

# Clinical presentation and outcome of aluminium phosphide poisoning

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## Abstract

**Introduction:** Pesticide poisoning, whether due to self, accidental, occupational or for homicidal purpose, is a global public health problem, and self-poisoning accounts for one-third of the world suicide rate. Since agriculture is the main occupation in Bangladesh, pesticides are widely and easily available in ordinary village grocery shops. Their easy availability makes them a popular method of self-harm particularly in the rural areas. **Objective:** To assess the clinical presentation and outcome of aluminium phosphide poisoning. **Methods:** It was a descriptive cross sectional study, performed in Department of Medicine, Shaheed Ziaur Rahman Medical College Hospital (SZMCH), and Bogura, Bangladesh. Over a period of six months from January 2018 to June 2018, consecutive 50 patients with history of Gas tablet poisoning admitted in all four Units of Medicine ward that fulfilled inclusion criteria at admission were enrolled in the study. **Results:** The number of cases of aluminium phosphide poisoning were 50 (0.62%) out of 8102 admitted patients. The mean age was  $24.7 \pm 8.8$  years. There were 27 (54%) male and 23 (46%) female, with male: female ratio being 1.7:1, 44 (88%) patients came from rural area and 6 (12%) patients from urban areas. Incidence of poisoning was high among married persons 38 (76%) and housewives 16 (32%). Regarding education background and monthly family income more than half of the patients, 36 (72%) were below SSC group and 42 (84%) had between 5000-10000 TK BD respectively. Among 50 patients, 37 (74%) took one tablet. The commonest clinical presentation was GIT symptoms and concomitant cardiovascular symptoms. Clinical examination revealed tachycardia (54%) and cardiogenic shock (28%) at admission. Among the biochemical abnormalities raised S creatinine and hypokalaemias are associated with increased mortality. Out of 50 patients, 40 patients of aluminium phosphide poisoning where ECG was done at admission or subsequently and most common abnormality was tachyarrhythmia followed by ST depression (42.5%). Most of the cases reached to hospital within 2 hours and not a single patient was reported to survive when the time elapsed exceeded 4 hours. The overall mortality rate was 60%. **Conclusion:** In agriculture based developed countries like Bangladesh acute pesticide poisoning is a major health problem resulting in a high mortality and morbidity. The diagnosis of poisoning requires adequate history of exposure, clinical features and toxicological analysis of stomach content, particularly silver nitrate impregnation test in case of aluminum phosphide poisoning. Scientific diagnostic methods are not available in Bangladesh, so diagnosis is mostly clinical.

**Key words:** Clinical Presentation, Outcome, Aluminium Phosphide Poisoning, Bangladesh

## Introduction

Pesticide poisoning, whether due to self, accidental, occupational or for homicidal purpose, is a global public health problem, and self-poisoning accounts for one-third of the world suicide rate [1]. Since agriculture is the main occupation in Bangladesh, pesticides are widely and easily available in ordinary village grocery shops. Their easy availability makes them a popular method of self-harm particularly in the rural areas. Many people consider suicide as an acceptable way of relieving their personal misery or of reducing the financial and emotional burden they cause their family. Acute pesticide poisoning is a major clinical problem in developing countries like Bangladesh. Gas tablet containing Aluminium phosphide, one of the most commonly used grain preservatives has emerged as suicidal agent in few areas of Bangladesh. As it is highly toxic and case fatality is very high, it is very important to

know more about the Aluminium phosphide poisoning regarding its socio-demographic status, clinical presentation and outcome. Aluminium phosphide (ALP) is a solid fumigant which has been in extensive use to preserve grains all over the world. It has rapidly become one of the most commonly used grain fumigants because of its properties which are considered to be near ideal. It is toxic to all stages of insects, highly potent, does not affect seed viability, is free from toxic residues and leave little residue on food grains [2]. Aluminium phosphide, because it is cheap, easily available, highly toxic, and has no antidote, has emerged as the most common suicidal agent in developing countries like India. In a study conducted by Siwach and Gupta, Aluminium phosphide poisoning was found to be the most common cause of acute poisoning in India. Aluminium phosphide (ALP) poisoning also has emerged as a common of accidental poisoning in children with mortality

ranging from 37% to 100%. Despite the alarming increase in the incidence of this poisoning, there is hardly any mention about it in the literature and textbooks. The toxic effects of Aluminium phosphide are due to deadly phosphine gas liberated when it reacts with water or hydrochloric acid in stomach. The lethal dose for a human weighing 70 Kg is 150 mg to 500 mg. In human beings, phosphine causes toxicity by inhalation and ingestion. Whereas only isolated cases of toxicity by inhalation (primary toxicity) from fumigated bulk of grain have been reported, it is latter route which is commoner.

