

## Suicide by Fire Extinguisher Powder Ingestion: A Case Report

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**Abstract-** A 51-year-old man committed suicide by swallowing the contents of a fire extinguisher. A few hours after his suicide attempt, he was referred to the medical center for poisoning. At the time of admission, the patient was conscious with stable vital signs. The patient complained of burning lips and mouth, mentioning diarrhea. Initial treatments included gastric lavage with activated charcoal, while paraclinical measures were requested. The patient had undergone hypernatremia (Na: 152 mEq/l) and metabolic alkalosis. Treatment focused on the adjustment of sodium level and alkalosis. On the first day of hospitalization, the patient experienced recurrent episodes of tonic-clonic seizure along with the loss of consciousness. On the third day of hospitalization, the patient developed respiratory arrest followed by cardiac arrest and death.

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### Introduction

Fire extinguisher powder is a mixture of certain chemicals applied to put out the fire. There is a wide variety of chemical extinguisher powder used on non-metal class A, B, and C fires, whereas the dry powder which is used to extinguish metal class D fire. These chemical powders are divided into two groups: 1) typical chemical powder based on sodium bicarbonate, potassium bicarbonate, potassium carbonate, urea bicarbonate and potassium chloride suitable for extinguishing Class B and C fire, 2) multipurpose chemical powder based on ammonium phosphate suitable for extinguishing Class B and C fire.

Naturally, swallowing these powders, whether intentionally or unintentionally, can cause electrolyte imbalance. This condition in most cases involves hypernatremia (1).

Hypernatremia is known as a common complication diagnosed in patients admitted to the hospital (2). Moreover, it refers to serum sodium over 145 mmol/L (3). Hypernatremia is regarded a biochemical disorder associated with high morbidity and mortality. The hospital mortality rate of hypernatremia has been reported to be somewhere between 30 to 82% (4).

If a large amount of sodium is eaten in a suicide attempt, the person will develop severe hypernatremia within a few minutes. The consequent vascular damage

caused by sudden brain shrinkage will be accompanied by intracranial hemorrhage. Similar to consequences of a suicide attempt, hypernatremia can within a few minutes cause extreme fever, seizures, hypertonia, intracranial hemorrhage and coma (5). Symptoms of hypernatremia arise from changes in cell volume such as water displacement from intracellular compartment into extracellular compartment, which is rather hypertonic leading to cellular shrinkage (5). Two tablespoons of salt (30 g) can quickly elevate serum sodium by 30 mEq depending on body weight (4). Previous studies found that rapid intake of large amounts of salt is associated with terrible prognosis. Hence, it is essential to immediately adjust sodium levels (4).

Generally, hypernatremia occurs in various forms due to the following causes: 1) hypovolemic hypernatremia (loss of fluids more than sodium intake such as diarrhea), 2) hypervolemic hypernatremia (sodium intake more than fluids such as receiving hypertonic serum), 3) hypernatremia, 4) euvolemic involvement of central nervous system (such as head trauma), and 5) nephrogenic involvement (6). Most cases of hypernatremia occur due to dehydration in the digestive tract (such as vomiting and diarrhea), skin (sweating) or urine (diabetes insipidus or osmotic diuresis due to glycosuria in diabetes mellitus (3).

Hypernatremia is associated with higher morbidity and mortality in the elderly. The results of a study

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conducted on 8441 elderly patients in the ICU showed that the mortality rate was 33.6% in those who were hospitalized with hypernatremia. In contrast, the mortality rate was 15% in people who had not been diagnosed with hypernatremia. Moreover, the mortality rate was 45-30% in people who had normal serum sodium at admission and experienced hypernatremia during hospitalization (7).

Treatment is difficult for the majority of patients with hypernatremia. Despite administration of appropriate fluids, hypernatremia is adjusted successfully only in 56% of patients (2). Furthermore, the side effects of treatment can be problematic, since an immediate treatment of hypernatremia can lead to central pontine myelinolysis (5).

Most commonly, hypernatremia can be found in the elderly patients due to dehydration or excessive intake of salty substances. In a previous study, one patient was diagnosed with severe depression. The patient had taken too much salt, leading to hypernatremia which can, in turn, cause neurological symptoms and eventually death (8).

The current case report focused on an individual who had swallowed fire extinguisher powder in a suicide attempt, undergoing acute hypernatremia.

