Original Article

ECG: A Simple Tool of OPC Poisoning Management.

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Abstract

Background: Organophosphate compound (OPC) poisoning represents a major health problem in developing countries like Bangladesh. Like other systems, cardiac manifestations also often accompany them which is manifested by ECG changes.

Objective: This study aimed to determine the ECG changes in patients with OP poisoning with their association with severity and prognosis.

Materials and Methods: This descriptive cross-sectional study was conducted in the Department of Medicine, Mymensingh Medical College Hospital, Mymensingh from September 2017 to November 2019. A total of 101 OPC poisoning patients were included. After receiving informed written consent relevant information was gathered by taking history, clinical examination, and ECG was done during admission. The severity of OPC poisoning was determined by the Peradeniya organophosphorus poisoning (POP) scale. Collected data were analyzed by statistical software SPSS 22.

Results: In this study, the mean age of the study subjects was 30.97±9.88 (SD) with males (58.40%) predominant. Most of the poisoning cases (73.30%) showed electrocardiographic changes which include sinus tachycardia 40.60%, prolonged QTc 25.70%, sinus bradycardia 23.80%, ST depression 11.90%, T inversion 5.90%, ST-segment elevation 3.96%, PR prolongation 1.98%, Atrial fibrillation 1.98% and extra systole 0.99%. Both outcome and severity of the patients were significantly associated with Sinus Bradycardia, Atrial fibrillation and QTc prolongation ($p<.05$). Logistic regression analysis revealed Sinus bradycardia and Prolongation of QTc as an independent predictor of mortality of OPC poisoning.

Conclusion: Early detection of ECG abnormalities can be an important issue regarding the effective management of OPC poisoning patients as it is significantly related to severity and prognosis.

Keywords: Organophosphate compound (OPC), ECG, Peradeniya organophosphorus poisoning (POP) scale.

Introduction

The World Health Organization (WHO) has identified pesticide poisoning as a leading cause of public health problems. Globally, death from deliberate ingestion of pesticides claimed more than 168000 lives every year, which accounts for 20% of all suicides.[1] The majority of these incidents were reported from developing countries (Kamaruzaman et al. 2020).[2, 3] Among these pesticides most commonly used is the organophosphorus compounds (OPC).[4] Due to their easy availability, it is widely used for deliberate and accidental poisoning. In Bangladesh, an estimated caseload of OPC poisoning in hospitals is 7.1% of total admissions.[5]

OPC insecticides cause inhibition of cholinesterase activity resulting in accumulation of acetylcholine at synapses, causing overstimulation and disruption of neurotransmission in both central and peripheral nervous systems.[6,7]Additionally, cardiac manifestations of OPC poisoning occur in a majority of the affected patients. It can be assessed by simple electrocardiographic changes.[8,9] In most patients, ECG may show simple effects to lethal changes due to the poisoning. These include sinus tachycardia, repolarization abnormalities including ST segment deviation and T wave abnormalities, extra systole, Q-T prolongation, and A-V blocks. These changes also predict the severity and outcome of the poisoning. A significant association has been linked between ST segment alterations in ECG with poisoning outcomes.[10] QTc prolongation has shown significant on the severity of

poisoning as well as death.[11,12] ECG showing cardiac complications with the poisoning may be serious and can often be fatal. As clinical course of OPC poisoning may become severe and need intensive care management, simple tool like ECG can be very helpful.[13, 14]

Early recognition of abnormalities in ECG in OPC poisoning protects the patients against life-threatening conditions.[15] This study aimed to find out the electrocardiographic changes in OPC poisoning with its association with severity and prognosis of poisoning.

Materials and Methods

This study was conducted in the Department of Medicine, Mymensingh Medical College Hospital, from September 2017 to November 2019. A total of 101 cases with OPC poisoning patients admitted to the hospital were confirmed as the study population as per predefined inclusion and exclusion criteria. Ethical clearance was taken from the IRB Mymensingh Medical College. Informed written consent was taken from the patient/attendant (in case of altered consciousness). Data were collected by face-to-face interview with necessary clinical examination and investigations. Data was analyzed using Microsoft Excel and SPSS software.

Inclusion criteria

All the patients (Age 18-50 yrs.) admitted to the Medicine ward of both sexes have a definitive history of OPC poisoning with clinical signs and symptoms.

Exclusion criteria

- Patients with poisoning due to compounds other than OPC.
- Arrival after 24 hours of poisoning.
- Patients having a history of previous heart diseases including HTN.
- Patients taking drugs like sympathomimetics or parasympathomimetics have effects on ECG changes.
- Patients who received partial treatment before admission to this hospital.
- Patients unwilling to give consent for the study.

Results

This descriptive cross-sectional study conducted in the Medicine department of Mymensingh Medical College and Hospital from September 2017 to November 2019 included a total of 101 cases of OPC poisoning.

