

Acute Atrial Fibrillation After Inhalation of Chlorine Gas

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Klor Gazı İnhalasyonu Sonrası Akut Atrial Fibrilasyon

Çıkar çatışması: Yazarlar çıkar çatışması bildirmemişlerdir.
Finansal destek: Bu çalışmaya herhangi bir finansman desteği verilmemiştir.
Hasta onamı: Hasta onamı alınmıştır.

Conflict of interest: The authors have not declared any conflicts of interest.
Funding: This study received no funding support.
Informed consent: Patient consent was obtained.

Cite as: Gülaştı F, Gülaştı S. Acute atrial fibrillation after inhalation of chlorine gas. GKDA Derg. 2020;26(1):45-9.

ABSTRACT

Mixture of cleaning materials is one of the most common causes of poisoning with chlorine gas. After inhalation of chlorine gas, eye and throat irritation, wheezing, coughing, shortness of breath, hypoxemia, abnormal findings in lung graphs are frequently reported and pulmonary complaints are generally seen. Although the cardiac effects of chlorine gas are not fully known, chest pain and palpitations have been rarely reported. We have discussed our 26-year-old male patient who developed atrial fibrillation due to chlorine gas toxicity after mixing the cleaning materials. Written consent was obtained from the patient for the publication of this case.

Keywords: chlorine gase, atrial fibrillation, cardiac effect

Öz

Klor gazı nedeniyle zehirlenmelerin en yaygın nedenlerinden biri temizlik maddelerinin karışımıdır. Klor gazı solunmasından sonra göz, boğaz tahrişi, hırıltı, öksürük, nefes darlığı, hipoksemi, hırıltılı, anormal akciğer grafikleri sık bildirilir ve genellikle akciğer yakınmaları görülür. Klor gazının kardiyak etkileri tam olarak bilinmemekte olup, ender olarak göğüs ağrısı ve çarpıntı bildirilmiştir. Biz bu olguda temizlik malzemelerinin karıştırılmasından sonra klor gazı toksisitesine bağlı atriyal fibrilasyon gelişen 26 yaşındaki erkek hastamızı tartıştık. Bu makalenin yayınlanması için yazılı izin hastadan alınmıştır.

Anahtar kelimeler: klor gazı, atriyal fibrilasyon, kardiyak etki

INTRODUCTION

Chlorine gas is a yellow-green coloured toxic gas which is 2.5 times denser than air. It irritates the lungs and dissolves in water moderately [1]. Chlorine gas is one of the most common causes of respiration-induced intoxication by inhalation of the vapour of the cleaning materials which contains a mixture of sodium hypochlorite (NaClO) and hydrochloric acid (HCl) [2]. Since this mixture is moderately water-soluble, irritant effects in the lung occur throughout the

entire airway, but are particularly prominent in bronchioles and alveoli [3]. While the respiratory symptoms are reported in poisonings after inhalation of chlorine gas, cardiac symptoms are rarely reported. Atrial fibrillation (AF) is the most common arrhythmia in the society and there are a few case reports in the literature about its relationship with chlorine gas toxicity (414). We reported a 26-year-old male patient who was observed with AF attack due to chlorine gas inhalation. Written consent was obtained from the patient to publish this case.

Received: 9 August 2019

Accepted: 15 December 2019

Publication date: 31 March 2020

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CASE

After a 26-year-old male patient had mixed the sodium hypochlorite (NaClO) with hydrochloric acid (HCl) (spirit of salt, degreaser and powder disinfectant) to clean the bathroom of his house, he stayed there for cleaning for 15 minutes. The patient had no previous known cardiac disease. Then he was admitted to emergency service with complaints of dyspnea, coughing, sore throat and sweating. In the examination of the patient, the pharynx was hyperemic and the respiratory sounds were normal without any rhonchi and rales. His respiratory rate was 25 breaths per minute, SpO₂: 95%, arterial blood pressure 130/75 mmHg, sinus rhythm was detected in EKG, and pulse rate was determined as 95 beats per minute. No abnormal finding was observed in the laboratory values (Table 1). The arterial blood gas of the patient was 7.38, PO₂: 87 mmHg and PCO₂: 33 mmHg. The postero-anterior lung film was normal (Figure 1). The patient was admitted to the intensive care unit due to toxication after chlorine gas inhalation. Because of the patient's dyspneic complaints, methylprednisolone 40 mg IV, inhaler ipratropium bromide and salbutamol, N-acetylcysteine IV and oxygen (O₂) 5 lt / min were given with a mask. Atrial