## Case Report

The patient was a 51-year-old man who had committed suicide by ingesting the contents of a fire extinguisher and was then brought to the hospital. The patient vomited twice containing white powder dough. On arrival at the medical center, the readings were BP=130/80 mmHg, PR=118 beat/min, T=37 °C, RR=16/min, GCS=15/15. About three and half hours after his suicide attempt, the patient was referred to and hospitalized in the poisoning ward. During hospitalization, the patient was conscious with stable vital signs, even though there was some diarrhea. In observation of the patient's status, he was mentioned to be a war veteran. His acquaintances stated that he had been diagnosed with PTSD by a psychiatrist. Moreover, he had a history of previous suicide attempts.

Gastric lavage and activated charcoal were administered to the patient. He complained of burning lips and mouth. Examination of abdomen and lungs was normal. On the same day, the patient was kept NPO because of good general health conditions, followed by request for psychiatric consultation. Any necessary tests were also requested. On the first day of hospitalization (about 10 hours after his suicide attempt), the patient

experienced recurrent tonic-clonic seizures and loss of consciousness. The patient went through neurology consultation where a brain CT scan was requested while prescribing several medications such as phenytoin, Depakine, dexamethasone, lorazepam, and Memantine. Various tests were requested to be repeated. On the same day, the patient experienced fever (T=38.8 °C), which was examined and treated with antibiotics .

On the first day of testing, the readings were BS=138 (mg/dl), LDH=508 (U/L), Na=152 (mEq/l), K=3.3 (mEq/l), Ca=11 (mg/dl), P=3 (mg/dl), Mg=1.2 (mg/dl), ABG: PH=7.50, PCO<sub>2</sub>=50.7 (mmHg), HCO<sub>3</sub>=39.3 (mmol/l), PO<sub>2</sub>=30.6 (mmHg). Other tests had normal results

The treatment for hypernatremia was initiated. The result of brain CT scan was normal. On the second day of hospitalization (about 20 hours after suicide attempt), the readings were BS=221 (mg/dl), Na=160 (mEq/l), K=2.9 (mEq/l), ABG: PH=7.49, PCO<sub>2</sub>=53.2 (mmHg), HCO<sub>3</sub>=40.5 (mmol/l), PO<sub>2</sub>=66.3 (mmHg), O<sub>2</sub> Sat=95.2%. Other tests had normal results. The hypernatremia was treated with distilled water via gavage and other procedures .

The patient experienced additional episodes of seizure. The neurological consultation was conducted on the second day of hospitalization. The results of brain CT scan was normal. The primary nervous factor was less associated with seizures and loss of consciousness. Upon patient's stable status, brain MRI and Na adjustment were recommended. On the second day of hospitalization, the patient's ECG indicated no obvious variations in ST-T wave. The patient still had fever while blood pressure was normal.

On the second day of testing, the readings were Hb=15.6 (gm/dL), WBC=16100/μl and Neu=83% and BUN=20, GFR>60 and Cr=1.18. On the evening of the second day, the readings were (mg/dl) Na=149 (mEq/l), BS=87. Early morning on the third day of hospitalization, examinations and tests indicated Na=141 (mEq/l), BS=96 (mg/dl), and K=3 (mEq/l).

The patient still had fever without any blood pressure drop. In urinalysis, the readings were WBC=1-2, RBC=10-12. About three hours after the last examinations, the patient experienced respiratory arrest, upon which he was intubated and connected to a ventilator. About an hour later, the patient went into cardiac arrest, upon which CPR was immediately performed, but resuscitation was not successful, leading to the patient's death. The deceased was sent for autopsy. The positive points in the subsequent toxicology and pathology included heart weighing 275

## Suicide and fire extinguisher

grams with stenosis of 80% LAD, 50% RCA and LCX arteries. The average edema involved pulmonary alveolar and bronchial fluid neutrophils. Toxicological examination indicated negative results. There was evident subarachnoid hemorrhage. The clinical course, findings of laboratory tests (hypernatremia and metabolic alkalosis) during hospitalization, findings of the autopsy and toxicology testing with the toxicity of fire extinguishers ingredient (sodium bicarbonate) is consistent. Other causes of poisoning, including opium and other drugs in forensic toxicology were negative.

This study was approved by the Ethics Committee of Guilan University of Medical Sciences.

## Discussion

Salt overdose and subsequent hypernatremia are a common cause of death. Usually, individuals taking too much salt suffered from underlying conditions such as mental illness or dementia, while many did so to commit suicide. Similarly, in the current case report, the patient had been diagnosed with PTSD and had a history of suicide attempts.