Table I: Distribution of population by general data (n=101).

Variables		Frequency	Percent %
Age	≤20	20	19.80
	21-30	36	35.60
	31-40	26	25.70
	41-50	19	18.80
	Mean ± SD (years)	30.97±9.88	
Sex	Male	59	58.40
	Female	42	41.60
ECG changes	Yes	74	73.30
	No	27	26.70

Table-I shows the age of the patients ranged from 18 to 50 years with a mean of 30.97±9.88 years. Out of 101 patients, 58.40% were male 41.60% female, and 73.30% patients were presented with ECG changes.

Table II: Distribution of the population by different ECG changes.

ECG changes	Frequency	Percent (%)
Sinus Tachycardia	41	40.60
Prolonged QTc	26	25.70
Sinus Bradycardia	24	23.80
ST segment Depression	12	11.90
T Inversion	06	5.90
ST segment Elevation	04	3.96
PR Prolongation	02	1.98
Atrial fibrillation	02	1.98
Extra Systole	01	0.99

*Multiple responses considered

Table-II: shows among the study cases sinus tachycardia, prolonged QTc, sinus bradycardia, ST segment depression, T inversion, ST segment elevation, PR prolongation, Atrial fibrillation and extra systole were observed in 40.60%, 25.70%, 23.80%, 11.90%, 5.90, 3.96%, 1.98%, 1.98%, and 0.99% study cases respectively.

Table III: Distribution of population by POP scoring and inpatient outcome (n=101).

Variables		Frequency	Percent %
POP scoring severity	Mild (0-3)	54	53.50
	Moderate (4-7)	30	29.70
	Severe (8-11)	17	16.80
Inpatient outcome	Recovered	82	81.20
	Death	19	18.80

Table III: shows that according to POP scoring maximum patients were presented with mild severity (53.50%), 29.70% were moderate and 16.80% were severe. 81.20% of patients recovered completely and 18.80% of patients died.

Table IV: Correlation of ECG changes with severity based on POP score of the study subjects (n=101).

Variables	Severity (POP score)			P value
	Mild (n=54)	Moderate (n=30)	Severe (n=17)	
Sinus Tachycardia	29(53.7)	5(16.67)	7(41.18)	0.004
Sinus Bradycardia	0(0)	15(50)	9(52.94)	0.000
Atrial Fibrillation	0(0)	0(0)	2(11.76)	0.006
Extra Systole	0(0)	1(3.33)	0(0)	0.303
ST segment elevation	2(3.7)	1(3.33)	1(5.88)	0.902
ST segment depression	5(9.26)	5(16.67)	2(11.76)	0.603
T inversion	3(5.56)	2(6.67)	1(5.88)	0.979
PR prolongation	1(1.85)	1(3.33)	0(0)	0.729
Prolongation of QTc	6(11.11)	11(36.67)	9(52.94)	0.001

Figures within parentheses indicate percentage

Table IV shows the relation between various ECG changes and the severity based on POP score. Significant association was noted between Sinus tachycardia, Sinus bradycardia, Atrial fibrillation and Prolongation of QTc with severity (p value <0.05).

Table V: Relationship of ECG changes with in-hospital outcome of the study subjects (n=101).

ECG Changes	In hospital outcome		
	Recovered (n=82)	Death (n=19)	P value
Sinus Tachycardia	36(43.9)	5(26.32)	0.160
Sinus Bradycardia	13(15.85)	11(57.89)	0.000
Atrial Fibrillation	0(0)	2(10.53)	0.034
Extra Systole	1(1.22)	0(0)	1.000
ST-segment elevation	3(3.66)	1(5.26)	0.572
ST segment depression	8(9.76)	4(21.05)	0.270
T inversion	4(4.88)	2(10.53)	0.315
PR prolongation	1(1.22)	1(5.26)	0.342
Prolongation of QTc	14(17.03)	12(63.16)	0.000

Figures within parentheses indicate the percentage

Table V shows the relationship between ECG changes and hospital outcomes. Here significant association was noted in Sinus bradycardia, Atrial fibrillation, and Prolongation of QTc ($p<0.05$).

Table VI: Logistic regression analysis of factors associated with the outcome of the patients (n=101).

