



## CLINICAL PROFILE IN ZINC PHOSPHIDE POISONING WITH SPECIAL REFERENCE TO CARDIOLOGICAL MANIFESTATION IN TERTIARY CARE HOSPITAL

Shital Rathod

Dr. Shankarrao Chavan Government Medical College and Hospital, Vishnupuri, Nanded, Maharashtra, India

Arvind Chavan

Dr. Shankarrao Chavan Government Medical College and Hospital, Vishnupuri, Nanded, Maharashtra, India

Madhur Maniyar\*

Senior Medical Officer, ESIS Hospital Aurangabad, Maharashtra, India  
\*Corresponding Author

**ABSTRACT** **Background:** Poisoning is a major health problem worldwide and rodenticides are one of the commonest substances used for poisoning in India. Zinc phosphide is legal, inexpensive, and readily available rodenticides, is generally misused intentionally for suicidal purpose. The present study was undertaken to assess clinical profile in zinc phosphide poisoning with special reference to cardiological manifestation in Tertiary care hospital. **Method:** Total 151 patients who consumed zinc phosphide compound of age >14 years hospitalized in a tertiary healthcare center during the period from 1st August 2018 to 1st December 2020 were included and studied to assess the outcomes. **Results:** Most of the patients were in the age group of 21-30 years (49.7%) with male predominance (60.92%). 47.68% of cases consumed zinc phosphide in the form of powder, majority (83.4%) were suicidal and 86.75% reached the hospital within 24 hours. Nausea and vomiting was most common presenting symptom (84.7%) and icterus was commonest sign (23.2%). Commonest ECG abnormality being sinus tachycardia (21.9%) followed by sinus bradycardia (7.3%). Most common complication being Arrhythmia (43%). Maximum patients recovered without complications (82.1%) while 14(9.8%) were died. Atrial tachycardia (50%) followed by myocarditis (28.6%) were the principal causes of death. Occurrence of death in patient who consumed liquid form of zinc phosphide, presented >24 hours and occurrence of death among hypotensive patient were statistically significant. **Conclusion:** Patients with zinc phosphide poisoning should be observed in the hospital for 2 days and followed up for cardiovascular symptoms/problems because these are the main causes of death in present study.

**KEYWORDS :** Poisoning; Rodenticides; Zinc phosphide; Cardiological manifestation; Tachycardia; Bradycardia; Arrhythmia; Myocarditis

### INTRODUCTION

Poisoning is mostly preventable, commonly suicidal and rarely being accidental form of death in developing agrarian countries. Among poisoning, in our region, next to organophosphorus poisoning, rat killer or rodenticide poisoning remains the second most common ingested poison [1]. Zinc phosphide is effective fumigants and rodenticide widely used in many countries, especially in developing countries. However, in recent years zinc phosphide poisoning has become a common cause of suicidal poisoning in adults [2]. A dosage of 4 to 5 g of zinc phosphide (55–70mg/kg) had resulted in human deaths in acute toxicity. The most common presentation is cardiogenic shock secondary to myocarditis. Neurological, gastrointestinal and renal involvement is also commonly seen [3].

The mortality rate of zinc phosphide poisoning is around 37–100% [4]. Cardiotoxicity is a significant cause of death in phosphide poisonings [5]. It manifests as refractory hypotension, congestive heart failure and electrocardiographic (ECG) abnormalities and elevation of cardiac markers, such as creatine phosphokinase-MB (CPK-MB) fraction [6]. Phosphide poisonings also causes myocarditis and pericarditis with ECG changes such as sinus tachycardia, bradycardia, supraventricular ectopic, ventricular ectopics, atrial fibrillation, ventricular fibrillation, conduction defects namely wide QRS complex, A-V conduction defects, bundle branch block, complete heart block and ST-T changes such as ST depression, ST elevation, T wave changes [4, 7].

Although the outcome of phosphide poisoning can be correlated with the number of induced vomiting the patient gets, severity of hypovolemia and acidosis. Majority of the deaths had occurred in first 12 to 24 h and main causes identified are refractory hypotension and arrhythmias. The late deaths (beyond 24 h) had been commonly due to adult respiratory distress syndrome, liver failure and renal failure. Furthermore the outcome is poorer with delayed presentation, development of coagulopathy, hyperglycaemia and multiorgan failure [8].

The epidemiological factors such as geography, occupation, socioeconomic status, literacy rate, and cultural and religious practices can influence the clinical presentation and outcome of the poisoning patients. This urges the need for periodical study for understanding the pattern of poisoning in a specific geographical area [9] and their complications needed to be studied. Clinical studies and reports of zinc

phosphide poisoning in human beings are limited. Therefore present study aims to assess clinical profile in zinc phosphide poisoning with special reference to cardiological manifestation in tertiary care center.

