

CASE
REPORT

A Rare Case of Acute Respiratory Distress Due to Hydrochloric Acid Inhalation

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ÖZET

Hidroklorik asit inhalasyonuna bağlı akciğer hasarı sık görülmesine rağmen görüntüleme bulguları iyi bilinmemektedir. Bu vakada hidroklorik asit inhalasyonu sonrası ARDS (Akut Solunum Sıkıntısı Sendromu) gelişen ve kliniği kötüleşen hastanın durumunu tartışmayı amaçladık. Astım nedeniyle takip edilen 37 yaşında kadın hasta, evde çamaşır suyu ile temizlik yaptıktan sonra ani nefes darlığı ve göğüs ağrısı şikayeti ile polikliniğimize başvurdu. Her iki akciğerde çevreye doğru progresif olarak ilerleyen yamalı camsi opasiteler ve konsolidasyonlar gözlemlendi. Hastaya klinik olarak akut solunum sıkıntısı sendromu tanısı konuldu. Hidroklorik asit etiyolojik ajan olarak saptandı. Hidroklorik asit, günlük kullanımda güçlü bir temizlik maddesi olarak kullanılan renksiz bir maddedir. Radyologlar, pulmoner intoksikasyonların radyografik bulgularından haberdar olmalıdır. Bunlardan bazıları hayatı tehdit edici olabilir ve acil teşhis gerektirebilir. Hastanın genel durumu kötü olduğunda ve klinisyenler tarafından anamnez alınmadığında radyolojik bulgular tanınabilir ve klinisyene yol gösterici ipuçları verilebilir. Bu sayede hastalarda zehirlenme sonucu gelişebilecek ARDS gibi ölümcül hastalıkları erken tanıyarak ve erken tedavi ile mortalite ve morbiditeyi azaltmayı hedeflemelidirler.

Anahtar kelimeler: HCl, Hidroklorik asit, İnhalasyon, İntoksikasyon, Respiratuar distress sendromu

ABSTRACT

Although lung injury due to inhalation of Hydrochloric acid (HCl) occurs frequently, imaging findings are not well known. In this case, we aimed to discuss the progression of the patient who developed ARDS (Acute Respiratory Distress Syndrome) after inhalation of hydrochloric acid and progressive during follow-up. A 37-year-old female patient who was followed for asthma was admitted to the outpatient clinic with complaints of sudden dyspnea and chest pain after cleaning with bleach at home. In both lungs, patchy glassy opacities and consolidations were observed, progressively progressing towards the periphery. The patient was clinically diagnosed as acute respiratory distress syndrome. Hydrochloric acid was detected as the etiological agent. Hydrochloric acid is a colorless, which is used as a powerful cleaning agent in everyday use. Radiologists should be aware of the radiographic findings of pulmonary intoxication. Some of these may be life-threatening and require urgent diagnosis. When the general condition of the patient is bad and the anamnesis cannot be obtained by clinicians, radiological findings can be recognized, and guidance tips can be given to the clinician. In this way, they should aim to reduce the mortality and morbidity by recognizing the fatal diseases such as ARDS which may develop in patients as a result of intoxication and with early treatment.

Keywords: HCl, Hydrochloric acid, Inhalation, Intoxication, Respiratory distress syndrome

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INTRODUCTION

Although lung injury due to inhalation of Hydrochloric acid (HCl) occurs frequently, imaging findings are not well known. ARDS (Acute Respiratory Distress Syndrome) is severe acute lung injury characterized by increased permeability of the alveolar and capillary barrier, edema with high protein content, hyaline membrane formation, and surfactant inactivation resulting from inadequate ventilation perfusion (1). In this case, we aimed to discuss the progression of the patient who developed ARDS after inhalation of HCl and progressive during follow-up.

CASE PRESENTATION

A 37-year-old female patient who was followed for asthma was admitted to the outpatient clinic with complaints of sudden dyspnea and chest pain after cleaning with bleach at home. The patient was examined by physical examination and auscultation and wheezing and rales were detected. In both lungs, patchy ground glass opacities were observed in perihilar areas. The patient was followed up in the clinic and his general condition deteriorated and his chest X-ray was taken on a daily basis. In both lungs, patchy glassy opacities and consolidations were observed, progressively progressing towards the periphery (Figure 1,2).



Figure 1. The patient was followed up his chest X-ray was taken on a daily basis. In both lungs, patchy glassy opacities and consolidations were observed, progressively progressing towards the periphery.



Figure 2. The patient was followed up his chest X-ray was taken on a daily basis. In both lungs, patchy glassy opacities and consolidations were observed, progressively progressing towards the periphery.

HCl The patient was clinically diagnosed as acute respiratory distress syndrome. HCl intoxication was detected as an etiological agent. Unfortunately, computed tomography could not be performed because the general condition of the patient was bad, and she could not leave the ventilator device. The patient later died due to ARDS.

DISCUSSION

HCl is a colorless, irritating and corrosive gas with a sharp odor. It is a highly soluble chemical in water that produces hydrochloric acid which decomposes completely into protons and chloride ions in water. It is used as a powerful cleaning agent in everyday use. It is also widely used in the industry and workers dealing with HCl are constantly at risk of inhalation. HCl is frequently preferred as a cleaning agent and in the industry. It can cause serious damage to the respiratory system due to improper use. Also,

its use has increased significantly due to coronavirus anxiety recently. The exposure of the mucous membranes to high concentrations of HCl is so severe that the environment should be evacuated immediately after detecting the smell. Despite its general use, dosimetric human data for exposure to HCl is not sufficient and, after exposure to inhalation, imaging properties are not well defined. ARDS is a fatal disease characterized by acute lung injury and progressive dyspnea and hypoxemia. It is also caused by exposure to a number of toxic agents, including HCl. ARDS is a lung injury that develops acutely and progresses with severe hypoxemia due to exposure to various factors, including HCL. Inhalation of HCl may damage the alveolar-capillary membrane, impaired mammalian passages, and increase permeability, resulting in accumulation and activation of pulmonary edema and polymorphonuclear neutrophils in this area and induces release of various cytokines from neutrophils (2-3).

