

# Rapid Death from Aluminum Phosphide Poisoning

Mustafa ALPASLAN<sup>1</sup>

<sup>1</sup>Nevsehir State Hospital, Department of Emergency Medicine, Nevsehir, Türkiye

## Abstract

Aluminum phosphide is a chemical used as an insecticide and pesticide to improve the storage conditions of agricultural products. Combined with the humidity in the air or after being taken orally as a tablet, it reacts with the acidic environment of the stomach and turns into phosphine gas and can cause poisoning. Suicidal use is also common. When poisoning develops, deep metabolic acidosis, hypotensive shock, acute respiratory failure, multi-organ failure, cardiac arrest and death may occur. Resistant hypotension and deep metabolic acidosis are the most important indicators of poor prognosis. In this case, an 18 year old male patient was brought to the emergency room after taking 3 tablets of aluminum phosphide. The patient was unconscious and had hypotensive shock. Despite gastric lavage, massive fluid replacement, positive inotropes, sodium bicarbonate, intravenous N acetyl cysteine loading, and hemodialysis, the patient died 6 hours after admission to the emergency department.

**Keywords:** aluminum phosphide, phosphine gas, pesticide poisoning

## Introduction

Phosphine gas is an extremely poisonous gas. It is mostly used to improve the storage conditions of agricultural products such as animal feed, leaf tobacco, and grain, and to repel or kill pests such as rodents and insects<sup>1</sup>. Aluminum phosphite is a chemical used as an insecticide and pesticide, and after being taken orally as a tablet, it reacts with the acidic environment of the stomach and turns into phosphine gas. When poisoning develops, deep metabolic acidosis, hypotensive shock, acute respiratory failure, multi organ failure, cardiac arrest and death may occur<sup>2</sup>. There is no specific antidote and most cases result in death<sup>3</sup>.

## Case Report

An 18 year old male patient was brought to the emergency department of our hospital by ambulance after taking medication for suicide. He was unconscious and his Glasgow Coma Score (GCS) was evaluated as 11. According to the anamnesis taken from the relatives it was learned that he took three aluminum phosphide tablets. The patient's pupillary

response was +/- isochoric, unconscious, respiration was mildly tachypneic and superficial. Blood pressure was 75/55 mmHg, pulse was 120, fingertip oxygen saturation was 94, fingertip blood glucose was 121, and body temperature was 36.2°C. Gastric lavage was performed, taking into account the recommendations of the National Poison Information Center. Activated charcoal was not given. Brain tomography imaging was performed on the patient and it was observed to be normal. When laboratory tests are evaluated; WBC: 14.3, AST: 13 U/L, ALT: 8 U/L, Creatinine: 1.5 mg/dl, INR: 1.22, Na:134 mmol/L, K: 3.3 mmol/L, pH : 7.19, HCO<sub>3</sub>: 12 mmol/L, lactate: 8.49 mmol/L. In accordance with the recommendations of the National Poison Counseling Center, the patient was loaded with 150 mg/kg N-Acetyl Cysteine treatment within 1 hour and admitted to the intensive care unit. Blood gas results after 2 hours; pH: 6.95, HCO<sub>3</sub>: 7.9 mmol/l and lactate: 11.83 mmol/l. While the creatinine value of the patient increased to 2.28 mg/dl, hypoglycemia developed in the patient. The patient did not have any urine output, and his blood pressure decreased to 50/20 mmHg. The patient was intubated, positive inotropic, sodium bicarbonate treatment was given. Hemodialysis was

**Corresponding Author:** Mustafa ALPASLAN **e-mail:** mustafalpaslan@gmail.com

**Received:** 11.01.2023 • **Accepted:** 30.01.2023

**Cite this article as:** Alpaslan M. Rapid Death from Aluminum Phosphide Poisoning. Eurasian J Tox. 2023;5(1): 11-13

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started in the patient who did not respond to the treatment. The patient developed cardiac arrest and resulted in death.

