



Awareness of Toxicity Induced by Chlorine

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1. Background

Chlorine is a strong oxidizing agent. Hypochlorous acid (HClO) as a simple form of chlorine is an anti-bacterial agent used in drinking water and public swimming pools (1). Because of the higher density of chlorine than the air, it tends to condensate at the bottom and accumulates at high concentrations and may lead to aggravating toxicity (2). Chlorine can be detected with high sensitive devices at 0.2 parts per million (ppm) and is detectable by smell at 3 ppm; the IDLH (immediately dangerous to life and health) concentration is very low at 10 ppm. The clinical presentations, such as coughing and vomiting may occur at 30 ppm and lung damage at 60 ppm. Also, exposure concentrations higher than 1000 ppm lead to significant increase in mortality. The occupational safety and health administration (OSHA) has set the acceptable exposure limit at 1 ppm. According to the recommendation of OSHA, exposure to chlorine must be limited to 0.5 ppm over 15 minutes (3, 4). Acute exposure can result in symptoms in the airway and lung, including chest discomfort and dyspnea. Even exposure to low concentrations of chlorine may cause eye manifestations, such as pain, burn sensation, irritation, blurred vision and eventually cataract or glaucoma. Skin and mucosal presentations include erythema, inflammation, irritation, pain, dermatitis, and ulcerations (5, 6).

1.1. Diagnosis

There are several diagnostic tests for further evaluation of exposed victims, including hypoxia, non-anion gap hyperchloremic metabolic acidosis, pulmonary edema, pneumonitis, and signs of ARDS and myocardial depression (i.e. assessment of pulse oximetry, serum electrolyte, blood urea nitrogen, arterial blood gas, creatinine

level, chest radiography, electrocardiogram, CT scan of the chest, ventilation-perfusion scan, pulmonary function tests, laryngoscopy or bronchoscopy) (7, 8). Chlorine gas was first used as a weapon in World War I by Germany in the Second Battle of Ypres. The soldiers complained about a combination smell of pepper and pineapple and metallic taste. Also, uncomfortable feeling in the throat, chest, and eyes was reported (9, 10). The Nobel laureate German scientist, Fritz Haber developed methods for discharging chlorine of an exposed soldier (11).

Treatment of chlorine inhalation is a supportive and conservative. Oxygen administration and mechanical ventilation are 2 beneficial treatments used in chlorine toxicity. Also, multiple drug therapies, such as corticosteroids, adrenergic, and anticholinergic bronchodilators, that are approved for other lung diseases, are useful in chlorine toxicity. However, these treatments control symptoms, but, do not ameliorate the primary pathogenesis (12).

Using chlorine in chemical warfare agents causes high concentrations of toxicity, and release of chlorine gas or liquid with high concentrations could cause significant damage. There are some reports of using chlorine in Syria and Iraq by ISIS and other terrorist groups (13). There have been many casualties from chlorine poisoning and skin reactions that referred to hospitals in Iran.

There are many specialists involved in treatment of patients who are poisoned with chlorine, including pulmonologists, cardiologists, nephrologists, radiologists, ophthalmologists, and dermatologists.

It is mandatory that all medical practitioners be familiar with chlorine poisoning, especially in the military settings.

Footnote

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