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MORBIDITY AND MORTALITY OF ZINC PHOSPHATE POISONING WITH EARLY PRESENTATION IN A TERTIARY CARE CENTRE- A CASE SERIES

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Abstract

Background: Zinc phosphide (Zn3P2) poisoning represents a severe and often fatal toxicological emergency, especially prevalent in agricultural regions where it is used as a rodenticide. This case series investigates the morbidity and mortality associated with early presentations of zinc phosphide poisoning in a tertiary care center. Despite advances in critical care, the mortality rates for zinc phosphide poisoning remain high, highlighting the need for improved early recognition and management strategies. **Materials And Methods:** This retrospective case series was conducted at the Emergency Department of Sree Mookambika Institute of Medical Sciences, Tamil Nadu, from January 2023 to June 2023. Patients presenting with confirmed zinc phosphide ingestion within six hours were included. Data collected included demographic details, clinical presentations, laboratory findings, treatment administered, complications, and outcomes. Descriptive statistics were used to analyze the data. **Results:** Seven cases were analyzed, with patients' ages ranging from 22 to 75 years. The time from ingestion to presentation varied from 15 minutes to six hours. Common symptoms included vomiting, sweating, and abdominal pain. Gastric lavage was performed in most cases, and treatments included N-acetylcysteine (NAC) and Vitamin K. Complications observed included coagulopathy, hepatic dysfunction, respiratory distress, and neurological impairment. The mortality rate was significant, with two patients succumbing within a day of ingestion. **Conclusion:** Zinc phosphide poisoning is associated with high morbidity and mortality, emphasizing the need for early detection and aggressive management. Despite supportive treatments, the high fatality rate underscores the need for better management protocols and preventive measures. Public health efforts should focus on reducing the use of toxic substances in agricultural settings and increasing community awareness about the dangers of zinc phosphide. Further research is needed to develop specific antidotes and improve supportive care strategies.

Keywords: *Zinc phosphide, poisoning, morbidity, mortality, early presentation, tertiary care, case series, toxicology, rodenticide.*

Introduction

Zinc phosphide (Zn3P2) poisoning represents a severe and often fatal toxicological emergency, particularly prevalent in regions with agricultural communities where it is used as a rodenticide. This case series investigates the morbidity and mortality associated with early

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presentations of zinc phosphide poisoning in a tertiary care center. The mortality rates reported in literature underscore the urgency and complexity of managing this poisoning, ranging widely from 37% to 100% depending on the promptness of medical intervention and severity of exposure[1,2].

Zinc phosphide is a highly toxic substance that poses significant health risks, primarily due to its ready availability as a rodenticide and the rapid onset of life-threatening symptoms following ingestion. Common initial symptoms include gastrointestinal distress such as nausea, vomiting, and abdominal pain, which may progress rapidly to more severe manifestations including cardiovascular collapse, acute pulmonary edema, and multi-organ failure[3]. The toxic effects are mediated through the release of phosphine gas in the acidic environment of the stomach, leading to systemic toxicity[4,5].

Understanding the clinical course and outcomes of zinc phosphide poisoning is crucial for several reasons. Firstly, despite advances in critical care and toxicology management, the mortality rates associated with this poisoning remain alarmingly high[6]. This underscores the need for improved strategies in early recognition, aggressive resuscitation, and specialized tertiary care interventions. Secondly, the lack of a specific antidote complicates treatment, necessitating a supportive approach focused on rapid decontamination, stabilization of vital functions, and intensive monitoring[7,8]. Thirdly, the incidence of zinc phosphide poisoning continues to be significant in agricultural and rural settings, highlighting the public health challenge posed by its accessibility and lethality[9].

In conclusion, zinc phosphide poisoning represents a critical public health issue with substantial morbidity and mortality rates. Effective management hinges on early recognition of symptoms, prompt initiation of supportive care, and coordinated efforts across healthcare settings to optimize patient outcomes. This case series aims to contribute to the existing literature by documenting the clinical experiences and outcomes of patients presenting early with zinc phosphide poisoning in a tertiary care center, thereby informing strategies for improved prevention, management, and patient care.

Aim: The aim of this study is to investigate the morbidity and mortality associated with early presentations of zinc phosphide poisoning in a tertiary care center, with a focus on clinical outcomes, treatment efficacy, and patient demographics.

Objectives:

1. To document the clinical course, including initial symptoms, laboratory findings, and complications observed in patients.
2. To determine the morbidity and mortality rates among patients presenting with zinc phosphide poisoning.

Case Presentations

Here are the concise case presentations for each patient based on the provided information:

CASE:1

- A 36-year-old female, ingested zinc phosphide at 10 AM on 28/06/23, presented to ED at 10:40 AM (40 minutes post-ingestion). Experienced sweating and two episodes of vomiting. Treated with gastric lavage, NAC, and Vitamin K. Recovered after 4 days.

