

## The Study of Various Cardiac Arrhythmias in Patients Poisoned With Aluminum Phosphide (Rice Tablet)

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### ABSTRACT

**Background:** The poisoning is mostly due to suicide and is observed in younger age groups. The systemic manifestations of ALP poisoning are common but pernicious manifestations of them are cardiotoxicity, shock, and ARDS. The clinical hallmark of cardiotoxicity is arrhythmia. The aim of this study was to investigate cardiac arrhythmias in patients poisoned with ALP who were admitted to Razi Hospital to reduce mortality rate.

**Methods:** This survey was performed as a cross sectional descriptive study. Overall, 102 patients were admitted to the hospital. Their gender, age, first blood pressure (BP), and the number of consumed tablet were registered. A cardiologist studied the patients' ECGs and recorded various arrhythmias. Then, data were analyzed using SPSS version 11.

**Results:** In this study the mean age was  $29.75 \pm 14.34$  years and 66.7% of the patients were male. Used tablet and first BP average were  $1.74 \pm 1.25$  and  $69.51 \pm 27.31$  mmHg, respectively. Arrhythmia was recorded in 75.5% of the patients, among which arterial fibrillation (AF) was the most prevalent with the rate of 40.3%. PVC, Junc and PAC were the most common arrhythmias, respectively. Another arrhythmia was categorized in one group. All kinds of arrhythmia were common in younger males who had used more than one tablet and had first BP less than 90 mmHg. All patients with arrhythmia died.

**Conclusion:** Cardiotoxicity is an important cause of death in all studies and in this study as well. All patients with arrhythmia, demonstrated through ECG, died. Therefore, this study can be the basis for more detailed studies.

**Keywords:** Aluminum Phosphate, Arrhythmia, Phosphine, Rice Tablet.

### INTRODUCTION

Aluminum phosphide poisoning (ALP) is a common mode of suicide in the agricultural community in the north of Iran. ALP is a highly toxic, low cost rodenticide and an extremely lethal poison (1,2). Ingestion is usually suicidal in intent, uncommonly accidental and rarely homicidal (2). It is available as tablets (3 g) or as pellets (0.6 g quickphos, alphos, and cellphos). The fatal dose is 0.15-0.5 g, so that for a 70 kg adult, it is approximately 0.5 g (2, 3).

Upon exposure to moisture, it liberates phosphine gas, which is absorbed rapidly by inhalation, dermally, or gastrointestinally (1). Clinical features of ALP poisoning depend on

the route of administration (2), but the most common symptoms are severe vomiting, resistant hypotension, metabolic acidosis, and myocardial suppression (1,2). Cardiovascular involvement is seen in approximately 100% of cases and includes hypotension, shock, bradycardia or tachycardia, palpitation, arrhythmia, ECG changes (ischemic pattern and heart failure), S3 Gallop, increased jugular venous pressure (JVP $\uparrow$ ), myocarditis, pericarditis, and rarely congestive heart failure (CHF) (4, 5, 6).

Current management is supportive; however, survival is unlikely if more than 1.5 g is ingested (7), although outcome correlates best with the frequency of vomiting the patient

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gets after ingestion and the severity of hypotension the patients develops (7). Mortality rate is highly variable, ranging from 37-100% (2).

Out of the patients, 95% die within 24 hours and the most common cause of death in this group is arrhythmia (2, 7). Numerous types of ECG variations can be found in these patients (2, 3, 8). Death after 24 hours is due to shock, acidosis, ARDS, and arrhythmia (2).

As regards, there are no comprehensive studies on arrhythmic patterns in these patients and known treatments for this poisoning. Noticing the geographical location of Guilan (north of Iran) providing a background for ALP poisoning due to agricultural practices, this study was done to collect and analyze the information on heart arrhythmia, so as to obtain information on the treatment of these patients.