## Methodology

It was a descriptive cross sectional study, performed in Department of Medicine, Shaheed Ziaur Rahman Medical College Hospital (SZMCH), Bogura, Bangladesh. Over a period of six months from January 2018 to June 2018, consecutive 50 patients with history of Gas tablet poisoning admitted in all four Units of Medicine ward that fulfilled inclusion criteria at admission were enrolled in the study.

### ▪ Inclusion criteria

- i. History of Gas tablet consumption
- ii. Age of the patient more than 13 years

### ▪ Exclusion criteria

- i. Patient below 18 years of age who can't exactly mention the name of poison
- ii. Patients with multiple drugs poisoning
- iii. Patients suffering from psychiatric illness before poisoning

The diagnosis was based on information taken either from the patient or from the patient's relative regarding the tablet ingestion. As clinical features were variable and specific tests were unavailable a positive history of ingestion was the basis of diagnosis in most cases. Diagnosis of any other causes of poisoning by deliberate self-harm or presence of any other organic cause of coma or who unwilling to give informed consent were not included in the study. After initial management detail history, thorough clinical examination was performed. Attempt was made to collect the sample of the ingested tablet. The patients were assessed daily till discharge to see their outcome. The patients were managed according to standard clinical protocols. All data were collected in an individual case record form (Annex). Before data collection verbal or written informed consent was taken from patients or their relatives. Data were analyzed using the SPSS 12.0. Data were presented as mean and percentage as applicable.

### ▪ Operational definitions

**Epidemiology:** The study of the distribution and determinants of disease or conditions in a defined population

**Cardiac failure:** Clinical findings with echocardiographic evidence

**Angina:** Typical chest pain supported with ECG & Echocardiography, no invasive investigation will be done

**Atrial fibrillation:** Clinical findings with ECG Confirmation

**Bradycardia:** Clinical findings with ECG confirmation

**Tachycardia:** Clinical findings with ECG confirmation

**VT/VF:** Clinical findings with ECG confirmation

**Shock:** Clinical findings of heart rate, blood pressure, urine output and skin condition

## Results

Consecutive 50 patients of Gas tablet poisoning in to the department of medicine of Shaheed Ziaur Rahman medical college Hospital, Bogura were included in this study. Among them 26 were male and 24 were female. Presentation shows the age of aluminum phosphide tablet poisoning cases were ranged from 16 years onwards. The mean age was  $24.20 \pm 2.55$  (Mean  $\pm$  SD) years. The highest number of patient was 21-22 years age group. It also shows male cases were more than female. Male to female ratio was 1.08:1. Out of 50 patients married 80% and unmarried 20%. Out of 50 patients 16 were housewife (32%), Day laborer 12 (24%), Business man 4 (8%), Service 4 (8%), Student 12 (24%), Others 2 (4%). Out of 50 patients of ALP poisoning, illiterate cases were 9 (18%), Below SSC 35 (70%) and Above SSC 6 (12%). Among 50 patient 88% resides in rural area and 12% resides in urban area. Out of 50 patients, 20% patients are from low income families, 72% are from middle income families and 8% from high income families. Among 50 patients took one tablet (72%), followed by less than (24%) and more than one tablet took (4%) (TABLE 1).

The commonest manifestation of ALP poisoning study was found to be GIT symptoms (76%) followed by CVS symptoms (64%), Respiratory Symptoms (20%), Anuria/Oliguria (10%), and CNS features (10%) (TABLE 2).