### MATERIALS AND METHODS

This prospective cross-sectional study was conducted in total 151 patients who consumed zinc phosphide compound of age >14 years hospitalized in emergency department, medicine wards and Medicine Intensive care unit of Department of General Medicine at tertiary healthcare center during the period from 1<sup>st</sup> August 2018 to 1<sup>st</sup> December 2020 were included in the study. Prior approval for the study was obtained from the Institutional Ethics Committee. After explaining the possible prognosis, written consent from a responsible attendant of the patient were taken. Patients poisoned with other compound poisoning or mixed poisoning, patient with history of primary liver diseases, HBsAg and HCV antigen positive, history of ischemic heart disease, cardiac arrhythmias, congenital heart disease, malignancy, tuberculosis, pregnant women, zinc phosphide compound poisoning in less than 14 years age and who were not willing to give consent for the study were excluded.

Before starting the study investigator undergo training about diagnosis and management of various poisoning. A good rapport was made between patient and investigator and after explaining the purpose of study a voluntary consent of patient and those patient who give voluntary consent were considered as a study subject. When the patient was first encountered in emergency department after registering as medicolegal case by duty medical officer patient has received primary treatment and done with ryles tube and gastric lavage was being given with normal saline. Proper history of patient taken to know quantity and time of consumption of poison and time of reporting in our hospital and primary treatment received. Enquiry about details of referral were noted. Biochemical parameters such as AST, ALT, total bilirubin, serum electrolyte, KFT and estimation cardiac enzymes were used for assessment.

### Data Analysis

Statistical analysis was carried out with help of statistical Software Epi Info, Version 7 (Atlanta, Georgia, USA). Using this software range, frequencies, percentages, means, standard deviations, Chi-square and 'p' values were calculated. Kruskal Wallis Chi-square test was used to test the significance of difference between quantitative variables and

Yate's tests for qualitative variables. Quantitative data were presented with the help of Mean, Standard Deviation, Median and IQR, comparison among study group was done with the help of Unpaired T test. Qualitative data were presented with Frequency and Percentage. P-values less than 0.05 were considered statistically significant.

**OBSERVATIONS AND RESULTS**

A total of 151 zinc phosphide poisoning patients were enrolled in the study. The maximum number of patients were belonged to 21-30 years age group (49.7%) followed by 31-40 years (31.8%) with male predominance (60.92%) as shown in table 1.

**Table 1: Demographic profile of the patients**

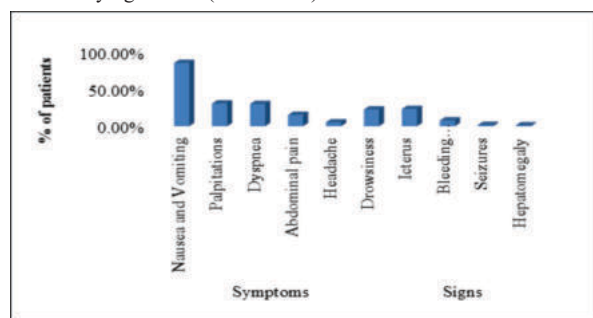
Parameters	No. of patients	Percentage	
Age group	14-20	15	9.9
	21-30	75	49.7
	31-40	48	31.8
	41-50	09	5.9
	>50	04	2.6
Gender	Male	92	60.92
	Female	59	39.07

Out of 151 study subjects, majority 126(83.4%) were suicidal, 11 (7.3%) were accidental and 13 (8.6%) were homicidal. Most of the patients presented in 2- 6 hours after consumption as show in table 2. However, out of 151 subjects, 131 (86.75%) reached the hospital within 24 hours of poisoning among them 6 died while 20 (13.2%) reached >24 hours after poisoning and among them 8 died. The association of time interval between poisoning to hospital presentation was statistically significant. (p=0.00001)

**Table 2: Distribution of study subjects according to time interval between poisoning to hospital presentation**

Time Interval	No. of patients	Percentage
0 to 2 hours	56	37.1
2 to 6 hours	62	41
6 to 12 hours	09	5.9
12 to 24 hours	10	6.6
>24 hours	13	8.6

Among patients nausea and vomiting was most common presenting symptom (84.7%) and icterus was most common sign (23.2%) as depicted in figure 1. Bleeding manifestations were Rash-5, Patechie-3, Malena-2, Gum bleeding-1, Hematemesis-1. Thus, rash followed by petechiae was most common bleeding manifestation. Out of 151 study subjects, 128 (84.7%) were normotensive, 23 (15.2%) study subject was hypotensive while 9 (5.9%) patient had hypertension. The association between death and blood pressure was found to be statistically significant. (P=0.00001)



**Figure 1: Distribution of study subjects according to signs and symptoms**

Most common ECG abnormality in patients being sinus tachycardia (21.9%) followed by sinus bradycardia (7.3%) as shown in table 3.

