

# Fatal outcome due to aluminum phosphide poisoning in an old man with a psychiatric disorder as a latent post-COVID-19 challenge: A case report

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## Abstract

Aluminum phosphide is a metal phosphide widely implemented as a pesticide. In the country of Iran, it is recognized by the colloquial name of rice pill. Any trace of accidental or intentional ingestion of aluminum phosphide can result in severe hemodynamic disorders and metabolic acidosis, ultimately leading to the patient's mortality. In this report, we document the unfortunate demise of an 85-year-old man who lived in isolation, having lost his wife to COVID-19. The patient consumed aluminum phosphide tablets and, despite resuscitation efforts, inevitably succumbed to the toxic effects.

## Keywords

Aluminum phosphide, pesticide, poisoning, COVID-19

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## Introduction

Aluminum phosphide (ALP), known as rice pill in Iran, is a metal phosphide utilized as a highly effective pesticide. Alongside magnesium and calcium phosphides, it is currently widely used within the agricultural industry due to its affordability, lack of adverse effects on agricultural products, and remarkable efficiency. Significantly, ALP plays a major role in safeguarding products during transportation by ships and trains, as well as during storage within silos.<sup>1</sup> Despite the fact that pesticides have made a significant impact on human life by enhancing the quality and protection of agricultural products in the contemporary world, it cannot be overlooked that their accidental or intentional consumption has led to severe and fatal poisoning, resulting in the loss of numerous lives worldwide each year.<sup>2</sup> The likelihood of fatalities linked to phosphide poisoning ranges from 30% to 70%,<sup>1</sup> as per available data. In addition, the statistics furnished by Iranian forensic medicine illustrate that deaths attributed to ALP poisoning are significantly higher, particularly in the northern regions of the country.<sup>3</sup> Such a situation imposes a substantial societal, economic, and psychological challenge on the affected individuals and the family members of the deceased.

Suicide is a pressing public health issue that can manifest at any point throughout one's life, from childhood through old age; however, it is more prevalent in developed countries among the elderly.<sup>4</sup> Recently, with the emergence of the COVID-19 pandemic in late 2019,<sup>5</sup> which resulted in widespread social distancing and mandatory quarantine measures, there has been a noticeable decrease in human social interactions. As a result, and compounded by the loss of life due to the disease, family members have been increasingly

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subjected to severe grief, thereby exacerbating mood disorders and elevating the incidence of suicide, which are serious implications of depression.

The clinical presentation of ALP poisoning encompasses a spectrum of gastrointestinal symptoms, including but not limited to, nausea, vomiting, diarrhea, and epigastric pain. In addition, cardiovascular manifestations such as cardiac dysfunction, arrhythmia, severe hypotension, and shock have also been documented.<sup>6,7</sup> Herein, we present the case of an 85-year-old man who resided alone after his wife passed away as a result of contracting COVID-19. He unfortunately ingested an ALP tablet, and despite resuscitation efforts, he ultimately passed away.

## Case presentation

On April 13, 2022, an 85-year-old man was brought to our emergency room (ER) with his family complaining of symptoms such as weakness, fatigue, nausea, vomiting, abdominal pain, diarrhea, and drowsiness. The patient reported that he had consumed two ALP tablets (known locally as Ezee Deva) along with a glass of water approximately an hour prior to his arrival at the ER. Upon examination, the patient's vital signs were measured as follows: blood pressure at 90/55 mm Hg, heart rate at 61 beats/min, respiratory rate at 28/min, O<sub>2</sub> saturation at 98% on room air, and body temperature of 36.8°C. As for the patient's medical history, he had a previous diagnosis of hypertension and cervical discopathy, which was treated with medical support such as physiotherapy and rehabilitation. However, following the loss of his wife due to COVID-19, the patient has been experiencing feelings of emptiness, hopelessness, and low mood. He has been taking sertraline tablets at a dose of 50 mg once daily to manage these symptoms.

During the COVID-19 pandemic, as a consequence of adhering to social distancing mandates, he was unable to receive the necessary care for his treatment in a punctual manner. Furthermore, for an extended period, he found himself living in isolation due to the negligence of his progeny, which further agitated their already pre-existing depressive disposition culminating in suicidal ideations. In the ER, the results of all laboratory tests were normal. The results of the arterial blood gas indicated a pH level of 7.30 (7.35–7.45), PCO<sub>2</sub> at 24.4 mm Hg (35–45 mm Hg), and HCO<sub>3</sub> at 14.1 mEq/L (22–28 mEq/L). Following this, a nasogastric tube was inserted, potassium permanganate wash was performed, and three vials of sodium bicarbonate (HCO<sub>3</sub>-Na) were administered. An intravenous infusion with two vials of HCO<sub>3</sub>-Na, 1 g of calcium gluconate (10%), and 4 g of N-acetylcysteine (NAC) was promptly initiated. Despite receiving immediate medical attention through cardiopulmonary resuscitation, the patient's condition deteriorated as evidenced by a loss of color in the skin; cold, cyanotic limbs; and gasping breaths. Eventually, the patient was intubated, but unfortunately, after 30 min, the patient died.

This study was conducted according to the Declaration of Helsinki Principles. Also, Consensus-based Clinical Case Reporting (CARE) guidelines and methodology have been followed in this study.