Age		Total number of patients	Percentage (%)
16-20 year	Male	6	12%
	Female	4	8%
21-25 year	Male	10	20%
	Female	9	18%
26-30 year	Male	4	8%
	Female	6	12%
31-35 year	Male	3	6%
	Female	2	4%
36-40 year	Male	2	4%
	Female	2	4%
41-45 year	Male	1	2%
	Female	1	2%
<b>Marital Status</b>			
Married		40	80%
Unmarried		10	20%
<b>Occupation</b>			
Housewife		16	32%
Day Labourer		12	24%
Business		4	8%
Service		4	8%
Student		12	24%
Others		2	4%
<b>Education Status</b>			
Illiterate		9	18%
Below SSC		35	70%
Above SSC		6	12%
<b>Habitat Status</b>			
Rural		44	88%
Urban		6	12%
<b>Socio-economic Status</b>			
<5000 take		10	20%
5000-10000 Take		36	72%
>10000 Taka		4	8%
<b>Tablet Ingestion</b>			
Less than one		12	24%
One		36	72%
More than one		2	4%

**Table 2. Clinical manifestation of ALP poisoning (N=50)**

Clinical manifestation	Total Number of patient	Percentage (%)
GIT Symptoms	38	76%
CVS Symptoms	32	64%
Respiratory Symptom	10	20%
Anuria/Oliguria	5	10%
CNS Manifestation	5	10%
Jaundice	5	10%

\*\* Most of the patients presented with more than one manifestation.

**Table 3. Distribution of patients on the basis of common clinical signs (N=50)**

Clinical signs	Number of patient	Percentage (%)
Tachycardia	30	60%
Cyanosis	5	10%
Un-recordable BP	18	36%
Tachypnoea	12	24%
Others	6	12%

\*\* Most of the patients presented with more than one manifestation.

**Table 4. Distribution of patients on the basis of biochemical reports (N=40)**

Biochemical reports	Number of patient	Percentage (%)
Increased S. Creatinine	13	32.50%
Increased S. Bilirubin	6	15%
Increased SGPT	6	15%
Electrolyte changes	19	47.40%
Decrease S. Magnesium	8	16%

\*\* Most of the patients presented with more than one biochemical abnormalities.

**Table 5. ECG abnormalities in ALP poisoning (N=40)**

ECG Abnormalities	Total no of patient	Percentages (%)
Tachycardia	34	85%
AF	11	27.50%
VT	7	17.50%
ST Elevation	10	25%
ST Depression	7	17.50%
Bradycardia	6	15%

\*\* Most of the patients presented with more than one ECG abnormalities.

**Table 6. Time of intake of gas tablet and mortality**

Time elapsed between intake of poison and admission to the hospital	Number of patient died		Number of patient survived	
	Number	Percentage (%)	Number	Percentage (%)
0-2 hour	5	10%	12	24%
2-4 hour	12	24%	8	16%
4-6 hour	7	14%		
6-8 hour	3	6%		
>8 hour	3	6%		
<b>Total</b>	<b>30</b>	<b>60%</b>	<b>20</b>	<b>40%</b>

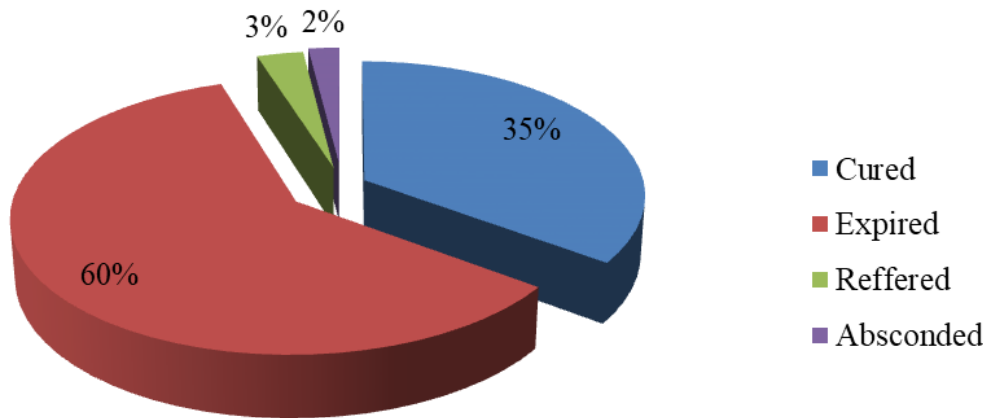


FIGURE 1. In this study shows case mortality is more, 30 (60%)

TABLE 3 Shows Clinical examination at admission of ALP poisoning patients revealed tachycardia (60%), un-recordable BP (36%), Tachypnoea (24%), Cyanosis (10%) and others (12%)

Out of 50 patients, in 10 patients biochemical reports were not possible due to early death. Biochemical reports of 40 patients showed raised serum creatinine 32.5%; serum bilirubin raised in 15%, SGPT is raised in 15%; Electrolyte changes in 47.4%, Decreased serum Mg in 16% (TABLE 4).