## Discussion

Although phosphine gas is extremely deadly, it causes poisoning when aluminum phosphite is taken orally, combined with hydrochloric acid in the stomach or moisture in the air, and enters the body through inhalation<sup>4</sup>. Biological warfare weapon is also used as a terrorist agent due to its poisoning by inhalation<sup>6-7</sup>. In mostly agricultural countries, organophosphate poisoning is the first and aluminum phosphite poisoning is the second<sup>9</sup>. Under normal conditions, the odor that emerges after the reaction of aluminum phosphide, an odorless colorless chemical, resembles the smell of rotten fish or garlic<sup>7</sup>.

Phosphine gas disrupts oxidative phosphorylation in all organs and tissues systemically by stopping the cytochrome c oxidase enzyme from working in the body. Free oxygen radicals are formed by inhibiting the peroxidase, superoxide dismutase and catalase enzymes. Thus, the membrane structure of the cells is disrupted and protein denaturation develops<sup>5</sup>. According to studies, the toxic dose range could not be clearly determined, and intakes of more than 0.15-0.50 grams were found to be fatal<sup>9</sup>. The first symptoms of patients with suspected poisoning may be respiratory distress, hypotension, nausea, vomiting, dizziness, drowsiness, fainting, seizures, and coma. In the future, deterioration in kidney and liver functions may be observed. If poisoning is suspected, early admission and prompt treatment can improve the prognosis. As for suicidal purchases, the risk of mortality increases due to the late application. Deep metabolic acidosis and resistant hypotension are the two main indicators of poor prognosis<sup>7</sup>. With the deterioration of cell membrane function seen in the mechanism of poisoning, too much fluid is lost to the extravascular space, which causes deep hypotension<sup>6-7</sup>.

In this case, there was suspicion of ingestion of approximately 3 tablets (9 grams). The patient had drowsiness and impaired consciousness at the first admission. The patient had sweating, tachypnea, and hypotension. While the creatinine value was 1.5 mg/dl at the time of application, it increased to 2.28 mg/dl at the second hour. There was no deterioration in liver function tests. According to the blood gas results analyzed at the time of the patient's arrival, there was profound metabolic acidosis. High dose, delayed admission, and clinical and laboratory findings included all poor prognostic factors. It ultimately resulted in death 6 hours after admission.

While intervening in all cases with aluminum phosphide poisoning or suspected aluminum phosphide poisoning, health personnel should take care of themselves in the first place and care should be taken to use protective equipment such as gloves, masks and glasses. All clothes of the patient

should be taken off and purification should be ensured by washing with plenty of water, including the eyes<sup>4</sup>. The first goal in treatment should be to replace the fluid that escapes into the extracellular space with intravenous hydration<sup>7</sup>. The use of positive inotropes will not be effective without fluid administration and should be given after massive fluid loading therapy. In addition to the fact that using inotropes in the early period does not provide much benefit, it has been observed that cardiac arrhythmia may develop by increasing oxygen consumption in myocardial cells<sup>9</sup>.

It is predicted that free oxygen radicals secondary to the enzyme inhibition mechanism created by aluminum phosphide poisoning in the body play a major role. Intravenous N-acetyl cysteine (NAC), calcium gluconate, magnesium sulfate, trimetazidine, and pralidoxime treatments are the most commonly used treatments<sup>2-5-8</sup>. Hemodialysis is not recommended as a routine treatment.

In the literature, resistant hypotension and metabolic acidosis have mostly been observed in aluminum phosphide poisonings that developed unintentionally or with the intention of committing suicide, resulting in death<sup>2-5-6-10</sup>. However, there have also been cases who were treated in the early period and discharged despite hypotensive shock<sup>1-2-3</sup>.

Aluminum phosphide poisoning has started to become one of the most common cases due to misuse, inhalation transmission and especially suicidal purchases. There have been cases with good prognosis with early diagnosis and treatment. Resistant hypotension and profound metabolic acidosis are the two worst prognostic markers. In these cases, patient detoxification and massive fluid replacement are extremely important. Especially those who are engaged in agriculture should be informed that this chemical is extremely deadly. The sale of aluminum phosphide tablets must be strictly controlled and restricted.

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