## MATERIALS AND METHODS

This survey was conducted as a cross-sectional descriptive study. The variables of this study include age, gender, number of consumed tablet, initial blood pressure, types of arrhythmia, and final condition of patients. Method of sampling was census from all patients poisoned with aluminum phosphide who referred and were admitted to the Educational Razi Hospital in Rasht during 2005-2006 period. The diagnosis was based on the authentic history of ALP ingestion, remnants of ALP tablets, containers left in the house after ingestion, and clinical manifestations.

The main factor which guided the management was treatment of shock/hypotension with appropriate measures. After admission, all baseline routines and specific investigations were carried out, including regular arterial blood gas analysis (ABG). Soda bicarbonate was given empirically to all patients in a 1-1.5 mEq/kg body weight dose and was further adjusted for correction of metabolic acidosis as per ABG reports. Also, initial blood pressure of patients was measured. The goal of administration of fluids was to maintain systolic BP above 80 mmHg. The procedure of gastric lavage was usually done

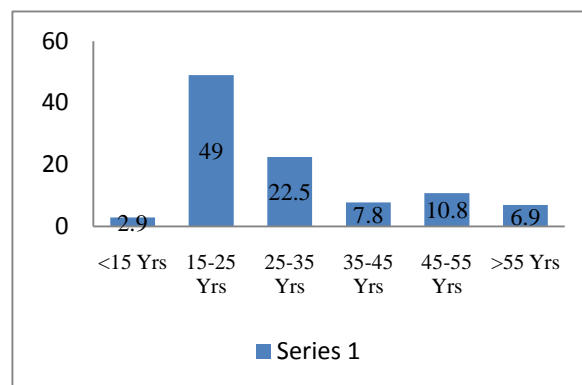
12-15 times in the first hour by charcoal. ECG was taken and all of the poisoned patients underwent cardiac monitoring, if there was any change in ECG, long lead had taken. All ECGs were studied by a cardiologist and the results were recorded in the questionnaire.

Information on age, gender, and the number of consumed tablets were obtained from the patients or their entourage and recorded in the questionnaire. SPSS for Windows version 16 was used for data analysis. The quantitative and qualitative data were analyzed by Chi-square and Fisher's exact test, respectively. Continuous variables were presented as mean  $\pm$  standard deviation (SD); categorical variables were presented in percentages ( $P < 0.05$ ).

## RESULTS

In this study, 125 patients poisoned with rice tablets were studied. Overall, 66.7% of the patients were men and 33.3% were women.

Mean age of patients was  $29.75 \pm 14.34$  years, with the greatest frequency (49%) for the age group of 15-25 years (Figure 1). In all age groups, men were more than women. 66.7% of the patients over 45 years old had used more than one tablet and the figure for under 45 year old patients was 46.4%. All patients over 45 died ( $P < 0.03$ ).

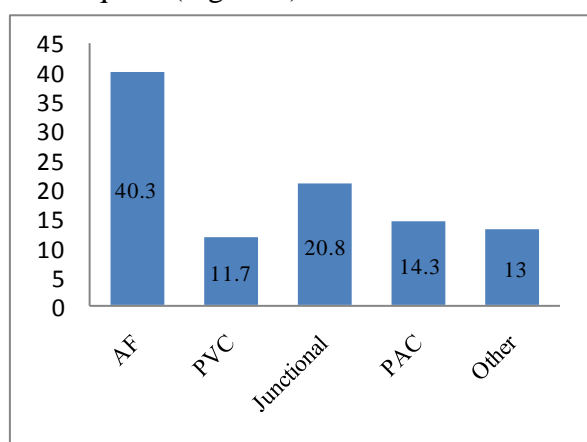


**Figure 1.** Relative frequency distribution of patients poisoned with ALP according to age

The mean of consumed tablets was  $1.74 \pm 1.25$ , the minimum was  $\frac{1}{4}$  and the maximum was 7 tablets. The number of consumed tablets by men was significantly higher than women, so that 57.4% of the men and just 35.3% of the women had consumed

more than one tablet ( $P < 0.036$ ). All patients with more than one tablet consumed died ( $P < 0.01$ ). Initial systolic blood pressure of the patients was within the range of 40-130 mmHg, the mean was  $69.51 \pm 27.31$  mmHg. There was no significant difference between men and women with initial  $BP \leq 90$  mmHg. Of the patients with initial  $BP \geq 90$  mmHg, 94.1% had taken one tablet or less ( $P < 0.01$ ).