Metabolic alkalosis can be associated with hypernatremia as well as high morbidity and mortality rates (9). This report similarly involved metabolic alkalosis with hypernatremia.

There have been a few case reports released about individuals who encountered fire extinguisher powder either in a suicide attempt or accidental exposure.

A 76-year-old woman put on the fire extinguisher by nasal cannula and inhaled the content to commit suicide. She immediately experienced shortness of breath, visiting the hospital. The findings of lung radiography and CT scan were in favor of aspiration pneumonia. There was evident hypoxemia in ABG. Mechanical ventilation was applied, but hypoxemia aggravated. After 19 days of hospitalization, the patient died (10).

In another case, brought to the hospital was a 25-year-old man who had swallowed fire extinguisher dry powder in a suicide attempt. On the very admission, vital signs were quite stable. After the tests, the readings included white cell count of 30,700/mm<sup>3</sup> with 75% neutrophils and a hemoglobin level of 15.4 g per 100 ml. The patient had undergone sharp elevation of serum phosphate level, mild elevation of sodium and sharp decline in calcium. Moreover; there was metabolic acidosis. A few hours later, the patient suffered ventricular tachycardia and subsequently cardiac arrest. Having been treated with cardiopulmonary resuscitation, the patient was transferred to the ICU. Despite the

medical measures taken, the patient died (11).

Following a car accident, an 18-year-old man suffered multiple fractures and hypoxemia. He was immediately admitted to the ICU. Hypoxemia did not respond to treatment. During bronchoscopy, there were evident contents of fire extinguisher powder found in his airways. During hospitalization, the patient experienced ARDS. After two months of treatment, mechanical ventilation was disconnected. Upon appropriate lung function, the patient was discharged (12).

A 25-year-old man was brought to the hospital, which had swallowed fire extinguisher powder containing monoammonium phosphate. He went through hyperphosphatemia, hypocalcemia, and hypomagnesemia. Moreover, he experienced recurrent episodes of ventricular tachycardia. Serum electrolytes were adjusted. The patient received supportive treatment and mechanical ventilation in the ICU (13).

The slight discrepancy in the mentioned case reports and the current one lie in the different contents of fire extinguishers. In the present case, because the main base content of powder fire extinguisher was sodium bicarbonate, the patient developed hypernatremia was accompanied by alkalosis. But in previous cases, electrolyte imbalance in patients with elevated phosphate and decreased calcium was present because the main ingredient powder fire that had been poisoned was monoammonium phosphate.

In their study, Bataille *et al.*, examined a total of 85 patients with severe hypernatremia ( $\text{Na} \geq 150$  mmol/l) admitted to the emergency department. The mean age of patients was 79.7-year-old, 28% of whom had dementia. Moreover, 24% of patients died during hospitalization. Mortality was independently associated with being male, having mean low blood pressure and low sodium adjustment rate (but not the severity of hyperosmolarity) during hospitalization. The results of this study indicated that risk of death could be associated not only with rapid sodium adjustment but also with slow sodium adjustment regardless of the patient's initial sodium level. Any overtreatment and undertreatment should be avoided, since both may lead to neurological complications such as cerebral edema, seizures, and coma. Administration of fluids must be reasonable. Neurological complaints are common among patients with hypernatremia. In this study, 66% of patients had at least one neurological complaint during hospitalization. Because of extracellular dehydration in most cases, there are hypernatremia, renal dysfunction, and hypotension. In elderly patients, hypernatremia has been accompanied by brain atrophy. Major risk factors for death in patients

include extracellular dehydration, hypotension, and renal failure. The mortality rate in this study was not associated with serum sodium (14).

It is recommended that hypernatremia is adjusted at 1 mmol/L/h within a few hours of occurrence. In case hypernatremia has long occurred, it should be adjusted at 0.5 mmol/L/h. Similar to quick adjustment, a slow sodium adjustment can cause irreversible cerebral edema and neurologic sequel.

Unless in cases of shock or hypotension, isotonic and hypertonic solutions are not recommended. Alternatively, the fluids can be recuperated through the administration of isotonic fluids and mild hypotonic lactated ringer's solutions (15).

Preventive measures should be taken to keep fire extinguishers away from individuals prone to committing suicide particularly those with a history of such attempts. Finally, early diagnosis, prompt treatment of electrolyte levels, appropriate supportive treatment and hospitalization of patients in the ICU can be helpful.

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