A Study on the Cardiac Manifestations in Organophosphorous Compound Poisoning

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ABSTRACT

Introduction: Organophosphorous compound (OPC) poisoning is estimated to kill around two lakhs population per year, largely in pacific asian region, majority of incidences take place in rural populations. Majority of the mortality is due to cardio-respiratory compromise. Study aimed to see the clinical profile of myocardial involvement in various organophosphorous compound poisoning.

Material and methods: This study was conducted at Intensive medical care unit of Govt. Stanley Medical College, Chennai, Tamil Nadu from February 2014 to September 2014 with 60 patients.

Results: Patients who need mechanical ventilation had 15 times of odds to have death. Statistically significant association of low serum cholinesterase levels(<2500) and high CPKMB levels (>40U/L) with death in OPC poisoning.

Conclusion: There is an increasing trend of respiratory depression with DAY 3 CPK-MB Positivity. There is an increasing trend of respiratory depression with ECG ST Change Positivity, ECG QT Prolongation Positivity and is an increasing trend of mortality with DAY 3 CPK-MB Positivity.

Keywords: Organophosphorous Compound, CPK, Poisoning

INTRODUCTION

Organophosphorous (OP) pesticide self-poisoning is estimated to kill around two lakhs population per year, largely in pacific asian region, majority of incidences take place in rural populations and is mostly due to impulsion.

In most patients the ECG may show, simple effects to lethal changes. These include sinus tachycardia, repolarisation abnormalities including ST segment deviation and T wave abnormalities, Q-T prolongation and A-V blocks.[1] The reported prevalence of various electrocardiographical changes in OPC's is 89.1 %.[1]

Myocardial damage is caused by both sympathetic and parasympathetic over activity.[2] Yasue et al in 1974[3] discovered that parasympathetic over activity leads to coronary artery spasm, following that Horio et al[4] injected acetylcholine into the coronary arteries and demonstrated coronary vasoconstriction. Kiss and Fazekas identified transient myocardial infarction in five patients among the 168 cases included in a study.[5] Diffuse myocardial damage was found at autopsy in two cases of malathion intoxication.[6]

Kathi et al conducted a study in 37 patients[1] for a 3 year period of cardiac complication following organophosphorous intoxication; out of 37, 62.5% that is 23 of 37 patients had cardiovascular injury, 29.7% that is 11 out of 37 developed electrocardiographic changes suggestive of injury to myocardium (ST-T Changes); 3 out of 37 died, that is 8.1%.

CP Dalvi et al[5] studied the correlation of electrocardiographic changes in organophosphorous poisoning with its prognosis.

WANG Jian-dong et al studied the dynamic changes of cardiac enzymes and the acute poisoning with organophosphorous compounds. Fasting serum level of troponin T and cardiac enzymes (CK-MB, CK, AST, and LDH) in 92 patients with acute organophosphorous poisoning (AOPP) were measured following poisoning on 1,2,3,5 and 7 days, and measured one time in normal control group as well. There was an increase of different levels in troponin T and cardiac enzymes along with the degree of AOPP. They concluded that the level of cardiac troponin T and cardiac enzymes in patients with AOPP may be taken as a useful marker for the degree of poisoning and for prognosis.

GUO Ya-ying et al[7] conducted a study at the People's Hospital of Yingshang, Anhui. They studied the applied value of serum cardiac troponin T(cTnT) for diagnosing myocardial involvement in the acute organophosphorous poisoning. The serum cTnT and CK-MB were significantly higher than that in control group and increases with the degree of poisoning. They concluded that the level of serum cTnT increases significantly with the severity of AOPP and is a sensitive marker of myocardial injury.

More than three fourth of pesticide related hospital admissions are due to organophosphorus compounds and are associated with lethal human effects.[10]

2001 WHO published that eight lakh forty nine thousand people died due to pesticide poisoning yearly.[9]

The basic pathology is Ach binds with its receptors and releases calcium ions. In OPC poisoning due to excessive availability of Ach, which binds to its receptors, induces a mass inflow of calcium ions into cytosol, which leads to depolarization of muscle end-plates leading to muscular damage.

Current study aimed to see the clinical profile of myocardial involvement in various organophosphorous compound poisoning.

MATERIAL AND METHODS

This study was conducted at Intensive medical care unit of Govt. Stanley Medical College in Chennai, Tamil Nadu between february 2014 to september 2014.

