Hydroxyethyl Starch Could Save a Patient With Acute Aluminum Phosphide Poisoning

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Abstract- A 40-year-old male patient with suicidal ingestion of one tablet of aluminium phosphide was referred to the department of toxicology emergency of Baharloo Hospital, Tehran, Iran. The garlic odor was smelled from the patient and abdominal pain and continuous vomiting as well as agitation and heartburn were the first signs and symptoms. Systolic and diastolic blood pressures at the arrival time were 95 and 67 mmHg, respectively. Gastric lavage with potassium permanganate (1:10,000), and 2 vials of sodium bicarbonate through a nasogastric tube was started for the patient and the management was continued with free intravenous infusion of 1 liter of NaCl 0.9% serum plus $NaHCO_3$, hydrocortisone acetate (200 mg), calcium gluconate (1 g) and magnesium sulfate (1 g). Regarding the large intravenous fluid therapy and vasoconstrictor administering (norepinephrine started by 5 µg/min and continued till 15 µg/min), there were no signs of response and the systolic blood pressure was 49 mmHg. At this time, hydroxyethyl starch (HES) (6% hetastarch 600/0.75 in 0.9% sodium chloride) with a dose of 600 cc in 6 hours was started for the patient. At the end of therapy with HES, the patient was stable with systolic and diastolic blood pressure of 110 and 77 mmHg, respectively. He was discharged on the 6th day after the psychological consultation, with normal clinical and paraclinical examinations. This is the first report of using HES in the management of AlP poisoning and its benefit to survive the patient.

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Introduction

Aluminum phosphide (AlP) or "rice tablet" poisoning is one of the major public health problems in countries like India and Iran (1). This insecticide and rodenticide are easily available in these countries, and as well as its effectiveness in agriculture, it is very dangerous with a high mortality rate for a human. Unfortunately, the suicidal attempts with AlP are increasing, although its general usage is banned in countries like Iran. There is no effective antidote for AlP poisoning, and the management is almost supportive (2,3).

One of the most common signs of AlP toxicity is severe and profound hypotension and cardiac shock (2,4). The increased permeability of capillaries, inadequate systemic vasoconstriction and decreasing the left ventricular ejection fraction during AlP poisoning, are the leading etiologies for cardiovascular collapse. It is necessary to resuscitate the patients with large amounts of intravenous fluids and vasoactive agents as the first steps in the management of AlP poisoning.

Hydroxyethyl starch (HES) is the most frequently used colloid that is licensed for the treatment of hypotension. There are different types of HES regarding the concentration and molecular weight (5-7). The published data about the therapeutic effects and side effects of HES in the literature is contradictory. It is recommended not to use HES in septic shock. This is mainly because of the side effects of HES on kidney and coagulation system (5,8). As a volume expander, HES may be useful in the prevention of hypotension for example in spinal anesthesia for cesarean section (9). The remaining time of HES in the intravascular space makes it a preferable choice for management of hemodynamic instability comparing with crystalloids (10).

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Case Report

A 40-year-old male patient was referred to the department of toxicology emergency of Baharloo hospital, Tehran, Iran, due to suicidal ingestion of 1 tablet (5 grams) of aluminum phosphide about 2 hours before the arrival time. Abdominal pain and continuous vomiting were the first symptoms that occurred one hour after AlP ingestion. Agitation and heartburn were the main chief complaints at the admission time. He was conscious (Glasgow Coma Scale=15/15) at the first examination, and the systolic and diastolic blood pressure, pulse rate and respiratory rate were 95 and 67 mmHg, 80 and 14 per minutes, respectively. Garlic odor was smelled from the respiration of the patient. The pupils were mid-sized and reactive to light. Heart auscultation and respiratory examinations were normal. The patient was under treatment with buprenorphine (0.5 mg each 8 hours) for opium abstinence (he declared the history of addiction to heroin) till one year ago. Arterial *p*H, HCO_3^- and PCO_2 were 7.44, 14.8 mmol/L and 22 mmHg in the first arterial blood gas (ABG) sampling. The urine screen test was positive for benzodiazepine and amphetamine.