**Table 3: Distribution of study subjects according to ECG abnormalities**

ECG abnormalities	No. of patients	Percentage
Sinus tachycardia	33	21.9
Sinus bradycardia	11	7.3
Wide complex ventricular tachycardia	04	2.6
Atrial fibrillation	08	5.2
Diffuse ST segment elevation	08	5.2
ST elevation MI	02	1.3

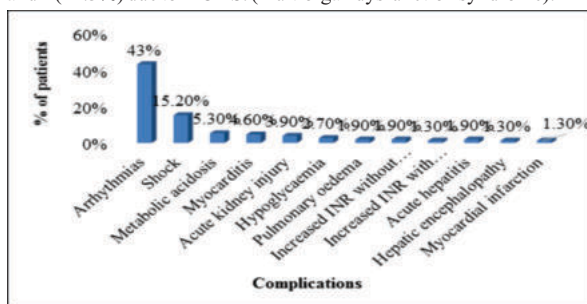
Non- ST elevation Mi	00	0.0
Abnormal repolarization (inverted T wave)	01	0.6

Table 4 show the mean value of laboratory parameters such as LFT, serum electrolyte, KFT, cardiac enzymes, ABG and mean RBC.

**Table 4: Distribution of study subjects according to laboratory parameters**

Laboratory Parameters	Mean ± SD	
LFT	AST (U/L)	165.5±45.7
	ALT (U/L)	104±32
	Total Bilirubin (mg/dL)	2.1±1.43
Sr. electrolytes	Serum sodium (mEq/L)	144.5±1.64
	Serum potassium (mEq/L)	3.95±0.16
KFT	Sr. creatinine (mg/dL)	1.3±0.41
	Urea (mg/dL)	44±9.96
Cardiac enzymes	CPK	358±84.5
	CPK-MB	23±15.64
	Troponin	1.5±0.23
ABG	pH	7.34±0.61
	HCO3 (mmol/L)	16.09±1.94
	pCO2 (mmHg)	50.40±8.42
	pO2(mmHg)	78.60±12.47
RBS (gm/dl)	Mean	107±39.11

Most common complication among patients being arrhythmia (43%) followed by shock (15.2%) with least common being myocardial infarction (1.30%) as depicted in figure 2. However, out of the 151 study subjects, 124 (82.1%) recovered without complications, 13(8.6%) recovered with complications while 14 (9.8%) died. Out of 14 deaths, 7 (50%) died due to atrial tachycardia, followed by 4 (28.6%) due to myocarditis, 3 (21.4%) due to myocardial infarction and 2 (14.3%) due to MODS. (multiorgan dysfunction syndrome).



**Figure 2: Distribution of study subjects according to complications**

The maximum patients (72 cases) consumed zinc phosphide in the form of powder followed by liquid (49). The association between death and form of zinc phosphide was found to be statistically significant. (P=0.0264), (Table 5).

**Table 5: Distribution of study subjects according to form of zinc phosphide compound and association with deaths**

Form of zinc phosphide compound	Deaths	Recovered	Total	P value
Liquid	10	41	51	0.0264
Cake	02	26	28	
Powder	02	70	72	
Total	14	137	151	

**DISCUSSION**

Pesticides like rodenticides are a heterogeneous group of compounds usually intended for killing rats and mice. These compounds, however, show sharply distinctive toxicities among humans and rodents [10]. Zinc phosphide poisoning is recognized as a significant cause of morbidity and mortality among both socioeconomically low but economically active age demographics, especially in developing countries [11]. In the present study occurrence of zinc phosphide compound poisoning was more common among males. The association between gender and outcome as death or recovered was found to be insignificant, (P=0.786). Most common age group involved for zinc phosphide poisoning was 21-30 years (49.7%) followed by 31 to 40 years (31.8%). Most of the patients were married. Maximum patients consumed zinc phosphide compound with suicidal intent. All these findings are comparable with the previous studies [10, 12-14].

Time interval between poison consumption and presentation to the hospital is important factor in outcome of patient. Most of the patients presented in 2- 6 hours after consumption. Occurrence of death in patient presented > 24 hours was found to be statistically significant. Most of the patients who presented within 24 hours recovered completely. Similar results are reported in study done by Balasubramanian K et al [10], Shashidhara KC et al [13], and Aya S et al [15].