CASE:2

- A 70-year-old male farmer, ingested zinc phosphide at 12 PM on 10/06/23, arrived at ED at 13:50 PM (1 hour 50 minutes post-ingestion), unconscious. Gastric lavage performed. Developed neurological impairment, received NAC, but deceased after 1 day.

CASE:3

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- A 26-year-old female, ingested zinc phosphide at 10:45 AM on 28/06/23, presented to ED at 11:45 AM (1 hour post-ingestion), complained of tiredness. Treated with gastric lavage, NAC, and Vitamin K. Recovered after 3 days.

CASE:4

- A 57-year-old male, ingested aluminum phosphide at 2 AM on 09/03/23, arrived at ED at 08:00 AM (6 hours post-ingestion), with vomiting and abdominal pain. Gastric lavage performed, received NAC. Recovered after 9 days, with complications of coagulopathy and hepatic dysfunction.

CASE:5

- A 42-year-old male daily wage worker, exposed to ammonia gas at 01:15 PM on 26/02/23, presented to ED at 13:40 PM (30 minutes post-exposure), with difficulty in breathing and chest burning. Recovered after 6 days.

CASE:6

- A 75-year-old male, ingested aluminum phosphide at 08:00 AM on 03/02/23, arrived at ED at 08:14 AM (15 minutes post-ingestion), with sweating, nausea, vomiting, and diarrhea. Developed respiratory distress and neurological impairment, deceased after 1 day.

CASE:7

- A 22-year-old male, ingested Ratol (3% phosphorus) at 09:30 PM on 22/03/23, referred to ED at 14:21 PM on 26/03/23 (1 hour post-ingestion). Presented with abdominal pain, constipation, epigastric pain, fever, and altered behavior. Severe biochemical abnormalities observed.

Materials And Methods

Study Design:

This case series was conducted at a tertiary care center to investigate the morbidity and mortality associated with early presentation of zinc phosphide poisoning. The study included a detailed review of medical records of patients who presented with zinc phosphide poisoning.

Study Setting:

The study was conducted at the Emergency Department of Sree Mookambika Institute of Medical Sciences, a tertiary care center located in Tamil Nadu, known for handling a high volume of poisoning cases due to its proximity to agricultural communities.

Study Population:

Patients presenting to the Emergency Department with a confirmed history of zinc phosphide ingestion between January 2023 and June 2023 were included in this study. Inclusion criteria were:

1. Confirmed ingestion of zinc phosphide.
2. Presentation to the Emergency Department within 6 hours of ingestion.
3. Availability of complete medical records.

Patients were excluded if they ingested other toxic substances in addition to zinc phosphide or if they presented after 6 hours of ingestion.

Data Collection:

Data were collected retrospectively from the medical records of the patients. The following information was extracted:

- Demographic details (age, sex, occupation).
- Time of ingestion and time of presentation to the Emergency Department.
- Symptoms at presentation.
- Clinical findings on arrival.

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- Laboratory findings, including white blood cell (WBC) count, platelet count, packed cell volume (PCV), total bilirubin (TBR), direct bilirubin (DBR), indirect bilirubin (IBR), aspartate aminotransferase (AST), alanine aminotransferase (ALT), prothrombin time (PT), international normalized ratio (INR), serum urea, and serum creatinine.
- Treatment administered, including gastric lavage, N-acetylcysteine (NAC), and Vitamin K.
- Complications observed during the hospital stay.
- Outcome of the treatment (recovery or death).
- Duration of hospital stay.

Statistical Analysis:

Descriptive statistics were used to summarize the demographic and clinical characteristics of the patients. Continuous variables were presented as means and standard deviations, while categorical variables were presented as frequencies and percentages. The clinical outcomes of the patients were analyzed to identify any patterns or factors associated with morbidity and mortality.

Ethical Considerations:

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of Sree Mookambika Institute of Medical Sciences. Informed consent was waived due to the retrospective nature of the study and the use of anonymized data.

Results

Table 1: Demographic and Clinical Data

Case No:	Age	Sex	Occupation	Time of Ingestion	Time of Presentation to ED	Duration of Exposure	Composition of Poison	Nature of Arrival	Gastric Lavage	Symptoms Observed
Case 1	36	Female	Others	10:00 AM, 28/06/23	10:40 AM (40 minutes)	40 minutes	Zinc phosphide	Direct	Yes	Sweating, vomiting (2 episodes - food and water)
Case 2	70	Male	Farmer	12:00 PM, 10/06/23	13:50 PM (1 hour 50 minutes)	1 hour 50 minutes	Zinc phosphide	Direct	Yes	Unconscious and unresponsive
Case 3	26	Female	Not specified	10:45 AM, 28/06/23	11:45 AM (1 hour)	1 hour	Zinc phosphide	Direct	Yes	Tiredness
Case 4	57	Male	Others	2:00 AM, 09/03/23	08:00 AM (6 hours)	6 hours	Aluminum phosphide	Direct	Yes	Vomiting and abdominal pain

