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A Rare Toxic Agent in the Emergency Department: Sulphur Hexafluoride

Acil Serviste Nadir Bir Toksik Ajan: Sülfür Hekzaflorid

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ABSTRACT

Introduction: Although sulfur hexafluoride (SF-6) is considered biologically inert, it may cause asphyxia and death, replacing oxygen. SF-6 is used in many areas, varying from medical devices to the aerospace industry.

Case Report: Two electricity workers, who were 19 and 32 years old, were admitted to our emergency deperatment with complaints of nausea, vomiting, and dizziness after SF-6 exposure of about 5-10 minutes because of malfunction of their high-voltage circuit breaker. At admission, the general condition and mental status of both patients were good. Their vital signs were stable. The patients, with normal physical examination findings, were hospitalized to the emergency observation unit for follow-up and treatment. Both patients were discharged after follow-up.

Conclusion: Although it is considered chemically and biologically inert, a rare toxic agent in the emergency department, SF-6, has a risk of death in acute exposure. Monitoring and follow-up of these patients are necessary for reducing fatal complications.

Keywords: Sulphur hexafluoride, intoxication, emergency service

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ÖZET

Giriş: Sülfür hekzaflorid (SF-6) biyolojik açıdan etkisiz kabul edilmesine rağmen, akut maruziyetlerde oksijen ile yer değiştirerek asfiksi ve ölüme neden olabilir. SF-6 tıbbi cihazlardan uzay sanayisine kadar pek çok alanda kullanılmaktadır.

Olgu Sunumu: On dokuz ve otuz iki yaşlarında iki elektrik işçisi, yüksek gerilimli elektriği kesmek için kullandıkları cihazın arıza yapması sonucu ortaya çıkan SF-6 adlı gaza yaklaşık 5-10 dakika maruz kalma ve takiben bulantı, kusma, baş dönmesi şikayetleri ile acil servisimize getirildi. Başvuru anında her iki hastanın da genel durumu iyi, bilinci açık ve vital bulguları stabil idi. Fizik muayene bulguları normal sınırlarda olan hastalar takip ve tedavi amaçlı acil gözlem ünitesine yatırıldı. Hastalar gözlem sürecinin ardından şifa ile taburcu edildi.

Sonuç: Her ne kadar kimyasal ve biyolojik olarak zararsız olsa da SF-6 acil servislerde nadir görülen bir toksik ajan olup akut maruziyetlerde ölüm riski taşımaktadır. Bu nedenle hastaların ölümcül komplikasyonlar açısından gözlem altına alınması ve izlenmesi faydalı olacaktır.

Anahtar Kelimeler: Sülfür hekzaflorid, intoksikasyon, acil servis

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Introduction

Sulfur hexafluoride (SF-6) is a colorless, odorless, and tasteless gas (1). Sulfur hexafluoride is one of the heaviest gases known, with a density of approximately 5 times greater than air. Sulfur hexafluoride is used as a gaseous insulator for high-voltage generators and other electrical equipment. Thus, SF-6 is used in many areas, varying from medical devices to the aerospace industry. It can be released into the environment through various waste streams. NIOSH (NOES Survey 1981-1983) has statistically estimated that 9282 workers are potentially exposed to sulfur hexafluoride in the US (2).

SF-6 is also used as a test tool in the study of respiratory physiology (3). Due to its durable characteristic as an internal buffer, it is used effectively in retinal reattachment surgery with intraocular injection (4). It is used as a contrast agent to improve the diagnostic efficiency in ultrasonography (USG). SF-6 increases the sensitivity of diagnosis and exclusion of abnormalities in the cerebral arteries and extracranial carotid or peripheral arteries with Doppler USG (5). There is a therapeutic method that consists of injecting gas into the postpneumonectomy pleural space (6).

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In this article, two cases who had complaints of nausea, vomiting, and dizziness after SF-6 gas exposure for approximately 5-10 minutes are presented together with their complaints, follow-up, treatments, and results.

