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Case Report
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Aluminum Phosphide Poisoning and Blast in Gastric Tube a Rare Phenomenon - A Case Report

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Abstract

Aluminum Phosphide (ALP) is a highly toxic fumigant which is used commonly as an indoor pesticide in agriculture based industry for storage of grains. ALP on ingestion reacts with a gastric water and release phosphine gas, which is highly flammable, and very toxic in nature. Over the last few decades ALP has emerged as an agent of choice being used as suicidal poisoning in a country where it is readily available. The high mortality rate is due to severe mitochondrial dysfunction leading to disruption of cellular respiration, causing tissue hypoxia and organ dysfunction. Despite long research no specific antidote could be developed and the treatment remained supportive. Spontaneous ignition of phosphine (PH3) is a rare but very peculiar phenomenon reported in the case of aluminum phosphide poisoning. Here we share our experience in a case of phosphine (PH3) poisoning, which presented with spontaneous ignition and blast during treatment which caught the attention of local and national media in India.

Keywords: Aluminum phosphide; Pesticide; Spontaneous ignition; Phosphine; Antidote

Introduction

Suicide by poisoning is the second most common cause of death by suicide (27.9%) as per The National Crime Records Bureau (NCRB) India in 2015 [1]. Aluminum Phosphide (ALP) is the leading agricultural poison used to commit suicide as where its availability is not properly regulated [2]. Aluminum Phosphide (ALP) is a highly toxic solid fumigant pesticide, rodenticide and insecticide. It is commonly used as outdoor and indoor pesticide in developing countries like India, Pakistan, Srilanka and Iran because it is a cheap, effective, free from toxic residue and do not alter the viability of seeds [3-7]. In India it is marketed as a tablet in the name of Alphos, Celphos, Quickphos, Phosphotek, Phosphume etc., and available as dark brown or grayish green tablet of 3 g each and also available as pellets, granules and as powder, sealed in tens and twenties in airtight aluminum containers [8].

Each tablet is composed of pure ALP (active ingredient 56%) and ammonium carbamate/carbonate/urea (inert ingredient 44%) which release CO_2 and NH_3 gases which prevents the self-ignition of phosphine gas. On coming in contact with moisture each (3g) tablet of aluminum phosphide liberates 1g of phosphine gas, which is the toxic principle of ALP poisoning [7]. The fatal dose of ALP is around 0.5 g and acute poisoning with ALP occurs either due to intentional ingestion of an ALP tablet for committing suicide or accidental inhalation of PH_3 gas. Death has been reported when people were travelling in fumigated boxcars containing grains fumigated with aluminum phosphide [7].

Phosphine gas is highly flammable and very toxic in nature [9,10]. Phosphine on coming in contact with atmospheric air may ignite spontaneously and burn with white fumes causing health hazards such as burns in poisoned patient as well as in health care professionals [11,12]. The purpose of present this case study is to spread awareness among emergency physicians and staff regarding rare but dangerous complication of ALP intoxication which liberates phosphine.

Case Presentation

A 40 year old woman was brought by police to the emergency section of the J. N. Medical College Hospital Aligarh from a town about 20 Km away from the city Aligarh with alleged history of ingestion of some unknown poisonous substance. On arrival she was very drowsy and was not responding to verbal stimuli (EMV-8). Her extremities were cold and hypotonic, and her

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skin was pale. Patient's vitals were unstable with pulse rate 112/min irregularities, blood pressure 68/54 mm of Hg, respiratory rate 22/min shallow and body temperature 30.1°C and characteristic strong garlicky odor on her breath. The ECG showed sinus tachycardia, pulse oximetry showed an arterial O_2 saturation of 90% and ABG (Arterial Blood Gas) analysis indicate metabolic acidosis with blood pH of 7.1. The Patient was attended immediately and treatment started with high-flow oxygen through face mask and IV line was secured. In order to remove residual ALP tablets from the stomach, a Ryle's tube was inserted into the stomach and suction was applied using 50 ml disposable syringe. During the suction of gastric contents spontaneous ignition of gas with flames and white fumes with sound like a blast was observed by resident doctors and paraclinical staff. Gastric aspirate along with Ryle's tube immediately sent to the forensic department where the Silver Nitrate test was performed and it was found strongly positive for phosphine gas.