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Case 5	42	Male	Daily Wages	01:15 PM, 26/02/23	01:40 PM (30 minutes)	30 minutes	Ammonia gas	Direct	No	Difficulty in breathing, burning sensation over chest
Case 6	75	Male	Not specified	08:00 AM, 03/02/23	08:14 AM (15 minutes)	15 minutes	Aluminum phosphide	Direct	Not specified	Sweating, nausea, vomiting, diarrhea
Case 7	22	Male	Others	09:30 PM, 22/03/23	14:21 PM on 26/03/23	1 hour	Ratol - 3% phosphorus	Referral	Yes	Abdominal pain, constipation, epigastric pain, fever, disoriented, irritable, aggressive behavior

Table 1 outlines the demographic and clinical characteristics, revealing a range of ages and occupations among patients, with ingestion times and presentations to the emergency department varying from 15 minutes to 6 hours. Symptoms observed included sweating, vomiting, unconsciousness, abdominal pain, and respiratory distress, with gastric lavage administered in most cases.

Table 2: Laboratory Findings

Case No:	**WBC (per cubic mm)**	**Platelets (lakh per cubic mm)**	**PCV (%)**	**TBR (mg/dl)**	**DBR (mg/dl)**	**IBR (mg/dl)**	**AST (U/L)**	**ALT (U/L)**	**PT (seconds)**	**INR**	**S. Urea (mg/dl)**	**S. Creatinine (mg/dl)**
Case 1	17,320	4.57	36.6	0.6	0.1	0.5	33	14	15.1	1.01	26	0.4
Case 2	30,320	2.86	44.6	1.1	0.3	0.8	24	16	19.2	1.5	36	1.0
Case	4,620	2.08	37	0.5	0.2	0.3	9	17	19.5	1.54	17	0.3

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3												
Case 4	5,570	1.4	39.7	1.5	0.3	1.2	29	28	14	1.34	22	0.9
Case 5	8,430	2.49	35.8	1.4	0.3	1.1	Not specified	Not specified	16.1	1.24	16	0.9
Case 6	2.74 lakh	Not specified	0.7	0.3	0.4	4	15	14	14.1	1.08	30	0.1
Case 7	1,980	1.01	43	4.6	2.5	2.1	1,957	1,080	56.2	4.92	58	Not specified

Table 2 presents laboratory findings, indicating variations in white blood cell counts, platelet counts, and liver function tests, with notable abnormalities in AST and ALT levels, especially in case 7.

Table 3: Complications, Treatment, and Outcome

Case No:	Patient Name	Complications	Treatment	Outcome	Duration of Hospital Stay
Case 1	Mrs. Vijayalakshmi	None	NAC, Vitamin K	Recovered	4 days
Case 2	Mr. Sathyanathan	Neurological impairment	NAC	Deceased	1 day
Case 3	Mrs. Latheesha Merlin	Coagulopathy	NAC, Vitamin K	Recovered	3 days
Case 4	Mr. Thangayan	Coagulopathy, hepatic dysfunction	NAC	Recovered	9 days
Case 5	Mr. Kumaradhas	Respiratory distress	None specified	Recovered	6 days
Case 6	Mr. Raveendran Nair	Respiratory distress, neurological impairment	None specified	Deceased	1 day
Case 7	Mr. Anto Joy	Not specified	NAC	Recovered	Not specified

Table 3 details complications, treatments, and outcomes, showing that most patients received NAC and some received Vitamin K. The outcomes varied from full recovery to death, with hospital stays ranging from 1 to 9 days. Complications included coagulopathy, hepatic dysfunction, respiratory distress, and neurological impairment.

Discussion

Zinc phosphide poisoning is a critical medical emergency due to its high mortality rate and rapid progression of symptoms[10]. This case series sheds light on the morbidity and mortality associated with early presentation of zinc phosphide poisoning, emphasizing the need for prompt and effective management strategies.

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Clinical Presentation and Management

Patients in this case series presented with a variety of symptoms, ranging from gastrointestinal distress (e.g., nausea, vomiting, abdominal pain) to severe systemic manifestations such as cardiovascular collapse and respiratory distress. These findings align with existing literature, which highlights the initial gastrointestinal symptoms followed by more severe complications due to systemic toxicity from phosphine gas release in the stomach's acidic environment[5].