It was conducted as a Prospective and observational study. A total of 60 patients with history of organophosphorous

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compound consumption who fulfil the inclusion and exclusion criteria were included in this study. It includes All symptomatic patients having ingested organophosphorous compound with moderate and severe organophosphorous poisoning, excluding Patients who consumed other substances in addition to opc, known CAD, RHD, hypertension, CKD, neuromuscular disease, chronic alcoholism, age <12 yrs or >70 yrs.

Methodology: Patients admitted with ingestion of organophosphorous compound to the Intensive medical care unit (IMCW) from February 2014 to September 2014 are included in the study. Patients were subjected to symptom analysis, clinical examination, laboratory investigations. The final analysis will be made at the end of the study to achieve the fore mentioned goals.

Sample Size Calculation: Sample size was determined on the basis of a pilot study in which the prevalence of death among organophosphorous poisoning patients was measured at 4%. We calculated a minimum sample size of 59 patients was required, assuming a type 1 error (two-tailed) of 0.05 and a margin of error of 10%. Therefore, the final sample selected was n= 60.

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

Description

n = required sample size

t = confidence level at 95% (standard value of 1.96)

p = estimated prevalence of malnutrition in the project area

m = margin of error at 10% (standard value of 0.05)

$$n = \frac{(1.96)^2 \times 0.04(1-0865)}{(0.05)^2}$$

$$n = \frac{3.8146 \times 0.0384}{0.0025}$$

= 59

= 60 in the study group

Data was collected using a pretested proforma meeting the objectives of the study. Detailed history, physical examination and necessary investigations were undertaken. The purpose of the study was explained to the patient and informed consent was obtained.

Using non-invasive methods cardiac injury in organophosphorous poisoning who fulfilled the inclusion criteria were assessed and also analysed the cardiac enzyme levels with the outcome of the patient.

Patients were classified into three grades using "Peradeniya organophosphorous poisoning scale". Changes in ECG were monitored and serum Creatine phosphokinase – MB, serum cholinesterase levels were measured at admission and repeated on third day and seventh day or at discharge. If the stay was more than seven days they were tested on alternate days till discharge, and taken for analysis. The course of acute cardiac injury and enzyme levels in organophosphorous poisoning and its effect on the prognosis were assessed.

Peradeniya score

This scale includes patients who attended hospital within 24 hrs of consumption of poisoning without any medical intervention. This criteria is based on patients at the time of admission and classified as mild moderate and severe poisoning. As per our goals blood samples are sent. Full recovery and death are considered as end points.

STATISTICAL ANALYSIS

Descriptive statistics was done for all data and suitable statistical tests of comparison were done. Continuous variables were analysed with the Unpaired t test/Anova and categorical variables were analysed with the Chi-Square Test and Fisher Exact Test. Statistical significance was taken as $P < 0.05$. The data was analysed using EpiInfo software (7.1.0.6 version; Center for disease control, USA) and Microsoft Excel 2010.

RESULTS

Arrhythmias, ST changes, hypertension, hypotension, AV blocks and bradycardia had 22 to 6 times of odds with OPC poisoning and death (Table-1). Death was associated with mechanical ventilation 31 times with significant P-value of 0.000 (Table-2). Low levels of cholinesterase was seen in dead patients (Table-3). Significant high levels of CPK-MB is in death patients on admitting day and low levels of CPK-MB is seen in the 7 th day (Table-4).

DISCUSSION

In the present study, the electrocardiographic presentations observed in the cases were sinus bradycardia, sinus tachycardia, atrioventricular arrhythmia, conduction disturbances, prolonged QTc interval, and non-specific changes in ST segment and T wave and hypertension, hypotension.

Morteza Rahbar Taromsari et al[10] in 2012 studied cardiac injury in opc poisoning by ECG changes. In his study 49 had ECG changes. In Rafigh Doost et al's[11] study which involved 51 patients with OP poisoning, 33 presented electrocardiographic changes.

Sinus tachycardia

In this study, sinus tachycardia was seen in 38 % (majority) of the patients with OP poisoning. Karki et al[12] reported that sinus tachycardia occurred in 40.5% of patients. Yurumez et al[13] reported that sinus tachycardia was a more frequent finding (in 31.8% cases) in their study. In another study, Saadeh et al[14] reported that sinus tachycardia was seen in 35.0% of cases.

