

ORIGINAL ARTICLE

Frequency of Cardiac Arrhythmias in Patients with Aluminum Phosphide Poisoning

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Abstract

Background: Cardiac failure is the major lethal consequence of aluminum phosphide (AIP) poisoning. This study was designed to determine the frequency of cardiac arrhythmias in patients with AIP poisoning.

Methods: In this prospective cross-sectional study, patients with definitive history of AIP poisoning treated at emergency department of Allied Hospital Faisalabad, Faisalabad, Pakistan, from July 2013 to November 2014 were included. On admission, twelve-lead electrocardiogram (ECG) was performed for all patients. During admission, all patients underwent continuous cardiac monitoring using a cardiac monitor. If an arrhythmia was suspected on the cardiac monitor, another ECG was obtained immediately.

Results: During the study period, 100 patients with AIP poisoning (63% men) were treated at Allied Hospital Faisalabad. Mean age of the patients was 26.7 ± 7.9 years ranging from 16 to 54 years. Tachycardia was detected in 68 patients and bradycardia in 12 patients. Hypotension was observed in 75 patients. Eighty patients developed cardiac arrhythmia. The most frequent arrhythmia was atrial fibrillation (31% of patients) followed by ventricular fibrillation (20%), ventricular tachycardia (17%), 3rd degree AV block (7%) and 2nd degree AV block (5%). In total, 78 patients died, depicting a 78% mortality rate following wheat pill poisoning. Among those who died, seventy-one patients had cardiac arrhythmia. Comparison of death rate between patients with and without cardiac arrhythmia showed a significant difference (71/80 (88.8%) vs. 7/20 (35%); $P < 0.001$).

Conclusion: Wheat pill poisoning causes a very high mortality, and circulatory collapse is the major cause of death among these patients. Most of the patients with AIP poisoning develop cardiac arrhythmias which are invariably life threatening. Early detection of cardiac disorders and proper management of arrhythmias may reduce mortalities.

Keywords: Aluminum Phosphide; Cardiac Arrhythmias; Cardiogenic Shock; Poisoning

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INTRODUCTION

Suicide is one of the ten leading causes of death in the world, accounting for more than 400,000 deaths annually. The pattern of suicide varies worldwide and many methods are used to commit suicide (1,2). Suicide is usually seen more among men than women, as men tend to make bolder attempts with the intention of completing the action (2,3). Poisoning is a common method of suicide and depending upon the availability; different substances are used for poisoning in different parts of the globe. In Pakistan, being an agricultural country, the use of wheat pills (a local name for aluminum phosphide or AIP containing pill, which helps to preserve crop from pests) is very common, especially in the rural areas (4). Since it is a highly toxic substance, wheat pill ingestion is a common method of committing suicide in this country (4). A standard tablet of wheat pill contains 56% AIP and 44% inert ingredients. AIP is an effective indoor fumigant for crops transport, storage and processing facilities (5).

AIP reacts with moisture in the air and in the gastrointestinal

tract to produce phosphine gas, the active component of AIP (6). AIP poisoning causes vomiting, epigastric pain, cardiac arrhythmias, circulatory failure, severe metabolic acidosis, renal failure, acute pulmonary edema, hepatic damage, convulsions and disseminated intravascular coagulation (6,7). At cellular level, phosphine gas inhibits cytochrome C oxidase, which leads to intensive cellular damage and ultimately cell death (8,9). The major lethal consequence of phosphine generation is profound circulatory collapse (10). This complication might be caused by direct effect of phosphine on cardiac myocytes, which leads to arrhythmias and hypotension, and shortly cardiogenic shock ensues (6,10,11). Considering these facts, this study was designed to determine the frequency of cardiac arrhythmias in a series of patients with AIP poisoning.

METHODS

In this prospective cross-sectional study, patients with definitive history of AIP poisoning treated at emergency department of Allied Hospital Faisalabad, Faisalabad, Pakistan, from July 2013 to November 2014 were included

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by using nonprobability consecutive sampling. Patients with concomitant poisoning with other poisons were excluded.

Examination of cardiovascular system was performed for all patients and parameters such as blood pressure and pulse rate were recorded on predesigned checklists. On admission, twelve-lead electrocardiogram (ECG) was performed for all patients. During admission, all patients underwent continuous cardiac monitoring using a cardiac monitor. They were observed for 24 hours and all types of arrhythmias were noted. If an arrhythmia was suspected on the cardiac monitor, another ECG was obtained immediately.

Data were analyzed using SPSS statistical software (IBM Corp., Armonk, NY, USA). Results are presented with

frequency and percentage and are shown with tables and graphs. The difference of frequency between two groups was analyzed by using chi-squared test. A p value less than 0.05 was considered statistically significant.