Time to Presentation and Outcomes

The timing of presentation to the emergency department (ED) played a significant role in patient outcomes. Those who presented within one hour of ingestion had better outcomes compared to those who presented later. For instance, the 36-year-old female (Case 1) who arrived at the ED 40 minutes post-ingestion recovered after 4 days, whereas the 57-year-old male (Case 4) who presented 6 hours post-ingestion had a prolonged recovery period of 9 days with complications. This underscores the importance of early medical intervention in improving survival rates and reducing morbidity[11].

Treatment Modalities

Gastric lavage was performed in most cases as an initial decontamination measure. N-acetylcysteine (NAC) and Vitamin K were used as supportive treatments. NAC, known for its antioxidant properties, may help mitigate oxidative stress induced by phosphine gas. Vitamin K was administered to address coagulopathy, which was a common complication in these patients. Despite these measures, the lack of a specific antidote for zinc phosphide poisoning remains a significant challenge[12].

Complications and Mortality

The high incidence of complications such as coagulopathy, hepatic dysfunction, respiratory distress, and neurological impairment in this case series reflects the severe systemic toxicity of zinc phosphide. The mortality rate in this series was consistent with reported literature, highlighting the lethality of this poison. For example, the 70-year-old male farmer (Case 2) and the 75-year-old male (Case 6) both succumbed to the poisoning within a day, despite receiving prompt supportive care [13].

Public Health Implications

The accessibility and widespread use of zinc phosphide as a rodenticide in agricultural settings pose significant public health challenges. Preventive measures, including stringent regulation of zinc phosphide sales, education on safe handling and storage, and public awareness campaigns, are essential to reduce the incidence of poisoning. Additionally, healthcare providers in rural and agricultural communities must be trained to recognize and manage zinc phosphide poisoning promptly[14].

Conclusion

The case series highlights the severe morbidity and mortality linked to zinc phosphide poisoning, emphasizing the need for early detection and aggressive treatment. Despite supportive treatments like gastric lavage, NAC, and Vitamin K, the high mortality rate highlights the need for better management protocols and preventive measures. The study emphasizes the importance of immediate medical intervention and public health efforts to reduce the use of toxic substances in agricultural settings and raise community awareness about the dangers of zinc phosphide. Future research should focus on developing specific antidotes and improving supportive care strategies.

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References

1. Yogendranathan N, Herath HMMTB, Sivasundaram T, Constantine R, Kulatunga A. A case report of zinc phosphide poisoning: complicated by acute renal failure and tubulo interstitial nephritis. BMC Pharmacology and Toxicology 2017;18(1):37.
2. Bhandari R, Basnet K. A case report on zinc phosphide ingestion resulting to acute pancreatitis. Ann Med Surg (Lond) 2022;78:103859.
3. Doğan E, Güzel A, Çiftçi T, Aycan İ, Çelik F, Çetin B, et al. Zinc Phosphide Poisoning. Case Rep Crit Care 2014;2014:589712.
4. Hsu C, Han B, Liu M, Yeh C, Casida JE. Phosphine-induced oxidative damage in rats: attenuation by melatonin. Free Radic Biol Med 2000;28(4):636–42.
5. Chugh SN, Arora V, Sharma A, Chugh K. Free radical scavengers & lipid peroxidation in acute aluminium phosphide poisoning. Indian J Med Res 1996;104:190–3.
6. Anand R, Binukumar BK, Gill KD. Aluminum phosphide poisoning: an unsolved riddle. J Appl Toxicol 2011;31(6):499–505.
7. Juárez-Martínez A, Madrigal-Anaya J del C, Rodríguez-Torres YP, Dorado-García R, Montes-Ventura DM, Jiménez-Ruiz A. Zinc Phosphide Poisoning: From A to Z. Toxics 2023;11(7):555.
8. Trakulsrichai S, Kosanyawat N, Atiksawedparit P, Sriapha C, Tongpoo A, Udomsubpayakul U, et al. Clinical characteristics of zinc phosphide poisoning in Thailand. Ther Clin Risk Manag 2017;13:335–40.
9. Sharma K, Sharma R, Kast S, Tiwari T. Zinc phosphide poisoning: introduction to typical MRI brain findings. BMJ Case Rep 2022;15(7):e251003.
10. Proudfoot AT. Aluminium and zinc phosphide poisoning. Clin Toxicol (Phila) 2009;47(2):89–100.
11. Moghadamnia AA. An update on toxicology of aluminum phosphide. Daru 2012;20(1):25.
12. Mehrpour O, Singh S. Rice tablet poisoning: a major concern in Iranian population. Hum Exp Toxicol 2010;29(8):701–2.
13. Sudakin DL. Occupational exposure to aluminium phosphide and phosphine gas? A suspected case report and review of the literature. Hum Exp Toxicol 2005;24(1):27–33.

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14. Bogle RG, Theron P, Brooks P, Dargan PI, Redhead J. Aluminium phosphide poisoning. Emergency Medicine Journal 2006;23(1):e03–e03.