Out of 50 patients 40 patient of ALP patient poisoning reached in hospital within 0-4 hours where ECG was done at admission or subsequently, form the subject matter of the study in 10% of the patients ECG was not possible due early death. Most of the patient presented with more than one ECG abnormality. Most common ECG abnormality was tachycardia (85%) then ST segment depression (17.5%) bradycardia in (15%) cases. patients of cardiac arrhythmia with haemodynamically unstable condition

managed in CCU with ECG monitoring (TABLE 5).

TABLE 6 Shows time elapsed between intake of poison and admission to the hospital. 20% survived cases reached hospital within 4 hours after the ingestion of the poison. Not a single patient was reported to survive when the time elapsed exceeded 4 hours.

**Discussion**

This study was carried out in consecutive 50 admitted patients of Gas tablets (aluminium phosphide) poisoning in department of medicine, Shaheed Ziaur Rahman Medical College Hospital, Bogura during a period of six month from January 2018 to June 2018 . During this period patients of Aluminium phosphide poisoning were diagnosed mostly from history taking from patient himself as well as attendance of the patient. After initial management, history taking and through clinical examination

including some investigations-various clinical presentations and outcome of aluminium phosphide poisoning was studied. This study shows most of the patients were between 21 to 25 years of age (36%). The mean age of the patients was  $24.7 \pm 8.8$  years. Maximum incidence (90%) of poisoning occurred below the age of 30 years which indicates that like other pesticide poisoning it is common among young people. These findings are close approximation with the finding of Ahmed et al and Faiz et al [3]. In our study 26 (52%) patients were male and 24 (48%) patients were female giving male female ratio of 1.08334:1, which differs with the study of Khan et al and Karki et al but similar to the studies done at CMCH [4-6]. Patients came from both rural and urban area with which much rural (88%) preponderance which indicates that patients from rural area are referred to tertiary hospital earlier. The reason may be that the study was done in hospital of Bogura where mostly rural population could avail the hospital facilities because of nearness of hospital, Singh S. et al study poisoning showed a distinct preponderance areas [7]. It coincided with the present study conducted in Shaheed Ziaur Rahman College Hospital that covered a wide range of area mainly rural area of Northern zone of Bangladesh. This study shows 40 (80%) patients were married and 10 (20%) patients unmarried who tells that pesticide poisoning is common in married group. In this poisoning were more common in less educational background i.e. below SSC group 36 (72%). The incidence of pesticide poisoning among the students were (22%), among the housewives 16 (32%), among the businessmen 4 (8%), among the laborer (8%) and others. Forty patients (80%) in this study had taken fresh tablets. This shows easy availability of fresh aluminium phosphide tablets pack due to unrestricted sale. Eight patients (20%) had taken exposed tablets. In this study showed most of the patient took one tablet 42 (84%) only 16% took less than one tablet and 4% took more than one tablet. In this study showed, the most predominant presenting symptom was GIT symptoms i.e. nausea and vomiting 74% followed by cardiac arrhythmias (62%), Respiratory symptoms (18%), Anuria /oliguria (12%), jaundice (10%) and CNS features (6%). These findings are close approximation with the finding of Mathai A. et al [8]. Another study by Jaisal S. et al Shock has been found to be the commonest and most important clinical sign in phosphine poisoning [9]. Shock has been described by many authors as the commonest manifestation and leading cause of death. This is thought to cause myocarditis [10]. In the present study, 28% (14 out of 50) patients presented with unrecordable blood pressure that nearly coincides with the above study. In the present study patients have shown predominantly tachycardia. This finding did not coincide with the findings of Chugh et al. where patient had shown bradycardia as well as tachycardia [11]. Pulse rates settled gradually among survivors. Out of 50 patients, biochemical tests in 10 patients were not possible due to early death. Biochemical reports of 40 patients showed raised s. creatinine in 30% cases, s. bilirubin in 12.5% and SGPT in 12.5% cases, Electrolyte changes (Na, K) in 52.5% and decreased s. magnesium in 16%. Serum creatinine levels were found to correlate well with mortality. Survivors had significantly lower serum creatinine level at admission as compared to non-survivors 0.64 milligram per decilitre respectively. All patients had normal levels of  $\text{Na}^+$  at admission to the hospital while 40% of patients had hypokalemia, statistically insignificant. Increased Serum levels of bilirubin, ALT at admission did not show any association with mortality. The high serum electrolyte changes in at admission which was nearly similar to the findings of Jaisal et al. Where 25% patient had elevated serum creatinine level and electrolyte changes occur in 45% patient with most of them hypokalemia [9]. The salient clinical investigations noted at admission are as given in ECG was done at admission or subsequently. In 10 patients ECG was not possible due to early death. Most of the patient presented with more than one ECG abnormalities. In this study ECG changes at admission were tachycardia (80%) AF 11 (27.5%), VT 7 (17.5%), ST Elevation 8 (20%), ST Depression 7 (17.5%) and Bradyarrhythmia 6 (12%) patients i.e. majority dysarrhythmias were of tachyarrhythmia which did not coincide with Khurana P et al reported, where 20.51% had supraventricular tachycardia and 22% had ST Depression. 44 cases (88%) reached hospital within 4hrs after the ingestion of the poison. Not a single patient was reported to survive when the time elapsed exceeded 4 hours

