory failure which has a high mortality.

**Aim of the study:** ECG changes and systemic manifestations with organophosphorous compounds and its relationship to the nature of the compound and its outcome.

**Materials and methods:** The study was conducted at Rajiv Gandhi Government General Hospital and Madras Medical College during a month period from June 2010 and October 2010. The study was conducted on a total of 102 patients admitted to the toxicology unit of Rajiv Gandhi Government General Hospital. A detailed history and physical examination and biochemical and ECG monitoring were done.

**Results:** Most of the patients were in the age group 21-30. The mortality rate was 17%. The percentage of death was noted to be increased in the extremes of age groups less than 20 and more than 60 years. Of the patients who expired mortality was highest in monocrotophos consumption and a majority of them had ECG changes and renal (16%)/respiratory failures (58%). The ECG abnormality was seen in 64% of individuals.

**Conclusion:** We concluded from this study that Electrocardiographic changes correlated independently with the prognosis of the OP poisoning cases and the identification of them, particularly QTc prolongation and timely shifting of cases to ICU and CCU where adequate

resuscitative measures, ventricular pacing facilities available can prevent such sudden cardiac deaths. Blood transfusion is said to have a role in severe poisoning in rapidly replenishing acetylcholinesterase enzyme.

## Key words

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Organophosphorus poisoning, ECG changes, Organ dysfunction.

## Introduction

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Organophosphorous compounds are chemical agents in widespread use throughout the world mainly in agriculture. They are readily available “over the counter” despite them being a major cause of morbidity and mortality [1]. Poisoning results in accumulation of acetylcholine causing overstimulation of both muscarinic and nicotinic receptors and subsequent disruption of nerve impulse transmission in the central and peripheral nervous system [2]. Organophosphorous compound poisoning is the most common medicotoxic emergency in India. These compounds, discovered more than 100 years ago, are at present the predominant group of insecticide and pesticide all over the world. Its widespread use and easy availability have increased the likelihood of poisoning with these compounds [3]. Cardiac manifestations often accompany poisoning with these compounds including, hypotension, hypertension, sinus bradycardia, sinus tachycardia and cardiac arrest [4]. Electrocardiographic changes reported in previous studies include QTc prolongation, ST-T changes, along with various forms of arrhythmias, which may be serious and fatal. These complications are potentially preventable if recognized early and treated adequately. The organophosphorus compounds are the organic derivatives of phosphorous-containing acids. The phosphonate, which are organic derivatives of phosphoric acid are, not used as insecticides but are used as chemical warfare agents. Organophosphorous compounds combine with esteratic sites of acetylcholinesterase, that is phosphorylated & phosphorylated esteratic sites undergo hydrolysis [5]. The phosphorylated enzyme is inactive and thus unable to hydrolyze acetylcholine. The biological effects of the organophosphorus compound are as a result of

the accumulation of endogenous acetylcholine at sites of cholinergic transmission. This causes disruption of transmission of nerve impulses in both peripheral and central nervous system [6]. Most organophosphorus compounds are readily absorbed through the respiratory, oral and gastrointestinal mucous membrane, and through intact skin, as they are lipid soluble. This binding is irreversible, except with early pharmacological intervention [7]. The diagnosis is based on the history of exposure and features of cholinergic over activity. The treatment includes atropine or glycopyrrolate, which acts as a physiological antidote and oximes which help in reactivating the enzyme [8]. Complications like respiratory failure, CNS depression, and ventricular arrhythmias should be anticipated and treated. Cardiac manifestations often accompany poisoning with these compounds including, hypotension, hypertension, sinus bradycardia, sinus tachycardia and cardiac arrest [9]. Electrocardiographic changes reported in previous studies include Sinus tachycardia, Sinus bradycardia, QTc prolongation, ST-T changes, along with various forms of arrhythmias, which may be serious and fatal. These complications are potentially preventable if recognized early and treated adequately. Organophosphate poisoning has been postulated both in animal and human studies to cause myocardiotoxic damage (myocardial necrosis). Electrocardiographic changes in organophosphate compound poisoning have been reported along with the associated structural myocardial damage. Organophosphate compound poisoning itself causes diarrhea and vomiting which can lead to electrolyte derangements which by themselves may impart electrocardiographic changes [10].

## Materials and methods

This study was conducted in the department of toxicology Government General Hospital Chennai between June 2010 and October 2010. It included 102 of the total 155 cases admitted. A detailed history and physical examination and biochemical and ECG monitoring were done.