RESULTS

Demographics

During the study period, 100 patients with AIP poisoning (63% men) were treated at Allied Hospital Faisalabad. Mean age of the patients was 26.7 ± 7.9 years ranging from 16 to 54 years. The majority of patients (72%) aged between 16 to 30 years (Figure 1). All exposures were following suicidal intentions.

Cardiovascular manifestations

Tachycardia was detected in 68 patients and bradycardia in 12 patients. Hypotension was observed in 75 patients. Eighty patients developed cardiac arrhythmia. The most frequent arrhythmia was atrial fibrillation (31 patients) followed by ventricular fibrillation (20 patients) (Figure 2). A small number of patients developed sustained atrioventricular (AV) conduction defect leading to 3rd degree AV block (7 patients) and 2nd degree AV block (5 patients).

Outcomes

In total, 78 patients died during this study, depicting a 78% mortality rate following wheat pill poisoning. Among those who died, seventy-one patients had cardiac arrhythmia. Comparison of death rate between patients with and without cardiac arrhythmia showed a significant difference (71/80 (88.8%) vs. 7/20 (35%); $P < 0.001$).

DISCUSSION

Pesticide poisoning is a common problem in developing countries (6,11,12). Among them, poisoning with AIP is associated with a very high mortality. This is due to the high

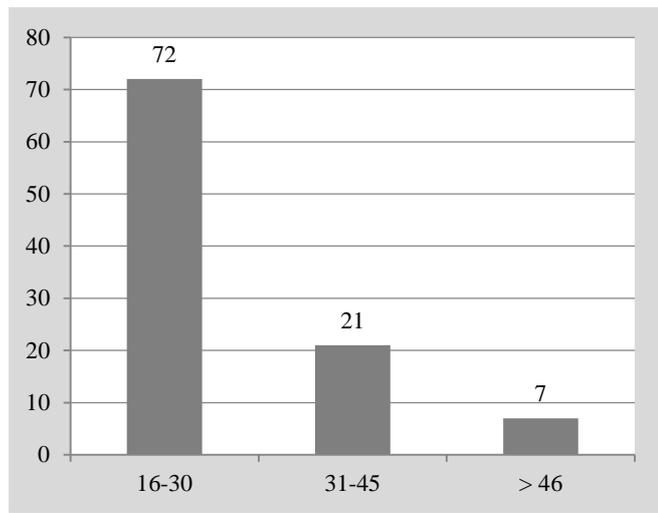


Figure 1. Age distribution of patients

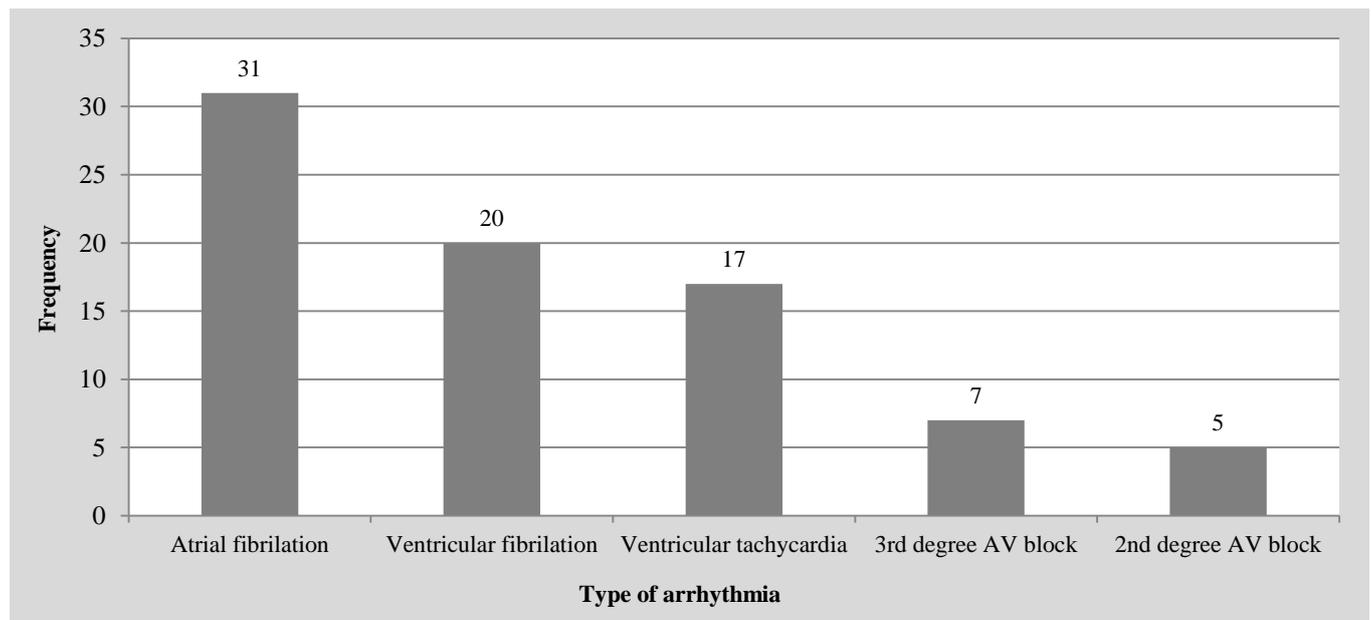


Figure 2. Frequency of cardiac arrhythmia in patients with AIP poisoning

toxicity of the substance. In addition, no effective antidote for this type of poisoning has been developed, so far (6,13).

The major complications following AIP poisoning are cardiac arrhythmia, hypotension, acute respiratory distress syndrome, acute renal failure, hepatic congestion, disseminated intravascular coagulopathy, and sometimes multi-organ failure (6,9,11). The most common cause of death following AIP poisoning is cardiogenic shock secondary to toxic myocarditis (14,15). In this study, we found that cardiac involvement has a significantly inverse impact on patients' survival. Circulatory collapse rapidly leads to death in AIP poisoning (10). Abnormalities of automaticity, which could arise from, a single cell, and abnormalities of conduction, which stem from abnormal interaction between myocytes, account for cardiac arrhythmias leading to circulatory collapse (16).

In our study, we observed that all of the patients, who had taken wheat pill, took it for suicidal intentions. Most of the patients were young with the mean age of 26.7 years, which was close to the previous Pakistani studies by Farooqi et al and Khurram et al who noted mean age of 24.4 and 24.5 years, respectively (17,18). There were more male patients attempting suicide in our study that was in accordance with the results of previous study by Farooqi et al, in which 60% of victims were men (17).