## Discussion

According to evidence, the utilization of ALP as an insecticide to conserve agricultural products is among the most common causes of death in several countries, specifically Iran, Morocco, Sri Lanka, Oman, and India.<sup>8–10</sup> The main cause of death resulting from the utilization of ALP is related to the release of phosphine gas. This colorless gas, which possesses an odor similar to that of garlic or spoiled fish, can act as a protoplasmic toxin. The phosphine gas is typically produced once the ALP tablet is either dissolved in water or reacts with stomach acid after consumption.<sup>6,11</sup> Once released, phosphine interrupts various cellular respiration processes in the mitochondria, thereby diminishing adenosine triphosphate (ATP) production, causing hypoxia, and triggering peroxide radical release, which ultimately results in cell death.<sup>12</sup> The lethal dose of ALP generally ranges between 150 and 500 mg.<sup>13</sup>

Symptoms of ALP poisoning are nonspecific initially, and delayed symptoms comprise cardiac arrhythmia, bradycardia, hypocalcemic tetany, pulmonary edema, liver failure, methemoglobinemia, metabolic acidosis, and thrombocytopenia.<sup>14</sup> Myocardial damage is a commonly observed clinical manifestation in cases of ALP intoxication, affecting a range of 60%–100% of such cases. The damage can present as various cardiac conditions, such as new-onset heart failure, refractory hypotension, subendocardial infarction, myocarditis, pericarditis, and shock.<sup>15</sup>

As there is no specific antidote for ALP poisoning, administering early resuscitation and performing gastric lavage with either potassium permanganate or coconut oil during the first few hours of onset are essential aspects of supportive care. In addition, NAC has proven effective in decreasing the duration of hospital stays, reducing the need for intubation, and lowering the mortality rate. Magnesium sulfate acts as an inhibitor of free radicals by stabilizing cellular membranes.<sup>16</sup> It is noteworthy that the anti-ischemic medication trimetazidine, through various mechanisms, stops intracellular calcium and increases intracellular ATP, thus warding off myocardial cell damage.<sup>17</sup> Considering the available treatments, the mortality rate resulting from ALP poisoning continues to remain considerably high.<sup>1</sup> Although there are recorded incidents of patients being saved by these treatments, it is pertinent to note that in a majority of such cases, the exact methodology of application has not been specified, or the concerned patient had dissolved the ALP tablet in water before intake.

In their report, Sharma et al.<sup>18</sup> presented a case of ALP poisoning in a 67-year-old Asian woman who had a prolonged history of a major depressive disorder. Apart from the

depression medication—escitalopram 20 mg—she was taking twice daily, the patient had no significant medical, surgical, or familial medical background. Upon admission, she showcased symptoms such as nausea and vomiting, loose stools, general body weakness, altered sensorium, severe hypotension, and drowsiness. Given her existing issues with cardiovascular and respiratory dysfunction, and her ejection fraction standing at 20%, the patient required intubation. The physicians initiated extracorporeal membrane oxygenation (ECMO) for intensive care. After several days of treatment, the patient's hemodynamics gradually improved, and she was eventually discharged in stable condition.<sup>18</sup>

Siddaiah et al.<sup>19</sup> documented a case of ALP poisoning in a 22-year-old female patient who experienced symptoms of cardiogenic shock due to myocarditis after consuming a 500-mg ALP tablet. The patient had no significant medical history and was not on any medication at the time. Given adequate time, an intra-aortic balloon pump (IABP) was used to assist with her cardio-circulatory support. Following the restoration of hemodynamics and the resolution of ALP-related effects, the patient was discharged from the hospital in good condition.<sup>19</sup>

Regrettably, in the present case, owing to the swift progression of symptoms and the onset of cardiogenic shock, it was not possible to implement an IABP or ECMO support system without initiating medication treatments. Tragically, despite cardiopulmonary resuscitation, the patient passed away after 30 min.

Muhamad et al.<sup>20</sup> documented the unfortunate demise of a 26-year-old female patient who reportedly ingested two ALP tablets and subsequently displayed symptoms such as vomiting, diarrhea, and unstable hemodynamics. The authors highlighted that their patient's experience was similar to the present case—despite aggressive resuscitation efforts, the patient passed away 7 h after ingestion, with cardiac arrest stemming from refractory pulseless ventricular tachycardia.<sup>20</sup>

## Conclusion

During the COVID-19 pandemic when there was a crucial need to maintain social distancing, there has unfortunately been a notable uptick in both depression and suicidal ideation among individuals. For this reason, it is imperative that periodic evaluations and psychological assessments be given due consideration. Furthermore, when it comes to cases of ALP poisoning, optimal results may be obtained through timely arrival, prompt diagnosis, aggressive resuscitation, and intensive monitoring.

## Authors' contributions

Z.Z. and M.S. contributed in the interpretation and collecting of data and editing of the manuscript. M.S. and H.R. embroiled in writing, editing, and preparing the final version of the manuscript. M.S. is responsible for submitting the manuscript. All authors

reviewed the paper and approved the final version of the manuscript.

## Data availability statement

The data are available to the correspondent author and can be obtained upon request.

## Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

## Ethical approval

This research was approved by the Mazandaran University of Medical Science Ethics Committee (No: IR.MAZUMS.REC.1399.7850) and was carried out in accordance with the Helsinki Declaration Principles.

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## Informed consent

Written informed consent was obtained from the patient's legally authorized representative to publish this report in accordance with the journal's patient consent policy in the ADF (additional document or form and main document).

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