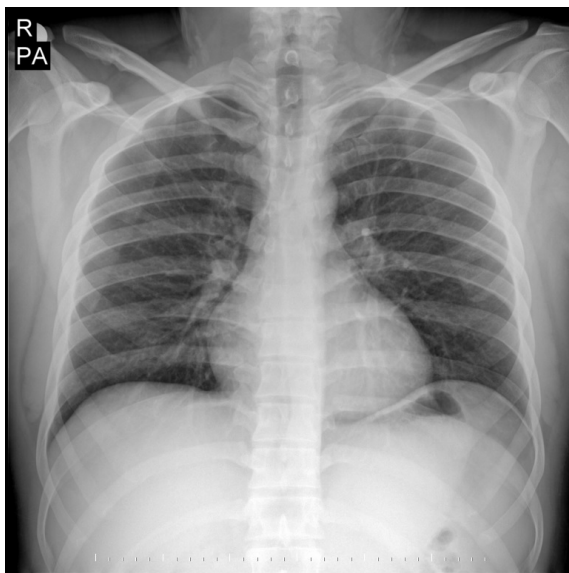


Figure 1. Lung radiography.

fibrillation was detected in electrocardiography (EKG) obtained (Figure 2) due to the complaint of palpitation at the 5th hour of follow-up. The patient's symptoms resolved spontaneously after 15 minutes and sinus rhythm was observed in follow-up EKG (Figure 3). Metoprolol 25 mg and unfractionated heparin 6000 IU bid SC were added to the treatment of the patient. In the transthoracic echocardiography of the patient, left ventricular diameter and wall movements were normal without any valvular pathology. The patient's troponin (0.7 pg/mL), TSH: (0.83 mU/L), T3 (2.84) and T4 (0.65) were within normal limits. Two days later, complaints of the patients resolved, and he was discharged with the prescription of metoprolol 25 mg to be used once a day. In the follow-up control in the cardiology outpatient clinic

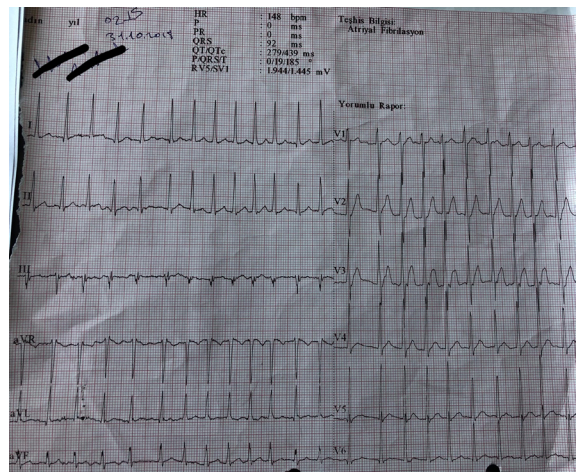


Figure 2. Atrial fibrillation detected EKG.

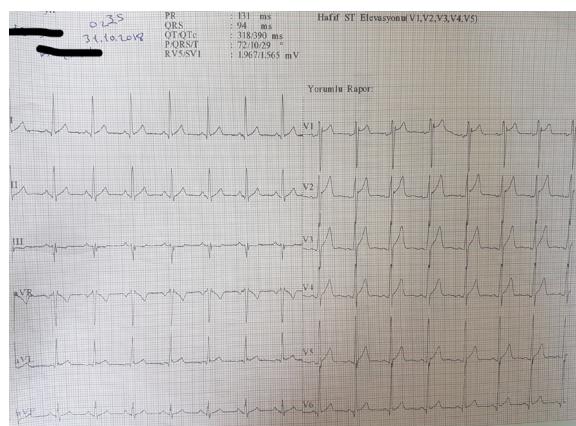


Figure 3. Sinus rhythm detected EKG.

Table 1. Laboratory values.

	First application	Discharged
Hemoglobine (g/dL)	15,0	14,5
Leukocyte (µl)	7400	6380
Plt (µl)	260000	217000
AST (U/L)	27	26
ALT (U/L)	24	43
Urea (mg/dL)	42	39
Creatinin (mg/dL)	1,0	1,0
APTT (sn)	23,6	22,8
INR	1,10	1,08

Plt: Platelet AST: Aspartate transaminase, ALT: Alanine transaminase, APTT: Activated partial thromboplastin time, INR: International correction rate.

performed one month later, arrhythmia and AF attack were not observed in the rhythm Holter. Since the patient was asymptomatic, follow-up and discontinuation of the metoprolol treatment was suggested.

DISCUSSION

In a study on chlorine gas inhalation, 73% of intoxications were found to be associated with mixing of acid and hypochlorite bleach-containing cleaning products, associated with swimming pools (14%), and industrial exposure (7%) [5]. As in this study, our case occurred after mixing the cleaning materials at home.

