

REVIEW ARTICLE ON ZINC PHOSPHIDE POISONING AND ITS MEDICOLEGAL ASPECTS

¹*Dr. Jagdish Kumar Anant and ²Dr. S. R. Inchulkar¹P.G. Scholar, ²Professor and HOD, P.G. Department of Agad Tantra Evum Vidhi Vaidyak, Govt. Ayurvedic College, Raipur, Chhattisgarh, India.

*Corresponding Author: Dr. Jagdish Kumar Anant

P.G. Scholar, P.G. Department of Agad Tantra Evum Vidhi Vaidyak, Govt. Ayurvedic College, Raipur, Chhattisgarh, India.

Article Received on 19/10/2018

Article Revised on 08/11/2018

Article Accepted on 29/11/2018

ABSTRACT

Zinc phosphide has been used widely as a rodenticide. Upon ingestion, it gets converted to phosphine gas in the body, which is subsequently absorbed into the bloodstream through the stomach and the intestines and gets captured by the liver and the lungs. Phosphine gas produces various metabolic and non-metabolic toxic effects. Clinical symptoms are circulatory collapse, hypotension, shock symptoms, myocarditis, pericarditis, acute pulmonary edema, and congestive heart failure. In this case presentation, we aim to present the intensive care process and treatment resistance of a patient who ingested zinc phosphide for suicide purposes.

KEYWORDS: Rodenticides, Zinc phosphide, Poisoning, Management, Medicolegal aspects, etc.**INTRODUCTION**

Zinc phosphide (Zn_3P_2) has been used in rodenticide biats. Commercial products are often available in dark grey crystalline compound or pellets marketed under various trade names (Agrophos, Commando, Sudarshan, Ratoff, Ratol, Robart, etc.). It has a repulsive odour of rotten fish. It is generally misused intentionally for suicidal purpose and accounts for the mortality. It is used as a rodenticide against such small mammals as mice, rats, field mice, and squirrels.^[1] It is possible to be exposed to zinc phosphide poisoning by accident or through suicide. Once ingested into the body it transforms into phosphine gas and then with the help of the stomach and intestines mixes into the blood and is caught up by the liver and lungs. There are no antidotes currently known. The mortality rate of zinc phosphide poisoning is around 37–100%.^[2] Organophosphate poisonings such as zinc phosphide poisoning are a significant cause of morbidity and mortality among socioeconomically low and economically active age demographics, especially in developing countries.

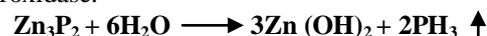
USES^[3,4]

- **Rodenticide:** Zinc phosphide used as rodenticide comes as a black powder containing 75% of zinc phosphide and 25% of antimony potassium tartrate.
- Grain preservation.

Mode of Action^[5,6]

- Is due to phosphine gas (PH_3) released on action with gastric HCl which causes multi-organ damage. It forms
 1. Hydroxyl radical with H_2O_2 .

2. Inhibition of cytochrome oxidase, catalase & peroxidase.

**Toxicokinetics^[7,8]**

1. **Absorption:** Zinc phosphide is absorbed mainly through the GIT.
2. **Distribution:** Zinc phosphide releases phosphine gas under acidic conditions in the stomach.
3. **Elimination:** Mainly excreted through the kidneys (urine), liver (bile) and colonic mucous membrane (feces).

Clinical Features^[9,10,11,12]

Zinc phosphide releases phosphine gas under acidic conditions in the stomach (similar to aluminum phosphide). Common presenting symptoms include:

- Metallic taste
- Vomiting
- Garlicky (or fishy) odour of breath
- Intense thirst
- Burning epigastric pain
- Diarrhea
- Dyspnea
- Lethargy
- Hypotension
- Cardiac arrhythmias
- Pulmonary edema
- Respiratory distress is invariably present with cyanosis
- Cold & clammy skin
- Metabolic acidosis
- Convulsions

- Circulatory collapse
- Coma and death may be occur.

Fatal Dose^[13,14]

- 5 gm.

Fatal Period^[15,16]

- 24 hours.

Diagnosis^[17,18,19]

- Garlicky odour in the breath.
- Liver function tests are often abnormal.
- ECG - sinus tachycardia, ST-T wave changes, bradycardia with heart block etc.
- Silver nitrate test: a piece of filter paper impregnated with 0.1 N silver nitrate solution is used in the form of a mask through which the patient is asked to breath in and out for 5-10 min. Blackening of the paper is indicative of the presence of phosphine in the breath.

Management^[20,21,22]

- **Gastric lavage:** gastric lavage is done with alkaline solution.
- **Demulcents** may be given.
- Management of circulatory shock with IV fluids (4-6 L over 6 hours).
- **Dopamine** can be given IV at a dose of 4-6 mcg/kg/min (maximum 10 mcg/kg/min).
- Management of respiratory distress with 100% humidified oxygen, intubation and assisted ventilation.
- Management of metabolic acidosis with **sodium bicarbonate** (50 mEq/15 min) until the arterial bicarbonate rises above 15 mmol/L.
- **Magnesium sulphate therapy:** Give IV as a 3 gm bolus, followed by 6 gm infusion over 24 hours for 5-7 days. Alternatively, 1 gm can be given IV to begin with, followed each hour by the same dose for 3 consecutive hours, and then 1 gm every 6 hours for 5 days.
- Magnesium sulphate is said to be beneficial in the management of cardiac arrhythmias.
- Conventional antiarrhythmic drugs such as digoxin and lidocain are ineffective.
- Purgatives are given for elimination.
- Symptomatic treatment.