Poisoning grade	TACHY	BRADY	HT	HYPO	SINUS_BRADY	SINUS_TACHY	NORMALECG	ST_TCHANGES	QT_PRO-LONG	AV_BLOCKS	ARRHYTHMIAS
Mild	11	0	4	0	0	10	9	1	1	0	0
Mod	13	9	13	3	9	12	3	9	5	5	0
Severe	0	10	4	5	9	1	0	6	5	3	2

Table-1: Frequency of ECG changes in poisoning

ST-T Changes

In our study, non-specific ST-T change was seen in 16 patients**.** Although non-specific ST-T changes have generally been recognized as not being directly related to any cardiac diseases, they also have been observed before ST elevation associated with coronary spasm. Thus, the non- specific ST-T change for the patient with OP poisoning has a considerable clinical meaning. In addition, large QT dispersion (longest-shortest QT interval on any of the 12 leads of the ECG) is a result of ischemic change which may conceal the QT prolongation in the affecting vascular area.

QT Prolongation

In our study prolonged QTc interval was reported in 11 patients. Karki et al.[12] also reported prolonged QTc interval in 14 cases (37.8%) In Yurumez et al's[13] study, 47 patients (55.5%) had a prolonged QTc interval.

Conduction distrubance

In this study conduction disturbances were observed in 8 patients. Similarly, in Rafigh Doost et al's[11] study in Iran, 64.71% of the patients had a prolonged QTc interval. ST-T changes in 11 cases (29.7%), and conduction defects in two cases (5.4%). Chuang et al.[15] determined that 97 (43.5%) patients had QTc prolongation, and these patients had poor prognosis. Moreover, Jang et al. determined that 67 of 170 patients had QTc prolongation and in this group, mortality rate, respiratory failure rate, and frequency of ventricular premature contractions were significantly higher than those of patients without QTc prolongation.

Our study shows that Arrhythmias, ST changes, hypertension, hypotension, AV blocks and bradycardia had 22 to 6 times of odds with OPC poisoning and death (table-2).

Serum cholinesterase and mortality

In our study there is Statistically significant association of low serum cholinesterase levels(<2500) and with death in OPC poisoning. This is similar to Rao et al[16] study which states that In 36 patients presenting with history of Organo-phosphorus poisoning 27% died. Higher mortality was seen patients having suppression of SCE activity.

CPK – MB levels in OPC poisoning

In our study CPKMB levels more than 40U/L have 10 to 20 times of odds of death within three days of admission. Compared to Dayanand et al[17] study the mortality in patient with elevated creatine kinase was 39.47% as against 4.76% in patients with normal creatine kinase. This is similar to our study

Mechanical ventilation in OPC poisoning

In our study patients who need mechanical ventilation had 15 times of odds to have death which is similar to Syed et al study[18] which says the mortality rate was 33.3%

. cc DEATH MEC_VEN

	MEC_VEN Exposed	Unexposed	Total	Proportion Exposed	
Cases	9	0	9	1.0000	
Controls	6	45	51	0.1176	
Total	15	45	60	0.2500	
	Point estimate		[95% Conf.	Interval]	
Odds ratio	.		15.03029	.	(Cornfield)
Attr. frac. ex.	.		.9334677	.	(Cornfield)
Attr. frac. pop	.				

chi2(1) = 31.76 Pr>chi2 = 0.0000

Note: exact confidence levels not possible with zero count cells

Death is associated with mechanical ventilation 31 times with significant P-value of 0.000

Table-2: 2X2 table for association of mechanical ventilation and death.

CONCLUSION

Arrhythmias, ST changes, hypertension, hypotension, AV blocks and bradycardia had 22 to 6 times of odds with OPC poisoning and death. Cholinesterase levels less than 2500 unit/L have two to three times of odds to have death within three days of poisoning. CPKMB levels more than 40U/L have 10 to 20 times of odds of death within three days of admission.

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Day	Mean cholinestrase levels	Mean cholinestrase levels in death	F value	Probability of F
admitting day	2176	890	30.4	0.0000
third day	2394	440	55.7	0.0000
seventh/discharge day	3094	322	5.4	0.02
ANOVA shows significant low levels of cholinesterase in death patients.				

Table-3: Cholinesterase levels on 0, 3 and 7 day over all and death patients (2554/550)

Index	odds ratio (cornfield)	P-value	F value	Probability of F
CPKMB>40 day 1	20	0.001	22.2	0.0001
CPKMB>40 day 3	10	0.009	0.04	0.82
CPKMB>40 day 7	3	0.14	14.33	0.0004
ANOVA shows significant high levels of CPK-MB levels in death patients on admitting day and low levels of CPK-MB levels in 7 th day.				

Table-4: CPKMB levels and death (CPK MB levels >40 and death with odds ratio on day 1, 3 and 7)

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