Despite the apparent and potent effects of HCl on the lungs, there are several relevant imaging studies that address most clinical symptoms, laboratory data, or treatment. As with methanol inhalation, HCl rarely causes clinical toxicity. Methanol inhalation, which has caused similar clinical outcome, has been reported in the literature before (4). Although the upper respiratory tract is most affected, the lower respiratory tract is also significantly affected. Despite the potent effects of HCl on the respiratory system, few imaging studies have addressed this issue. Rubin et al. In a study of tracheobronchial stenosis and asthma-CT findings after inhalation of acid without imaging in his acute phase, we found only one case report addressing lung injury due to inhalation of HCl in humans. Serious intensive care support and mechanical ventilation can significantly reduce mortality in patients who develop ARDS (5).

Clinically, HCl inhalation shows lung injury and progressive progression during the acute phase. In experimental animal models, HCl is an active agent (6) that causes direct

CONCLUSION

Radiologists should be aware of the radiographic findings of pulmonary intoxication, as they can be life-threatening and require urgent diagnosis. When the general condition of the patient is bad and the anamnesis cannot be obtained by clinicians, radiological findings can be recognized, and guidance tips can be given to the clinician. In this way, they should aim to reduce the

effects associated with pulmonary edema and ARDS through a biphasic process, increased permeability during the first hour, followed by indirect effects associated with inflammatory responses. After exposure to acute HCl, pulmonary function tests typically show obstructive abnormalities and return to the baseline within 7-14 days (7,8). However, chronic inhalation of HCl gas or mist may cause a decrease in pulmonary function (9).

The first effect is an increase in the permeability of the respiratory mucosa, then an indirect effect related to inflammatory events occurs. If the lungs are exposed to Acute HCl, obstructive-type abnormalities are seen in pulmonary function tests. Respiratory system returns to normal within 7-14 days after exposure ends. The irritating effects of HCl must be removed from the source before serious damage can occur to exposed persons. HCl showed that there were serial changes in the lung following radiographic findings after inhalation of single gas and the severity of lung injury may be related to morphological images seen in the first imaging scan (10). mortality and morbidity by recognizing the fatal diseases such as ARDS which may develop in patients as a result of intoxication and with early treatment. The reason why Covid-19 was not considered in the differential diagnosis was that no cases were diagnosed yet in this period. It is important to consider other causes of ARDS and Covid-19 in the current differential diagnosis.

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References

1. Radermacher P, Maggiore SM, Mercat A. Fifty Years of Research in ARDS. Gas Exchange in Acute Respiratory Distress Syndrome. *Am J Respir Crit Care Med*. 2017 Oct 15;196(8):964-984. doi: 10.1164/rccm.201610-2156SO.
2. Eijking EP, Gommers D, So KL, Vergeer M, Lachmann B. Surfactant treatment of respiratory failure induced by hydrochloric acid aspiration in rats. *Anesthesiology*. 1993 Jun;78(6):1145-51. doi: 10.1097/0000542-199306000-00019.
3. Screening information data sets (SIDS) in Organizing for Economic Co-operation Development (OECD) and World Health Organization (WHO). 2002. Available from: [www.inchem.org/ocuments/sids/sids/7647010.pdf](http://www.inchem.org/documents/sids/sids/7647010.pdf).
4. Vural S. Transdermal Methanol Intoxication Via Folk Medicine. *Journal of Emergency Medicine Case Reports*. 2019 Apr; 10(2): 50-52. doi: 10.33706/jemcr.551137.
5. Rubin AE, Wang KP, Liu MC. Tracheobronchial stenosis from acid aspiration presenting as asthma. *Chest*. 2003 Feb;123(2):643-6. doi: 10.1378/chest.123.2.643.
6. Reiss LK, Uhlig U, Uhlig S. Models and mechanisms of acute lung injury caused by direct insults. *Eur J Cell Biol*. 2012 Jun-Jul;91(6-7):590-601. doi: 10.1016/j.ejcb.2011.11.004.
7. Stevens B, Koenig JQ, Rebolledo V, Hanley QS, Covert DS. Respiratory effects from the inhalation of hydrogen chloride in young adult asthmatics. *J Occup Med*. 1992 Sep;34(9):923-9.
8. Agency for toxic substances & disease registry (ATSDR). Medical Management Guidelines For Hydrogen Chloride. 2007. Available from: www.atsdr.cdc.gov/MHMI/mmg173.pdf.
9. Health Protection Agency (HPA). Hydrogen Chloride/ Hydrochloric Acid Toxicological Overview. 2007. Available from: www.gov.uk/government/uploads/system/uploads/attachment_data/file/337689/hpa_hydrogen_chloride_toxicological_overview_v1.pdf.
10. Shim E, Choe Y, Kim JH, Kang E-Y, Oh YW, Chung YJ, et al. Computed tomographic and radiological analysis of HCl injury in human lungs. *Mol Cell Toxicol*. 2014 Jan; 10:433-442. doi: 10.1007/s13273-014-0048-1.