Case Report

Two electricity workers, who were 19 and 32 years old, were admitted to our emergency department with complaints of nausea, vomiting, and dizziness after SF-6 exposure for about 5-10 minutes because of malfunction of their high-voltage circuit breaker. At admission, the general condition and mental status of each patient were good. Their vital signs were stable. The physical examination findings were normal. In the 19-year-old patient's laboratory tests, creatine phosphokinase (CPK) was 313/uL, leukocyte count was 11,000 u/L, Hb was 15.5 g/dL, and platelet count was 263,000/dL, and the patient's arterial blood gas showed a pH of 7.42, a pCO_2 of 34.4 mm Hg, a pO_2 of 121.9 mm Hg, and an oxygen saturation of 98.7%. In the other patient's laboratory tests, creatine phosphokinase (CPK) was 210/uL, leukocyte count was 12,000 u/L, Hb was 17.5 g/dL, and platelet count was 296,000/dL, and the patient's arterial blood gas showed a pH of 7.40, a pCO_2 of 36 mm Hg, a pO_2 of 86 mm Hg, and an oxygen saturation of 96.6%. Chest radiographs were normal in both patients. The patients were hospitalized to the emergency observation unit for follow-up and treatment. In both cases, supplemental oxygen by mask, hydration, and symptomatic treatment (anti-emetic and H2 receptor blocker drugs) were administered. Without any additional treatment, both patients were found to be stable at follow-up, and then they were discharged.

Discussion

As a result of the increasing need for energy and consumption of energy in today's world, SF-6 is applied more frequently, and it is used especially in insulation systems and electrical breakdown devices. It has been reported in the literature that SF-6 exposure is more common among high-voltage electrical workers (7). Both patients in this study were electricity workers.

Although sulfur hexaflouride (SF-6) is biologically inactive, acute exposures can lead to death due to asphyxiation by displacing oxygen. Therefore, the findings of toxicity are more common in indoor environments. SF-6, replacing oxygen, causes hypoxemia. Symptoms, such as air hunger, fatigue, decreased visual acuity, headache, nausea, vomiting, dizziness, behavioral disorders, decreased coordination and decision-making ability, cyanosis, and HYPERLINK "http://tureng.com/search/changes%20in%20consciousness" changes in consciousness, can be seen clinically in patients (7). In both patients, there were only complaints of nausea, vomiting, and dizziness.

A physiologically inert gas, SF-6, is not chemically reactive (8). It can be chemically reactive and corrosive due to common usage in combination with other gases (hydrogen fluoride, sulfuryl fluoride, or thionyl fluoride). It can cause irritation to the eyes and respiratory tract. It may lead to chemical pneumonitis and/or non-cardiogenic pulmonary edema (8). Neurological symptoms, such as hearing problems, light excitation, and peripheral tingling sensations, can also occur in acute exposures. In the presence of severe hypoxemia, it can cause changes in mental status that vary from confusion to coma (9). In our patients, no changes in mental status or neurological symptoms were seen.

SF-6, as a result of chronic repetitive exposures, can lead to some of the clinical findings. Repeated high exposures can cause deposits of fluoride in the bones (fluorosis), which may cause pain, disability, and mottling of the teeth. Repeated exposure can cause nausea, vomiting, loss of appetite, diarrhea, or constipation. Both patients had mild toxicity symptoms, and they were associated with acute exposure. In the presence of a history of contact with SF-6 or in patients who are suspected of having contact with SF-6, arterial blood gas analysis and chest X-ray are required for the identification and monitoring of the clinical status (10). The results of both patient's arterial blood gases and chest X-rays were normal. The oxygen saturation with pulse oximetry of both patients remained within normal limits.

Initial treatment is decontamination of the affected area. The patient must be transported quickly to the decontaminated area from the affected area. If possible, contaminated surfaces of the body should be washed with clean water at room temperature (10). Patients must be monitored closely for respiratory distress. If cough or difficulty breathing is detected, the patient should be evaluated in terms of respiratory tract irritation, bronchitis, and/or pneumonia. Inhalation of high-flow oxygen should be started immediately, and the patient's respiration should be supported. Monitoring of patients for cardiac rhythm and oxygen saturation with pulse oximetry and follow-up should be applied. Inhaled beta-2 agonists and corticosteroids can be given parenterally to patients with bronchospasm (10). In the case of severe systemic exposure, patients should be followed closely for signs and symptoms. An airway should be provided and should be continued. Mechanical ventilation can be required to provide ventilation and oxygenation in patients with severe lung injury (10). Both patients were treated with oxygen by mask. Patients received only hydration and symptomatic treatment (anti-emetic and H2 receptor blocker medication), and without any additional treatment, they were discharged after follow-up.

Conclusion

Although SF-6 is chemically and biologically harmless, the possibility of diagnostic errors and fatal prognosis in acute exposure should be considered due to this rare toxic agent in emergency services. Similarly, as in carbon monoxide poisoning, leading to tissue hypoxia, a sufficient follow-up time for patients may prevent unwanted poor clinical outcomes.

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