Arrhythmia at ECG was recorded in 75.5% of individuals among whom arterial fibrillation (AF) with the rate of 40.3% was the most frequent (Figure 2).



**Figure 2.** Frequency distribution of patients poisoned with ALP according to type of arrhythmia

Among all patients, the number of men with cardiac arrhythmia was significantly higher than women, so that this figure was recorded to be 82.4% in men and 61.8% in women ( $P < 0.023$ ). Of all under 45 year old

patients, 72.6% had arrhythmia. The rate of arrhythmia among individuals over 45 was

88.9%. Arrhythmia was detected in 56.9% of the patients that had consumed  $\leq 1$  tablet and 43.1% of these patients have had no arrhythmia, while this rate significantly increased in patients that had consumed more than one tablet, and it was detected in 94.1% of them ( $P < 0.01$ ). Also, arrhythmia was seen in 88.2% of patients with initial  $BP \leq 90$  mmHg, while this figure significantly decreased and the rate reached 11.8% in patients with initial BP more than 90 mmHg ( $P < 0.01$ ).

Arrhythmia was indicated in the ECG of the 91.7% of the deceased individuals, whereas none of the patients who got discharged had arrhythmia ( $P < 0.01$ ). Among the 77 patients with arrhythmia in their ECG, AF, primary ventricle contractions (PVC), junction rhythm (Junc), and primary arterial contractions (PAC) were the most frequent. Other arrhythmias, such as heart blocks, sinus arrhythmia, supraventricular tachycardia, etc., were classified in one group (Figure 2). According to the study done on all types of arrhythmia and gender, we realized that all types of arrhythmia are more common in men than women, so that, for example, PAC was seen in 81.1% of men while it was just reported in 18.2% of the women who had PAC. All patients with PVC were  $\leq 45$  years old. Of course, it is noteworthy that the other types of arrhythmia were also more common in younger patients (Table 1).

**Table 1.** Frequency distribution of types of arrhythmia according to age

types of arrhythmia	Age $\leq 45$		Age $>45$		Total	
	Number	Frequency	Number	Frequency	Number	Frequency
AF	24	77.4	7	22.6	31	100
PVC	9	100	-	-	9	100
Junc	10	62.5	6	37.5	16	100
PAC	9	81.8	2	18.2	11	100
Other	9	90	1	10	10	100
Total	61	79.2	16	20.8	77	100

All types of arrhythmia, except PAC, were more common in individuals that had consumed more than one tablet (Table 2). All types of arrhythmia, except AF, were seen only in patients with initial BP  $\leq$  90mmHg. Out of

the patients with AF, 6.5% had initial BP more than 90mmHg (Table 3).

**Table 2.** Frequency distribution of types of arrhythmia according to number of consumed tablet

number of consumed tablet	$\leq 1$		$> 1$		Total	
	Type of arrhythmia	Number	Frequency	Number	Frequency	Number
AF	11	35.5	20	64.5	31	100
PVC	3	33.3	6	66.7	9	100
Junc	6	37.5	10	62.5	16	100
PAC	6	54.5	5	45.5	11	100
Other	3	30	7	70	10	100
Total	29	37.7	48	63.3	77	100

**Table 3.** Frequency distribution of types of arrhythmia according to Initial Systolic Blood Pressure

Initial BP	$\leq 90$		$> 90$		Total	
	types of arrhythmia	Number	Frequency	Number	Frequency	Number
AF	29	93.5	2	6.5	31	100
PVC	9	100	-	-	9	100
Junc	16	100	-	-	16	100
PAC	11	100	-	-	11	100
Other	10	100	-	-	10	100
Total	75	87.3	2	2.6	77	100

## DISCUSSION

Between January 2004 and September 2005, 102 patients poisoned with the aluminum phosphid (ALP) were evaluated at Razi Educational Hospital of Rasht. The similar previous study at this center (2000-2003) (10) included 116 subjects, so that the number of

the patients in the present study shows an increase. According to some studies done in other counties, consumption of this tablet is increasing, too (5).

