

A Case Report of Ammonium Sulfate Inhalation

Olgu Sunumu: Amonyum Sülfat İnhalasyonu

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Abstract

Ammonium sulfate is widely used in agriculture and the leather trade in many countries. Although it is reported to have potential effects on respiratory, gastrointestinal systems and the skin, there are a few case reports and toxicological studies about ammonium sulfate intoxication after ingestion and there is no case about ammonium sulfate inhalation. Thus, we report the clinical and laboratory findings of a patient who inhaled ammonium sulfate gas due to a work accident and was brought to our emergency department directly from the factory. When he arrived, loss of consciousness, cyanosis, tachypnea and metabolic acidosis were observed and convulsions were reported before arrival at the emergency department. After intubation and mechanical ventilator support in the emergency department, he was admitted to the intensive care unit, was given a T tube - mechanic ventilator support and was discharged in a healthy condition on the 8th day of admission. Ammonium sulfate intoxication should be suspected for the patients which brought from the leather industry or an agricultural environment, who inhaled bad or dense odored material, and had loss of consciousness, convulsions, acidosis and respiratory failure.

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Özet

Amonyum sülfat pek çok ülkede tarımda ve deri sanayisinde yaygın olarak kullanılmaktadır. Ancak solunum sisteminde, gastrointestinal sistemde ve deride potansiyel etkileri olduğu bilinmesine rağmen, çok az sayıda oral alım sonrası amonyum sülfat intoksikasyonu olgu sunumu ve toksikolojik çalışma bulunmaktadır, inhalasyon yoluyla alıma bağlı ise hiç olgu sunumu bulunmamaktadır. Bu nedenle burada, iş kazası sonucu amonyum sülfat gazı inhalasyonu sonrası fabrikadan acil servisimize getirilen bir olgunun klinik ve laboratuvar bulguları sunulmaktadır. Geldiğinde bilinci kapalı, siyanoze, takipneik idi ve metabolik asidoz saptandı ve acil servise gelmeden önce konvulziyonları olduğu öğrenildi. Acil serviste entübe edildikten ve mekanik ventilatör desteğine alındıktan sonra yoğun bakıma yatırıldı, T tüp -mekanik ventilatör desteğine geçildi ve yatışının 8. gününde sağlıklı bir şekilde taburcu edildi. Deri sanayinden veya tarım alanından getirilen hastalarda, kötü ve yoğun kokulu bir madde inhalasyonu öyküsü, bilinç kaybı, konvulziyonlar, asidoz ve solunum yetmezliği varsa amonyum sülfat intoksikasyonu akla getirilmelidir. (JAEM 2011; 10: 180-2)

Anahtar kelimeler: Amonyum sülfat, intoksikasyon, inhalasyon” olmalı

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Introduction

Ammonium Sulfate ($(\text{NH}_4)_2\text{SO}_4$) is an inorganic chemical compound with its nitrogen in the ammoniac form and a high sulfur content. It contains 21% nitrogen as ammonium ions and 24% sulfur as sulfate ions. Ammonium Sulfate is also a favorite source of N and S with many liquid blend producers. The raw materials used in the production of Ammonium Sulfate are ammonia and sulfuric acid (1). It forms large rhombic prisms, has a somewhat saline taste and is easily soluble in water. It is described as a mutagen.

Although ammonium sulfate is widely used in agriculture, the laboratory and processing leather, there is only limited knowledge on ammonium sulfate intoxication involving humans. There is one suicide case reported in 1999, acute poisoning by ingestion of

ammonium sulfate and due to the limited knowledge in humans, this case report has been established with an animal study (2). This study reports that ammonium sulfate is rapidly absorbed by ingestion in rabbits and hyperammonemia develops quickly and this hyperammonemia may induce abnormal Electroencephalography (EEG) findings and convulsions in rabbits (2).

There is no case report and there are only a few studies on the inhalation of ammonium sulfate. Due to this lack of knowledge, we decided to report the clinical and laboratory findings of the case that arrived to our ED with accidental ammonium sulfate inhalation.

Case

A 37-year-old male patient was brought to the emergency department (ED) of Uludag University Faculty of Medicine Hospital

by ambulance from the scene of the accident, after inhalation of a poisonous gas. When he arrived, loss of consciousness was detected, Glasgow Coma Scale was 5, his pupil reflexes were bilaterally positive and he was cyanosed, breath per minute was 28 and saturation with pulse oximeter was 76%. His blood pressure was 140/90 mmHg and pulse rate was 122/minute. The patient was washed by his co-workers and he aspired large amounts of water and blood. The oral airway was established and diazepam infusion was given the development of convulsion prior to the arrival.