Among patients nausea and vomiting (84.7%) was most common presenting symptom and icterus (23.2%) was most common sign. 12 (7.9%) patients had bleeding manifestations in the form of Rash, Patechie, Malena, Gum bleeding, Hematemesis, among them rash was most common bleeding manifestation. These findings are in accordance with the earlier studies [10, 12-15]. Most of the patients were normotensive but occurrence of death among hypotensive patient was statistically significant which is comparable with the study conducted by Aya S et al [15].

Most common ECG abnormality in patients being sinus tachycardia (21.9%) followed by sinus bradycardia (7.3%). In Lokesh NK et al [14] study most common ECG changes was sinus tachycardia (38%), followed by ST-T changes (14%). In Aya S et al [15] study eight patients out of the 18 patients had dysrhythmias, in the form of wide complex ventricular tachycardia, atrial fibrillation, diffuse ST segment elevation or abnormal repolarization in the form of (inverted T wave) as presented on ECG. Trakulsrichai S et al [16] reported ECG abnormalities were sinus tachycardia (18.1%), atrial fibrillation (4.8%), sinus bradycardia (1.2%), and right bundle branch block (1.2%).

In the present study, the mean AST value was 165.5±45.7 U/L, ALT value was 104±32 U/L, Total bilirubin was 2.1±1.4 mg/dl. It was found that the mean serum sodium was 144.5±1.64 mEq/L and serum potassium was 3.95±0.16 mEq/L. The mean value for serum creatinine was 1.3±0.41 mg/dL and urea was 44±9.96 mg/dL. The mean cardiac enzyme values were CPK- 358±84.5, CPK-MB- 23±15.6 and Troponin I 1.5±0.23. Among the study subjects, the ABG values were pH- 7.3±0.61, HCO<sub>3</sub> (mmol/L) - 16.0±1.9, pCO<sub>2</sub> (mmHg) was 50.40±8.42 and pO<sub>2</sub> was 78.60±12.47. The mean random blood sugar was 107±39.1 gm/dl. These findings are correlated with the study done by Shashidhara KC et al [13], Lokesh NK et al [14] and Aya S et al [15].

Most common complication among patients being Arrhythmia (43%) followed by shock (15.2%) with least common being myocardial infarction (1.3%). Patients who presented with myocardial infarction as complication were <30 years old. These findings are correlated with the other studies [14, 17 and 18]. However, in the current study, most of the patients recovered without complications (82.1%), 13 (8.6%) recovered with complications while 14 (9.8%) died. Among the patients who died Atrial tachycardia (50%) followed by Myocarditis (28.6%) were principal causes of death.

These findings are comparable with the previous studies [10, 12 and 14]. Trakulsrichai S et al study [16] found that most of the patients who died (75%) developed systemic symptoms such as cardiovascular or respiratory symptoms within 24 hours after ingestion. Cardiac manifestations in the form of hypotension and arrhythmias were predominant and indicated poor prognosis in the study done by Ahuja H et al [19]. Hosseinian A et al [20] found that hepatotoxicity and severe metabolic acidosis were the predominant causes of death in the study subjects.

Most common form of zinc phosphide compound consumed being powder which is comparable with the study carried out by Aya S et al [15]. Among patients those who consumed liquid form of zinc phosphide compound died and found to be statistically significant. The association between death and form of zinc phosphide was found to be statistically significant. (P=0.0264).

There are some limitations of the study which includes- 1. Long term effects of these poison could not be assessed; 2. Type of study we used was cross-sectional study. Hence, it may not reflect the diversity of the community. Other elements in the same cluster may share similar characteristics. All the limitations of cross sectional study are applicable.

## CONCLUSION

In the present study, nausea and vomiting was most common presenting symptom and icterus was most common sign. Symptomatic management of rodenticide poisoning at the earliest possible time is the mainstay, as there are no specific antidotes for any of the compounds. Patients with zinc phosphide poisoning should be observed in the hospital for 2 days and followed up for cardiovascular symptoms/problems because these are the main causes of death in present study.

## Recommendations

Our recommendations focus on the importance of providing awareness to medical and paramedical staff of the manifestations of zinc phosphide poisoning, to improve case management and to raise public awareness so as to limit the unregulated sale of this toxic compound and more policies are needed to restrict the availability and sale of zinc phosphide to limit the magnitude of the problem. Collaboration between different poison control centres for data-gathering about cases of zinc phosphide and other pesticide poisonings will help to create a solid database and a full picture of the actual condition in our country and will subsequently assist us to assess the magnitude of the problem and to perform the required actions. Early sensitive markers of cardiac affection and echocardiography performance are required to detect zinc phosphide cardiotoxicity. Another important issue is psychosocial counselling, which is an important aspect of the overall management of the problem of attempted suicide.

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