ECG abnormalities have been reported in 80% of cases (with ST-T changes in 40%) (9,11); in the current study, arrhythmia was

found in 75.5% of the patients which is 10% more than the results gained by Singh *et al* (12). Although it should be mentioned that in another study done by these researchers, ECG changes were recorded in less than 50% of the patients (13).

The most common type of arrhythmia was AF that is two times more than Siwach *et al*'s findings (14). The studies of these scientists showed that supraventricular tachycardia allocated the most frequent type of arrhythmia with 46.7%, whereas supraventricular tachycardia, heart block, and sinus arrhythmia were seen in only 13% of our subjects.

The number of consumed tablets by men was significantly higher than women and the number of men who used the tablet was more than women. Since the tablet is known as a fatal and toxic matter, men seem to have used it to commit suicide. In a study carried out by Siwach *et al* (15), the majority of ALP poisoning patients were young (78%) and peak incidence was seen in age group of 21-30 years.

The blood pressure of the patients was low; this may be due to the usage of the toxic matter. All types of arrhythmia were more common in men women. There were two justifications for this: First, men had used more tablets, and second, the physiological differences between the men and the women led to a lower level of estrogen in the men.

In this study, the most frequent rate of poisoning was seen in the youth group and more than half of these patients were between 15 and 25 years old. This is accordance with data presented in Indian studies (5). The number of poisoned men was higher than women in all age groups, so that it did not show any relationships between age and gender of the patients.

According to the results, approximately two thirds of the patients who were over 45 years old had taken more than one tablet. It should be mentioned that the number of these patients was less than the patients who were less than 45 years old and had consumed more than one tablet. This fact shows that the young

patients had used the tablets intentionally. Arrhythmia was found among patients who were upper than 45 years old, but there was no justification for the problem. It can be because of their age, but it is obvious that the young people who consumed more than one tablet faced arrhythmia, as well. In this study, all of the patients who were 45 years old or more died.

The men's blood pressure was related to the number of consumed tablets; therefore, more tablets led to lower blood pressure. There was a relationship between the number of tablets and arrhythmia, too. This is due to the mechanism of this tablet. Myocardial hypoxia that is affected by the pathogens of the tablet is the main cause of arrhythmia, so that consumption of many tablets would increase the level of myocardial hypoxia that leads to arrhythmia. PVC was found more than other types of arrhythmia when the number of consumed tablets increased. It should be mentioned that the most important cause of PVC is the myocardial hypoxia.

The main clinical manifestation reported in literature comprises the cardiovascular system (60-100%), including shock and cardiac arrhythmias as prominent features (16, 17). In the present study, 83.3% of the admitted patients had initial BP  $\leq$  90 mmHg; this was in accordance with other studies that show hypotension as the first sign of the poisoning that result in the ALP. Although in the another study which was done by Singh *et al*, hypotension was only reported in 37% of the patients (12).

Noticing the relationship between the number of consumed tablets, arrhythmia, and low blood pressure, it is clear that if the number of consumed tablets increases, myocardial hypoxia of cells will increase which leads to arrhythmia. Any disorder in the heart rate can lead to lower blood pressure and shock. Hypotension, in turn, can exacerbate arrhythmia.