The patient was transferred immediately to an isolated room and an intravenous infusion of magnesium sulfate and calcium gluconate started. The patient's condition gradually deteriorated and apnea developed, which needed resuscitation and ventilator support. Despite all possible effort the patient developed cardiac arrest and could not survive for more than two hours.

Discussion

Aluminum phosphide readily reacts with water and hydrochloric acid in the stomach to produce phosphine (hydrogen phosphide, PH_3) and a small amount of diphosphine [13,14].

$AlP+3H_2O\text{-}Al(OH)_3+PH_3$

$AlP+3HCl\text{-}AlC1_3+PH_3$

Phosphine gas is absorbed rapidly through the gastric mucosa, enters the blood stream and reaches to the cell. At the cellular level, it leads to non-competitive inhibition of the cytochrome oxidize of mitochondria, blocking the electron transport chain and oxidative phosphorylation, producing an energy crisis in the cells that cause cell death [15].

Further inhibition of catalane and the induction of superoxide dismutase lead to free radical formation, lipid per oxidation and protein denaturation of cell membrane, finally causing hypoxic injury to the cells [14]. PH_3 further inhibits myocardial cellular metabolism and necrosis of the cardiac tissue, resulting in the release of reactive oxygen intermediates, which leads to refractory cardiac muscle depression and this cause's high mortality rate [16,17].

Sudden internal ignition and thermal injury following ALP poisoning are unusual complication that may complicate the patient's condition and may be hazardous to the medical personnel attending the patient [18-20].

The pure phosphine gas itself is odorless, but a commercially available preparation of ALP tablets has a noticeable odor similar to 'garlic' or 'rotten fish' because of the presence of trace impurities such as the diphosphine (P_2H_4) [11,13]. It is generally believed to be the presence of traces of diphosphine which increases the risk of spontaneous ignition of phosphine/air mixtures at room temperature.

Phosphine and diphosphine are highly flammable gas, which may ignite spontaneously when its concentration exceeds its lower explosive limit of 1.8% volume by volume (v/v) in air [20-25]. If an air/phosphine mixture, in which the phosphine concentration exceeds this level, is ignited in an enclosed space, then an explosion like situation develops. The self-ignition temperature of phosphine gas is reported by some sources to be as low as 38°C [11,20].

When phosphine burns, it produces a dense white cloud of 'phosphorus pentoxide', a severe respiratory tract irritant. ALP is incompatible with oxidizing agents, which means it induces adverse reactions [22]. Potassium permanganate is recommended in ALP poisoning to convert phosphine to phosphate [26], but it is an oxidizing agent and when in contact with organic matter, it is reduced to manganese dioxide and the very corrosive potassium hydroxide [20,26,27]. This reaction is also exothermic and may have contributed in increasing injury as well as the occurrence of ignition events. Even though it is suggested that negative pressure during gastric suctioning may contribute to the ignition [27,28].

Conclusion

The present case report stresses on the need that the emergency physicians need to be highly alert and adequately prepared while handling such patients. Spontaneous ignition with the release of phosphine from ALP poisoned patients can affect not just the patient, but also pose a health hazard to emergency physicians and medical staff.

Forensic pathologist should take into the consideration that the signs of burn in the face and neck of the deceased may not mislead at autopsy.