We detected poor breath sounds with extended rhonchus and he also had accrued mucosal secretions on respiratory system examination. The patient was intubated and was put on mechanical ventilator support. Before intubation, the results of arterial gas analysis showed acidosis (pH:7.239) and hypoxemia (PO_2 :40,9 mmHg, SO_2 :76%). Base excess (BE) and HCO_3 levels were -10.7 mmol/L and 15.9 mmol/L, respectively. His ECG demonstrated sinus tachycardia. General bilateral infiltration was seen on chest X-ray (Figure 1). Leukocytosis was detected on complete blood count (WBC: 19.1 K/ μ L) and he had moderate hyperglycemia (250 mg/dL), mildly elevated liver enzymes (AST U/L 49, ALT:55 U/L), normal renal function tests (urea 30 mg/dL, and creatinine: 1.0 mg/dL) and low potassium level (K: 2.8 meq/L) at biochemical tests. The ethanol level was detected as 4.00 mg/dL in normal limits. Urine analysis was as follows; pH: 5.00, density: 1015 and glucose >1000. Other parameters were normal.

We obtained information from the poison information center and learned that mucosal irritation and pulmonary edema may occur following ammonia inhalation. During the period in ED, the patient was given bicarbonate for metabolic acidosis, potassium for hypopotassemia, steroid for the respiratory effects of ammonium sulfate and midazolam infusion due to the agitation of the patient. After 4 hours of arrival his level of consciousness increased and in the 7th hour of arrival, the patient was admitted to intensive care unit and was put on T tube mechanic ventilator support. Blood gas, biochemistry and chest X-ray was controlled daily and parenteral nutrition was given. The patient was extubated on his 6th day of hospitalization and started feeding with a nasogastric tube. The patient was

observed one more day at the clinic, and no respiratory problem occurred. The patient was discharged with advice to rest and attend a follow-up proposal in the 8th day of hospitalization.

Discussion

Apart from being widely used in agriculture and tannery for the leather process, ammonium sulfate is an agent that may cause intoxication via oral, inhalation or skin contact due to suicidal use or by accident. It has potential health effects; irritation of the respiratory tract with inhalation, irritation of the gastrointestinal tract following ingestion and symptoms may include nausea, vomiting and diarrhea, and irritation of the skin if contacted is revealed by redness, itching and, pain and finally irritation of eye contact causes redness and pain (3). In our case the victim was exposed to ammonium sulfate gas while working in the tannery on leather processing.

There is no case report about inhalation of ammonium sulfate. The only case of poisoning by oral ingestion is a post mortal investigation and clinical findings could not be observed (2). There are some experimental studies about acid aerosol inhalation, and there are studies which reported on air pollution and acid aerosol inhalation, especially with asthmatic patients. Ammonium sulfate is one of the leading forms of acid sulfate in the atmosphere (4). In a study using oral inhalation Utell et al. measured bronchial reactivity after brief exposures to sulphuric acid, ammonium sulfate, ammonium bisulfate and sodium bisulfate and changes on flow rates were detected only after sulphuric acid inhalation (5). In a study with donkeys Schlesinger et al. compared sulphuric acid and ammonium sulfate aerosols and brief inhalation with 2000 microgram/ m^3 of ammonium sulfate and produced no measurable change in pulmonary flow resistance and dynamic compliance, regional deposition and tracheobronchial mucociliary clearance (6).

LD_{50} is 2840 mg/kg in rats with oral ingestion (3). In a study Sato et al. gave 1500 mg/kg ammonium sulfate to rabbits by intestinally and observed the effects, and detected mydriasis, irregular respiratory rhythm, local and general convulsions and cardiac arrest with respiratory failure as the common symptoms (2). EEG showed slow, suppressive waves and a high-amplitude slowing wave pattern, which is generally observed clinically in hyperammonemia in humans and animals (2). In our case the exposure was by inhalation and although EEG could not be obtained and we observed no convulsions at ED. Diazepam was given by the ambulance crew upon the development of convulsions prior to the arrival.

It may be difficult to identify ammonium sulfate intoxication because there are no specific symptoms due to ammonium sulfate, and the symptoms which occur with inhalation are mild in comparison with other intoxication agents. Patients from the leather industry or agricultural environment, who inhaled bad and densely odorous material, have loss of consciousness and convulsions may suspect ammonium sulfate intoxication. Ammonium sulfate may easily be absorbed via the stomach, intestines and inhalation, so that it may be difficult to recognize (2). In our case as we talked with co-workers, we learned that they often have respiratory distress and, after taking a short break in the open air, their symptoms regress and they return to their work. This kind of intoxication due to inhalation may occur very frequently, so preventive medicine is very important.



Figure 1. Bilateral infiltration seen on AP chest X-ray

In our case metabolic acidosis developed, ammonium sulfate was obtained from sulphuric acid and has acid characteristics. In the study of Sato et al. on rabbits, there was a remarkable increase in the concentration of ammonium ion and inorganic sulfate ion in the serum, and blood gas analysis showed severe metabolic acidosis (3).

Conclusion

In the developing countries especially, like ours, for patients working in the leather industry and having symptoms of intoxication due to inhalation, it should be considered that the case might be ammonium sulfate poisoning. It could be concluded that the basic approach to patients with ammonium sulfate poisoning should include initial stabilization of the patient by supporting the airway, respiration and circulation, and treatment for complications such as seizures and metabolic acidosis given in the emergency department within a short time after inhalation, then the patient should be transferred to the intensive care unit in order to control the life-threatening complications, as well as for close observation.

Conflict of Interest

No conflict of interest was declared by the authors.

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