Postmortem Findings^[23,24]

- Non-specific external signs may be seen. Garlicky odor from the mouth and on opening the stomach may be observed in case of zinc phosphide poisoning.
- Signs of irritation of the GIT with degenerative changes in the stomach wall and occasional perforation may be there.
- Contents of stomach are often haemorrhagic with mucosal shedding.
- Degenerative changes in the liver, kidneys and heart may occur.

- Heart shows features of toxic myocarditis with fibrillar necrosis.
- Lungs may demonstrate evidence of ARDS (adult respiratory distress syndrome) with or without pulmonary oedema.
- Visceral organs are congested.

Medicolegal Aspects^[25,26]

- Suicidal poisoning is seen with the phosphide.
- Accidental cases occur with chronic exposure in industries, acute poisoning may occur with consumption of food stored and cooked in zinc galvanized metal containers.
- Homicidal cases are rare.
- It may be used as an abortifacient.

CONCLUSION

Zinc phosphide is a substance that causes life-threatening complications. Unfortunately, there is neither an antidote, nor a specific treatment for it. Despite a quick and aggressive supportive therapy, heart or lung damage due to zinc phosphide poisoning is associated with a quite high mortality risk.

REFERENCES

1. V V Pillay, Textbook of Forensic Medicine & Toxicology 18th edition-, Paras Medical Publisher Hyderabad, 2017; 500095: 552.
2. O. Sogut, Z. Baysal, and B. Ozdemir, "Acute pulmonary edema and cardiac failure due to zinc phosphide ingestion," Journal of Emergency Medicine, 2011; 40(6): e117-e118.
3. S. K. Singhal, Singhal's Toxicology at a Glance 9th reprint edition, The National Book Depot Mumbai, 2017; 400012: 105.
4. Anil Aggrawal Forensic Medicine and Toxicology for MBBS 1st edition-2016, Avichal Publishing Company Sirmour, 2016; 173030: (HP), 506.
5. V V Pillay, Textbook of Forensic Medicine & Toxicology 18th edition-2017, Paras Medical Publisher Hyderabad, 2017; 500095: 550.
6. S. K. Singhal, Singhal's Toxicology at a Glance 9th reprint edition-2017, The National Book Depot Mumbai, 2017; 400012: 105.
7. Gautam Biswas, Review of Forensic Medicine and Toxicology 4th edition-2019, Jaypee Brothers Medical Publishers (P) Ltd New Delhi, 2019; 110002: 517.
8. Rajesh Bardale, Principles of Forensic Medicine & Toxicology 2nd edition-2017, Jaypee Brothers Medical Publishers (P) Ltd New Delhi, 2017; 110002: 520.
9. Anil Aggrawal Forensic Medicine and Toxicology for MBBS 1st edition-2016, Avichal Publishing Company Sirmour, 2016; 173030: (HP), 503-504.
10. Gautam Biswas, Review of Forensic Medicine and Toxicology 4th edition-2019, Jaypee Brothers Medical Publishers (P) Ltd New Delhi, 2019; 110002: 517.

11. S. K. Singhal, Singhal's Toxicology at a Glance 9th reprint edition, The National Book Depot Mumbai, 2017; 400012: 105.
12. Jaising P Modi, Modi A Textbook of Medical Jurisprudence and Toxicology 26th edition-2018, Lexis Nexis publication Gurgaon-12202; Haryana, section-2, 59.
13. Anil Aggrawal Forensic Medicine and Toxicology for MBBS 1st edition-2016, Avichal Publishing Company Sirmour-173030; (HP), 506.
14. Rajesh Bardale, Principles of Forensic Medicine & Toxicology 2nd edition-2017, Jaypee Brothers Medical Publishers (P) Ltd New Delhi-110002: 520.
15. S. K. Singhal, Singhal's Toxicology at a Glance 9th reprint edition-2017, The National Book Depot Mumbai-400012: 105.
16. Gautam Biswas, Review of Forensic Medicine and Toxicology 4th edition-2019, Jaypee Brothers Medical Publishers (P) Ltd New Delhi-110002: 517.
17. V V Pillay, Textbook of Forensic Medicine & Toxicology 18th edition-2017, Paras Medical Publisher Hyderabad-500095: 551.
18. S. K. Singhal, Singhal's Toxicology at a Glance 9th reprint edition-2017, The National Book Depot Mumbai-400012: 105.
19. K. S. Narayan Reddy, The Essentials of Forensic Medicine and Toxicology 34th ed-2017, Jaypee Brothers Medical Publishers (P) Ltd New Delhi-110002: 492.
20. Gautam Biswas, Review of Forensic Medicine and Toxicology 4th edition-2019, Jaypee Brothers Medical Publishers (P) Ltd New Delhi-110002: 517.
21. V V Pillay, Textbook of Forensic Medicine & Toxicology 18th edition-2017, Paras Medical Publisher Hyderabad-500095: 551.
22. Rajesh Bardale, Principles of Forensic Medicine & Toxicology 2nd edition-2017, Jaypee Brothers Medical Publishers (P) Ltd New Delhi-110002: 520.
23. Gautam Biswas, Review of Forensic Medicine and Toxicology 4th edition-2019, Jaypee Brothers Medical Publishers (P) Ltd New Delhi-110002: 517.
24. V V Pillay, Textbook of Forensic Medicine & Toxicology 18th edition, Paras Medical Publisher Hyderabad, 2017; 500095: 551.
25. Gautam Biswas, Review of Forensic Medicine and Toxicology 4th edition, Jaypee Brothers Medical Publishers (P) Ltd New Delhi, 2019; 110002: 517.
26. V V Pillay, Textbook of Forensic Medicine & Toxicology 18th edition, Paras Medical Publisher Hyderabad, 2017; 500095: 551.