References

1. Accidental deaths and suicides in India 2015. A 2015 report by NCRB, Ministry of Home Affairs. The Government of India.
2. Aggarwal A. Essentials of Forensic Medicine and Toxicology. Avichal Publishing Company. 2017;1141-2.
3. Siwach SB, Yadav DR, Arora B, Dalal S, Jagdish. Acute aluminium phosphide poisoning: An epidemiological, clinical, and histopathological study. J Assoc Physicians India. 1988;36:594-6.
4. Koley TF. Aluminium phosphide poisoning. Indian J Clin Pract. 1988;9:14-22.
5. Gupta S, Ahlawat SK. Aluminium phosphide poisoning - A review. J Toxicol Clin Toxicol. 1995;33(1):19-24.
6. Mehrpour O, Singh S. Rice tablet poisoning: a major concern in Iranian population. Hum Exp Toxicol. 2010;29(8):701-2.
7. Bajpai SR. Aluminium Phosphide Poisoning: Management and Prevention. J Indian Acad Forensic Med. 32(4).
8. Chopra JS, Kalra OP, Malik VS, Sharma R, Chandna A. Aluminium phosphide poisoning: a prospective study of 16 cases in one year. Postgrad Med J. 1986;62(734):1113-5.
9. Meena MC, Mittal S, Rani Y. Fatal aluminium phosphide poisoning. Interdiscip Toxicol. 2015;8(2):65-7.
10. Bumbrah GS, Krishan K, Kanchan T, Sharma M, Sodhi GS. Phosphide poisoning: a review of literature. Forensic Sci Int. 2012;214(1-3):1-6.
11. Shadnia S, Rahimi M, Pajoumand A, Rasouli MH, Abdollahi M. Successful treatment of acute aluminium phosphide poisoning: possible benefit of coconut oil. Hum Exp Toxicol. 2005;24(4):215-8.
12. Member Alert: Phosphine Fumigant Explosions. 2009. Swedishclub.com [Internet].
13. Gurusinghe PG. Fumigants: phosphine and phosphine-generating compounds risk characterization document. Environmental fate. 2014.

14. Yatendra S, Subhash CJ, Vivekanand S, Abhisek G. Acute aluminium phosphide poisoning, what is new? Egypt J Intern Med. 2014;26(3): 99-103.

15. Bajwa SJ, Bajwa SK, Kaur J, Singh K, Panda A. Management of celphos poisoning with a novel intervention: A ray of hope in the darkest of clouds. Anesth Essays Res. 2010;4(1):20-4.

16. 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.

17. Bogle RG, Theron P, Brooks P, Dargan PI, Redhead J. Aluminium phosphide poisoning. Emerg Med J. 2006;23(1):e3.

18. Chugh SN, Dushyant, Ram S, Arora B, Malhotra KC. Incidence and outcome of aluminium phosphide poisoning in a hospital study. Indian J Med Res. 1991;94:232-5.

19. Nocera A, Levitin HW, Hilton JM. Dangerous bodies: A case of fatal aluminium phosphide poisoning. Med J Aust. 2000;173(3):133-5.

20. Kerby K, Hanfling D, Puccio E. Aluminum phosphide suicide: Emerging threat to healthcare workers. J Emerg Disaster Med. 2012;8:1-5.

21. Mirakbari SM. Hot charcoal vomitus in aluminum phosphidepoisoning - A case report of internal thermal reaction in aluminum phosphide poisoning and review of literature. Indian J Anaesth. 2015;59(7):433-6.

22. The Emergency Response Safety and Health Database. Centers for Disease Control and Prevention. 2019.

23. Material Safety Data Sheet. United Phosphorus, Inc. 2019.

24. Wahab A, Rabbani MU, Wahab S, Khan RA. Spontaneous selfignitionin a case of acute aluminium phosphide poisoning. Am J Emerg Med. 2009;27(6):752.

25. Yadav J, Athawal BK, Dubey BP, Yadav VK. Spontaneous ignition in case of celphos poisoning. Am J Forensic Med Pathol. 2007;28(4):353-5.

26. Shadnia S, Soltaninejad K. Spontaneous ignition due to intentional acute aluminum phosphide poisoning. J Emerg Med. 2011;40(2):179-81.

27. Dagli AJ, Golden D, Finkel M, Austin E. Pyloric stenosis following ingestion of potassium permanganate. Am J Dig Dis. 1973;18(12):1091-4.

28. Kochhar R, Das K, Mehta SK. Potassium permanganate induced oesophageal stricture. Hum Toxicol. 1986;5(6):393-4.