In our study, 75% of the patients developed hypotension while in a previous study by Iftikhar et al this sign was identified in 94% of the patients (19). The most likely cause of hypotension is AIP being cardio-toxic at cellular level. In general, electrocardiogram abnormalities were seen in 70% of patients by Rathore et al (5), in 58.7% of patients by Louriz et al (10) and in 45% of patients by Soltaninejad et al (20), in separate studies. The rate of cardiac arrhythmias was higher in this study (80%), which included 31% of patients having atrial fibrillation, 20% having ventricular fibrillation, 7% having 3rd degree AV block and 5% having 2nd degree AV block. Correspondingly, Soltaninejad et al reported atrial fibrillation in 35%, prolonged QTc interval in 35% and bundle branch block in 20% of AIP poisoned patients (20). To reverse cardiogenic shock, which is invariably the most fatal consequence of AIP poisoning, urgent steps should be taken. Mehrpour et al found intra-aortic balloon pump effective for saving lives of patients with AIP poisoning (15). Same scientists in another study reported the effectiveness of digoxin to treat AIP-induced cardiac failure (21).

Mortality rate due to wheat pill poisoning varies in available literature, but is undoubtedly high, so as it was 86.5% and 78% by Iftikhar (19) and Reyna-Medina et al (22), respectively, and we similarly observed 78% mortality in our research. However, experienced staff, early arrival of victims to hospital and advanced supportive measures for heart failure such as intra-aortic pump can remarkably lower the death rate as in the studies by Soltaninejad et al and Hosseinian et al, this rate was 40% and 18.6%, respectively (20,23).

AIP poisoning is still very common in our community causing high rate of fatalities (17-19). The major reason is that wheat pill is very cheap and easily available in the market. Based on the result of study, we recommend that

proper legislation should be enacted to control the sale of pesticides especially AIP ensuring that they are only used for crop protection and banning free purchasing.

LIMITATIONS

The validity of findings of this study might be affected by some limitations. The amount of poison consumed, the time interval between toxic exposure and hospital which may have impact on the prognosis of the cases were not recorded. Diagnosis of AIP poisoning was mainly based on history taking from patients or their relatives. No toxicological lab testing was performed to ascertain the diagnosis.

CONCLUSION

Wheat pill poisoning causes a very high mortality and circulatory collapse is the major cause of death among these patients. Most of the patients with AIP poisoning develop cardiac arrhythmias which are invariably life threatening. Early detection of cardiac disorders and proper management of arrhythmias may reduce mortalities.

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