Management of the patients started with supportive cares including gastric lavage with potassium permanganate (1:10,000), and 2 vials of sodium bicarbonate through a nasogastric tube, and free intravenous infusion of 1 liter of NaCl 0.9% serum plus NaHCO3 (2 vials). Other therapeutic agents were including hydrocortisone acetate (200 mg), calcium gluconate (1 g) and magnesium sulfate (1 g) in the first step of treatment. Management continued with order of IV infusion of normal saline and norepinephrine (if systolic BP<100 mmHg), hydrocortisone acetate (100 mg/8 hrs), calcium gluconate (1 g/8 hrs), magnesium sulfate (1 g/6 hrs for 3 doses) and methadone (5 mg/12 hrs). Vitamin C and E were administrated for him at the dose of 500 mg and 100 mg, respectively for each 12 hours. N-acetylcysteine was tried for him by the same protocol for management of acetaminophen toxicity (11). During 7 hours after admission, 5 vials of NaHC3 were administered to the patient (2 vials in each liter of serum), but the arterial concentration of HCO_3^- decreased to 9.3 mmol/L. Endotracheal intubation was indicated for the patient due to respiratory failure and gasping, 11 hours after admission. At this time, the systolic and diastolic blood pressure were 49 and 31 mmHg, respectively, despite receiving norepinephrine (15 µg/min), and the *p*H, HCO_3^- and PCO_2 in the ABG were recorded as 7.18, 9 mmol/L and 23.7 mmHg, respectively. Regarding the large intravenous fluid therapy and vasoconstrictor administering, and no signs of response, we decided to start therapy with HES (6% hetastarch 600/0.75 in 0.9% sodium chloride) with a dose of 600 cc in 6 hours based on a hypothesis regarding its efficacy in acute aluminum phosphide poisoning (6).

The systolic and diastolic blood pressure were checked each 2 hours (84/57, 83/61 and 110/77 mmHg) and the last recorded *p*H, HCO_3^- and PCO_2 recorded in the ABG were 7.34, 18.8 mmol/L and 34.2 mmHg, respectively. At the end of therapy with HES, the patient was stable, and neither hypotension nor acidosis recorded for him. In the second day, the NaHCO3 reduced to one vial in each liter of serum. In the third day, he was extubated. In the 4th day, the liquid diet started for the patient and after tolerating it, the regular diet was ordered. He was discharged on the 6th day after the psychological consultation, with normal clinical and paraclinical examinations. The laboratory and electrocardiography findings did not show obvious abnormality during the hospitalization and at the discharge time (data not shown).

Discussion

We reported a case of AlP poisoning with the typical signs and symptoms of this toxicity including vomiting, acidosis, hypotension and respiratory failure. The management was started 2 hours after ingestion one tablet of AlP with a glass of water. Although the patient received gastric lavage with potassium permanganate (1:10,000), 2 vials of sodium bicarbonate, free intravenous infusion of 1 liter of NaCl 0.9% serum plus $NaHCO_3$, hydrocortisone acetate (200 mg), calcium gluconate (1 g) and magnesium sulfate (1 g), as acceptable protocol in the management of acute aluminum phosphide poisoning, but the general condition of the patient deteriorated mainly because of hypotension. In this condition, we tried HES for increasing the blood pressure. Six hours after starting HES, the hemodynamic status and consequently, the acidosis of the patient was controlled and finally the patient survived from AlP poisoning. This is the first report of using HES in the management of AlP poisoning and its benefit to survive the patient.

As a fact, the exact mechanism of AlP toxicity is not clear. Cellular toxicity by means of mitochondrial toxicity, inhibition of cytochrome C oxidase, the formation of free radicals, lipid peroxidation and subsequently cellular injury and even reduction of

cellular glutathione are the possible mechanisms (2).

For many years, gastric lavage with potassium permanganate (1:10,000) and activated charcoal, was performed in the emergency department by means of oxidation of phosphine gas (the toxic ingredient) and absorption of aluminum phosphide in the gastro-intestinal system respectively; however, recent studies refuse their efficacy (12,13). So many patients suffer from an acute toxicity and multi-organ failure especially the hemodynamic failure as the main side effect of AlP poisoning leads to death.

HES, as a synthetic colloid, is the most frequently colloid that is used in the intensive care units for resuscitation and hemodynamic stabilization. The time that HES may remain in the intravascular space is noticeable. Other purpose effects of HES include reducing the leakage of fluids and albumin from the injured endothelial and decreasing serum lactate level (14-16). Considering these data, it was previously hypothesized that HES, despite the contradictory information about its effectiveness and the side effects, might be a good candidate for hemodynamic support in AlP poisoning, whereas it seems that the hypotension and the increased leakage of the vascular endothelium during this toxicity, is one of the main leading factors to poor prognosis and low survival (6).

This article, for the first time, publishes a report of success using of HES in the management of acute AlP poisoning in the phase that the hypotension was the main feature of toxicity. Although there are reports of not using HES in critical conditions, but regarding the high mortality of AlP poisoning especially when the refractory hypotension does not respond to high fluid therapy and vasoconstrictors, it seems that HES can help to stabilize the hemodynamic to prepare more time for other supportive therapies to help the patient to tolerate this toxicity.

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