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Awareness of Toxicity Induced by Chlorine; Coming Back of an Old Chemical Agent

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1. Background

Chlorine is a strong oxidizing agent cause extremely high reactions during short-term exposure. Hypochlorous acid (HClO) as a simple form of chlorine is an anti-bacterial agent that is used in drinking water and public swimming pools. Also, there is some industrial applications of chlorine in the production of many chemical agents, such as polyvinyl chloride (PVC). As a consequence of chemical reactions with other chemical agents, chlorine in the liquid phase forms flammable dangerous decomposition gas products, such as chlorine gas (1). Because of the higher density of chlorine than the air, it tends to condensate at the bottom and accumulates at high concentrations. It can lead to aggravating toxicity (2). Chlorine can be detected with high sensitive devices at 0.2 parts per million (ppm) and is detectable by smelling 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 also, lung damages at 60 ppm. Also, exposure concentrations higher than 1000 ppm lead to significant increases 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 of airway and lung manifestations, including chest discomfort and dyspnea. Even exposure to low concentrations of chlorine may present eye manifestations, such as pain, burn sensation, irritation, blurred vision and eventually cataract or glaucoma. Skin and mucosal presentations are erythema, inflammation, irritation, pain, dermatitis, and ulcerations (5, 6).

1.1. Abnormalities

There are several diagnostic tests for further evaluation of the victims, including hypoxia, non-anion gap hyperchloremic metabolic acidosis, pulmonary edema, pneumonitis, and signs of ARDS and myocardial depression, for instance pulse oximetry, serum electrolyte, blood urea nitrogen (BUN), arterial blood gas (ABG), creatinine level, chest radiography, electrocardiogram (ECG), 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 of the back, 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 therapy. Oxygen administration and mechanical ventilation are 2 beneficial treatments that are 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 to humans. There are some reports of using chlorine in Syria and Iraq civil war by ISIS and other terrorist groups (13). There have been many casualties with presentations of chlorine poisoning and skin reactions that

have referred to hospitals in Iran. There are some concerns about the increasing number of terrorist groups and their brutal behaviors, especially in the Middle East.

There are many specialists involved with patients, who are poisoned with chlorine, including pulmonologists, cardiologists, nephrologists, radiologists, ophthalmologists, and dermatologists. Therefore, it is necessary for researchers to focus on the toxicity induced by chlorine. Also, researchers are recommended to design a sensitive and specific diagnostic tool to improve the accuracy of diagnosis.

It is mandatory for all medical practitioners to be familiar with chlorine poisoning, especially in Middle Eastern military settings. Also, it is important for commanders and soldiers to be familiar with chlorine toxicity, management, and clinical presentations.

Footnote

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