**Inclusion criteria:** All adults with a history of consumption and/or exposure to OPC of either sex, admitted in the hospital within 12 hours of ingestion.

**Exclusion criteria:** All patients with poisoning due to compounds other than OPC, Patients with prior H/o consumption of OPC, Patients having H/o cardiac diseases.

ECG was recorded in all cases before administering atropine, pralidoxime or any other medications in casualty and serial ECG were taken in all cases until discharge following recovery from poisoning/death to study the possible abnormalities which could have been from organophosphate compound poisoning.

## Statistical analysis

Using this software range, frequencies, percentages, means, standard deviations, chi-square, and 'p' values were calculated. Kruskal Wallis chi-square test was used to test the significance of the difference between quantitative variables and Yate's chi-square test for qualitative variables. A 'p' value less than 0.05 was taken to denote the significant relationship

## Results

In our study of the total 102 organophosphorus compound admissions, 82 patients were referrals which accounted for 80%. 59% were in the age group of 21-30. Death percentage was maximum in age >50 years at 31.12%. There was a male predominance of 70.37% and of that expired 58.35 % were males. 35 persons-25.32% were on mechanical ventilation. The mortality in ventilated patients was 14 that was 37.14%. 43.7%-No changes, 31%- QT prolongation, 20%- ST-T changes, 25%- bradycardia, 5.4%- extra systoles, 16.4%- arrhythmias (**Table – 1**).

**Table – 1:** Association of ECG changes with op poisoning regarding their number of days of occurrence in serial 12 hour recordings.

|                 | MILD        |      | MODERATE    |      | SEVERE      |      | P Value      | Significance       |
|-----------------|-------------|------|-------------|------|-------------|------|--------------|--------------------|
|                 | Mean (days) | SD   | Mean (days) | SD   | Mean (days) | SD   |              |                    |
| QTc             | 2.39        | 0.92 | 1.88        | 0.77 | 1.28        | 0.95 | <b>0.001</b> | Highly significant |
| ST elevation    | 1.22        | 0.26 | 0.82        | 0.32 | 0.50        | 0.00 | <b>0.008</b> | Highly significant |
| T inversion     | 2.22        | 0.67 | 1.81        | 0.53 | 0.75        | 0.35 | <b>0.019</b> | Significant        |
| Low voltage     | -           | -    | 1.75        | 0.35 | 1.41        | 0.99 | <b>0.651</b> | Not significant    |
| PR prolongation | 2.00        | 0.00 | 2.50        | 0.71 | -           | -    | <b>0.424</b> | Not significant    |
| AF              | -           | -    | 2.25        | 1.06 | -           | -    | -            | Not significant    |
| Extra systole   | 0.87        | 0.25 | 1.60        | 0.55 | 0.81        | 0.27 | <b>0.016</b> | Significant        |

## Discussion

ECG changes were noted mostly in highly toxic compounds like monocrotophos, Quinalphos, Chlorpyrifos, Baytex. We have observed in our study that the majority of the patients were farmers coming from nearby villages. Majority of them were in the lower socioeconomic group. Of the cases, only 9 were spray poisoning. The

rest were accidental in nature [11]. All the patients except 2 received stomach and body wash. Atropine was administered to all of them. The average days of atropine requirement were 2 days [12]. Pralidoxime was administered to 112 patients. Ventilatory support was given to 35 patients [13]. Among the ECG changes observed overall, QTc prolongation tops the list with 68

cases (60.7%) followed by ST elevation (21.4%), T inversion (16.9%), Extrasystole (12.5%), Low voltage complexes (11.6%), PR prolongation (3.5%) and AF (1.7%) with 24, 19, 14, 13, 4 and 2 cases respectively. Among the ECG changes of survivors, QTc prolongation tops the list with 48 cases followed by ST elevation, T inversion, Extrasystole, Low voltage complexes, PR prolongation and AF with 20,14,11,5,4 and 2 cases respectively [14]. Thus the association of QTc prolongation, T inversion and Extrasystole with OP poisoning with regard to the number of days of their hospital stay appears to be highly significant; for Low voltage, complexes appears significant; and for ST elevation, PR prolongation and AF appears not significant [15].

### Conclusion

The organophosphorus compound is a widely used suicidal agent in our population. A few are accidental poisoning due to spray. The mortality rate in our hospital which is a referral center, where 80% were referral cases was 17% with the highest mortality in 20-30 years which is a very productive age group. Mortality is associated with a wide variety of ECG changes. Mortality is related to the nature of the compound. Monitoring of the sales of these compounds may help to limit its availability as a suicidal agent and a huge burden on the productive population.

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