Variables	Odds ratio	95% CI	p value
Age (>40 years)	0.717	0.187 – 2.748	0.627
Sex (Male)	0.974	0.354 – 2.677	0.959
Sinus tachycardia	1.618	0.297 – 8.814	0.578
Sinus bradycardia	6.264	1.189 – 32.998	0.030
Prolongation of QTc	5.987	1.703 – 21.042	0.005
ST segment depression	1.402	0.201 – 9.775	0.733
T inversion	3.750	0.283 – 49.688	0.316
ST segment elevation	1.875	0.114 – 24.362	0.631

Table VI shows binary logistic regression was performed to assess the impact of several factors on the likelihood of the death of the poisoned patient. The model contained eight independent variables (Age >40 years, Male sex, Sinus Tachycardia, Prolonged QTc, Sinus Bradycardia, ST segment Depression, T Inversion, ST segment Elevation). The full model containing all predictors was statistically significant, $\chi 2(df=6, N =101) = 23.845$, $p < .001$, indicating that the model could distinguish between respondents who reported death and recovered. Only two of the independent variables made a unique statistically significant contribution to the model (Prolonged QTc and Sinus Bradycardia). The strongest predictor of reporting death was ECG change of Sinus Bradycardia, recording an odds ratio of 6.264.

Discussion

This study aimed to detect various electrocardiographic changes of Organophosphorus compound poisoning patients and their association with the severity and in-hospital outcome was conducted among 101 patients over 27 months in Mymensingh Medical College & Hospital, Mymensingh.

The average age of the study OPC poisoning cases was 30.97±9.88 years, majority of the study subjects were male with a 1.41:1 male-female ratio. In our study, 73.30% of patients had electrocardiographic changes on admission. Among the ECG changes, 40.60% of patients had sinus tachycardia on admission, while bradycardia was recorded in 23.80% of patients. Sinus tachycardia could be related to nicotinic effects of OP compounds while sinus bradycardia can be attributed to muscarinic effects.[16] Although bradycardia is thought to dominate in the early cholinergic phase of OP poisoning, sinus tachycardia was a more frequent finding in our study probably because most of the patients were visited in the antimuscarinic phase of OP toxicity.

Muscarinic action induced by OP poisoning causes vagotomy and acetylcholine accumulation on nerve endings, which results in spastic contraction of the coronary artery. So, ST-T changes have generally been recognized as not being directly related to any cardiac disease, they also have been observed before the ST elevation associated with coronary spasm.[17] Our study found ST elevation in 3.96% of cases, ST depression in 11.90%, and T inversion in 5.90% of cases. In this study, we also found prolonged QTc interval in 26(25.70%) of patients. PR prolongation was found in 1.98% of cases. Extrasystole and AF were found in our study in 0.99% and 1.98% of cases respectively.

The mechanism of cardiotoxicity by organophosphorus compounds is still uncertain. However, sympathetic and parasympathetic over-activity, acidosis, electrolyte imbalance, and hypoxemia may be the possible mechanisms of these ECG abnormalities.[18] The severity of OPC poisoning was determined by the Peradeniya Organophosphorus Poisoning Scale (POP). The mean POP score of the OPC poisoning cases was 3.66±2.40. According to this scale, 54 (53.50%) had mild poisoning (POP score 0-3), 30 (29.70%) had moderate poisoning (POP score 4-7), and 17 (16.80%) had severe poisoning (POP score 8-11). Amir et al also found 62.91% of their study cases in the mild group, 16.70% in the moderate group, and 15.84% in the severe poisoning group.[19]

The overall death rate was 18.80%. The patients' outcome and baseline ECG change were statistically significantly associated with the severity of OPC poisoning (P<0.001 and 0.001 respectively). In the severe poisoning group, 100% of patients had abnormal ECG and the death rate was 58.81%; in moderate severity group 80% had abnormal ECG and death rate was 30%; in mild poisoning group 61.11% had abnormal ECG and all mild cases were successfully recovered. Perumal et al also observed 100% abnormal ECG in severe poisoning group[20]. Ali et al and Amir et al also observed higher mortality rate in severe cases than moderate cases than mild cases[21].

Among the baseline ECG changes significant association was noted in sinus tachycardia, sinus bradycardia, prolongation of QTc interval and Atrial fibrillation with severity.

The outcome of the patients was also statistically significantly associated with baseline ECG change. P value was found significant in the case of sinus bradycardia, QTc prolongation, and Atrial fibrillation. Mortality rate was 24.32% among patients having abnormal baseline ECG and mortality rate was 3.70% among patients having normal baseline ECG. Logistic regression analysis also showed baseline ECG change (Sinus bradycardia and QTc prolongation) as an independent predictor of bad prognosis. A study conducted by Tripathy et al, Perumal et al and Jayaprakash et al also found a significant association between abnormal ECG and a bad prognosis of OPC poisoning.

This present work demonstrated that various Electrocardiographic changes were observed among the patients with Organophosphorus compound poisoning which have a significant correlation with the severity and in-hospital outcome.

Conclusion

Patients with arrhythmias and Prolongation of QTc tended to present comparatively more severity of poisoning and worse outcomes significantly. So, early detection of these abnormalities using simple tools like ECG can be an approach to the effective management of OPC poisoning.

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