Chlorine gas, may cause mild effects on the respiratory tract, but it also induces a wide spectrum of lung injury, including acute respiratory distress syndrome. Chlorine gas reacts with water with resultant formation of hydrochloric acid, hypochlorite acid and free oxygen radicals. The toxicity of chlorine gas is related to its adverse effects of free oxygen radicals released by this acid on coagulation [5,6]. Eye and throat irritation, rhonchus, cough, chest tightness, shortness of breath, hypoxemia, wheezing, and abnormal chest radiographs can be seen after inhalation of chlorine gas [7].

In contrast to the known effects of chlorine gas on the respiratory system, the effects on the heart have not been fully revealed. In experimental studies con-

ducted with cadavers and animals, it has been emphasized that chlorine gas induce cardiomegaly [8]. Some necroptic examinations have shown that cardiomegaly developed in association with vascular occlusion of the lungs, liver and other organs. These findings suggest that pulmonary edema may be related to both cardiogenic and non-cardiogenic factors. Cardiomegaly may be caused by severe pulmonary injury and hypoxemia-induced pulmonary hypertension, on the other hand, it has been also thought that it can be derived from the release of vasoactive mediators such as endothelin and the reaction of Cl, HOCl or their metabolites with nitric oxide or metabolites [9].

Tissue damage is induced by the deterioration of the cellular protein structure caused by the free oxygen radicals which occur after chlorine gas interacts with water. If this condition occurs in myocardial tissue, it may lead to disruption of myocardial function. In our case, we aimed to reduce the effect of free oxygen radicals by using N-acetyl cysteine as an antioxidant.

Atrial fibrillation is the most common arrhythmia type seen in 1-2% of the general population.

AF is a rhythm disorder which can cause heart failure and impaired quality of life during thromboembolic events such as death and stroke. While the prevalence of AF is <0.5% at 40-50 years of age, it increases with age at a rate of 5-10% at 80 years of age [10]. Non-cardiac causes of AF include diabetes mellitus, hypertension, alcohol use, caffeine, air pollution, smoking, sleep apnea syndrome, emotional stress, hyperthyroidism, use of amphetamine, illegal drugs such as; cocaine and cannabis [11].

In a study, conducted by Sung-Woo Han et al in August 2014 on the basis of data obtained from temporary medical examinations of victims of random chlorine gas leakage in a circuit board factory, chest discomfort and cardiovascular symptoms were observed, especially in the high exposure group.

Eighteen of the 27 patients with high exposure had palpitation complaints but there was no EKG documentation [12]. Cardiac dysrhythmia after inhalation of chlorine gas has been reported in the literature in the form of sinus tachycardia, extrasystoles and ST depression [13,14]. In addition, any rhythm disorders have not been reported in patients with palpitations in some case reports [7]. Yüksel Doğan et al. reported a case with an AF attack lasting about 13 hours after inhalation of chlorine gas [4]. In our patient, palpitation was observed at the 5th hour of follow-up and AF rhythm was monitored in the EKG. As a result of bronchospasm and hypoxia, which may develop simultaneously with and after irritation of the respiratory tract, and also tachycardia and cardiac arrhythmia can be seen with the activation of sympathetic system. In our case, however, at the time of development of atrial fibrillation SpO₂: 97% and dyspnea were not observed. There are 3 important steps in the treatment of atrial fibrillation. These are; providing rhythm control, ventricular rate control and prevention of embolic events. In patients being admitted with a new onset AF attack, it is very common for rhythm to return spontaneously to sinus rhythm and this is observed in two thirds of these patients within the first 24 hours [15]. In patients with atrial fibrillation, the thromboprophylaxis is maintained in consideration of high, medium or low risk factors. This risk assessment is based on the gender of the patient, and the presence of stroke risk factors such as congestive heart failure, hypertension, age, diabetes, stroke, and vascular disease. In patients without valvular disease and risk factors, if acetylsalicylic acid (ASA) (75-325 mg/d) or antithrombotic therapy is not preferred; there is a guideline recommendation that antithrombotic treatment is not administered rather than ASA [16]. In a case report Yüksel Doğan et al., have used amiodarone IV infusion, ASA, and enoxaparin. As maintenance treatment, 50 mg metoprolol succinate and 300 mg ASA therapy has been applied once a day, maintained for 1 month and then discontinued [4]. Due to the short duration of AF attack and absence of risk factors in our patient, ASA treatment was not given since the patient was in the

low-risk group (CHA₂DS₂-VASc: 0). In this patient 50 mg metoprolol succinate was given once a day, then the patient was discharged and the treatment was discontinued 1 month later.

As a result, exposure to chlorine gas is known to affect several systems frequently the respiratory system. However, it should be kept in mind that acute atrial fibrillation may occur as in our case and these patients should be closely monitored in terms of arrhythmia as well as respiratory system dysfunction.

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