it coincides with Khurana P et al report [12]. The overall mortality from aluminium phosphide poisoning in the study period was 60% which does not coincides with other studies conducted in India where mortality was more. Such as Khurana et al showed mortality was 76% [12]. It may be due to some limitations of this study like small sample size, ingestion of previously exposed tablets, few severely poisoning patients absconded or referred to higher centre are also included in this study. Although there was no study regarding the mortality of aluminium phosphide in Bangladesh yet it indicates the mortality is very high and from the clinical findings and available investigations it is thought that the main cause of death due to cardiac arrhythmia and cardiogenic shock which may be due to electrolyte imbalance or myocardial injury.

### Limitation of the study

1. Silver Nitrate test of stomach content for confirmation of aluminium phosphide poisoning was not available
2. Financial constraints by the patients and poor logistics and drug availability in tertiary care hospital
3. Some important biochemical test like blood gas analysis, cardiac enzymes etc. were not done due to lack of facilities and financial constraints
4. Immediate cardiac and artificial respiratory support for the victim was not available when required

### Conclusions

In agriculture based developed countries like Bangladesh acute pesticide poisoning is a major health problem resulting in a high mortality and morbidity. Gas tablets are widely used in agricultural sector for grain preservative and rodenticide in few areas of Bangladesh like Bogura. Their easy availability and comparatively low price make them popular agents for self-harm. As it is highly toxic and have no specific antidote, prompt recognition and early treatment is mandatory in acute poisoning in order to minimize the mortality from these potentially lethal compounds. The diagnosis of poisoning requires adequate history of exposure, clinical features and toxicological analysis of stomach content, particularly silver nitrate impregnation test in case of aluminum phosphide poisoning. Scientific diagnostic methods are not available in Bangladesh, so diagnosis is mostly clinical. Treatment is not standardized and there is lot of variations amongst professionals. A national guideline should be introduced. Appropriate management of poisoning requires rapid decontamination, ICU support with effective manpower in the treatment of severe cases. Awareness regarding the lethality of aluminium phosphide poisoning, immediate first aid measures and hospital admission following poisoning should be raised among general population via audio visual and broadcasting media. Special care should be taken to depressed persons, showing suicidal tendencies. Education relating to moral and spiritual development can act as a tool to reduce suicidal incidences.

### Abbreviation

ALP	Aluminum Phosphide
ARDS	Acute Respiratory Distress Syndrome
BCPS	Bangladesh College of Physician and Surgeon
BD	Bangladesh
BP	Blood Pressure
CBC	Complete Blood Count
CRF	Case Record Form
CNS	Central Nervous System
CXR	Chest X-Ray

CVS	Cardiovascular System
DORB	Discharge on Request Bond
ECG	Electrocardiography
FCPS	Fellowship of the College of Physician and Surgeon
GCS	Glasgow Coma Scale
GIT	Gastro Intestinal Tract
RBS	Random Blood Sugar
SD	Standard Deviation
SGPT	Serum Glutamic Pyruvic Transaminase
SGOT	Serum Glutamic Oxaloacetic Transaminase
SSC	Secondary School Certificate
AF	Atrial Fibrillation
VT	Ventricular Tachycardia
VF	Ventricular Fibrillation

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