In patients who had initial BP more than 90 mmHg, just AF was recorded (6.5%). AF and other types of arrhythmia were seen in the patients with initial BP  $\leq$  90 mmHg with the

rate of 93.5%. Arrhythmia was recorded in 91.7% of the deceased patients. The study showed that there is a significant relationship between the decreased blood pressure and arrhythmia. On the other hand, arrhythmias were recorded in the 100% of the patients who died. Hence, we can conclude that shock and arrhythmia were the main causes of death that is in agreement with the results of other studies (18).

## REFERENCES

1. Bogle RG, Theron P, Brooks P, Dargan PI, Redhead J. Aluminium phosphide poisoning. *Emerg Med J*. 2006;23(1):e3.
2. Wahab A, Zaheer M, Wahab S, Khan R. Acute aluminium phosphide poisoning: an update. *Hong Kong J Emerg Med*. 2008;15(3):152-5.
3. Ranga G, Dwivedi S, Agarwal M, Kumar D. Aluminium phosphide poisoning in a young adult: A suicidal cardiotoxin simulating myocardial ischaemia. *J Indian Acad Clin Med*. 2004;5(4):369.
4. Haddad LM, Shannon MW, Winchester JF. *Clinical management of poisoning and drug overdose*: Saunders; 1998.
5. Chugh S N. Two commonly used pesticide and insecticide in agriculture are phosphides. *J Indian Academy of Clinical Medicine* 1999;4(2):83-9
6. Gupta MS, Malik A, Sharma VK. Cardiovascular manifestations in aluminium phosphide poisoning with special reference to echocardiographic changes. *J Assoc Physicians India*. 1995;43(11):773-4, 9-80.
7. Singh S, Singh D, Wig N, Jit I, Sharma BK. Aluminum phosphide ingestion--a clinicopathologic study. *J Toxicol Clin Toxicol*. 1996;34(6):703-6.
8. Mathur A, Swaroop A, Agarwal A. ECG changes in acute organophosphorus and aluminium phosphide poisoning. *Indian Practitioner*. 1999;52(4):249-52.
9. Bajaj R, Wazir H, Aggarwal R. Aluminium phosphide poisoning. Clinical toxicity and outcome in 11 intensively monitored patients. *Natl Med J India*. 1989;1:270-4.
10. Rahbar taramsari M, Ourangpour R, Zarkami T, Palizkar M, Mousavian roushan zamir SA. Survey patients poisoned with aluminum phosphide (rice tablet). *JGUMS*. 2006;14(56):42-7.
11. Gupta S, Mabajan A, Verma V, Gupta A. A clinical study of aluminium phosphide poisoning. *JK SCIENCE*. 2002;4(2):79-82.
12. Singh RB, Rastogi SS, Singh DS. Cardiovascular manifestations of aluminium phosphide intoxication. *J Assoc Physicians India*. 1989;37(9):590-2.
13. Singh S, Dilawari JB, Vashist R, Malhotra HS, Sharma BK. Aluminium phosphide ingestion. *Br Med J (Clin Res Ed)*. 1985;290(6475):1110-1.
14. Siwach SB, Singh H, Jagdish, Katyal VK, Bhardwaj G. Cardiac arrhythmias in aluminium phosphide poisoning studied by on continuous holter and cardioscopic monitoring. *J Assoc Physicians India*. 1998;46(7):598-601.
15. Siwach SB, Gupta A. The profile of acute poisonings in Harayana-Rohtak Study. *J Assoc Physicians India*. 1995;43(11):756-9.
16. Siwach SB, Yadav DR, Arora B, Dalal S, Jagdish. Acute aluminum phosphide poisoning--an epidemiological, clinical and histopathological study. *J Assoc Physicians India*. 1988;36(10):594-6.
17. Chugh SN, Singhal HR, Girhar NK, Arora BB, Malhotra KC. Aluminium Phosphide-Analysis of 226 cases (Abstract). *J Assoc Physicians India*. 1989:37-8.
18. Khosla S, Nand N, Kumar P. Cardiovascular complications of aluminum phosphide poisoning. *Angiology*. 1988;39(4):355-9.