

CHLORINE GAS POISONING

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ABSTRACT

Objective: To describe a chlorine gas poisoning accident with regards to rapid diagnosis, proper treatment, prognosis, and outcome.

Methods: At King Hussein Air College, during Summer August 1999, the water supply unit was using chlorine gas pressurized in cylinders for decontamination of water. Sixteen patients were brought to the emergency room at King Hussein Air College medical clinic concomitantly, during a period of 2 hours, complaining of eye irritation, sneezing with nasal watery discharge, and difficulty in breathing, after exposure to chlorine gas leaking from cylinder. A specially designed record form was used containing patients complete history, physical examination, and initiation of treatment with oxygen mask and follow up of patients.

Results: All patients were exposed to chlorine gas prior to initiation of symptoms, the most common presenting symptoms were, eye irritation, and sneezing in 75% of patients (n=12), where the least common symptom was vomiting in 12.5% of patients (n=2). Remarkable improvement was obtained using humidified oxygen mask in 50% of patients (n=8), eight patients required bronchodilator nebulizer and four of them were given intravenous hydrocortisone that accounted for (25%) of cases. Follow up of all patients after 3 days in the chest clinic (King Hussein Hospital) showed that only 12.5% of patients (n=2) were found to have obstructive pattern of lung disease.

Conclusion: Workers in water supply units must be instructed about the dangers of chlorine gas leakage, the value of using protective masks, and follow the proper management of leaking cylinders. Physicians must act quickly and properly in management of chlorine gas exposure, having in mind the possible respiratory sequelae of chlorine gas inhalation (hyper reactive airway disease).

Key words: Chlorine gas, emergency management, hyper reactive airway disease, poisoning.

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Introduction

Chlorine gas is a greenish-yellow gas at room temperature and atmospheric pressure; normally it is transported as a pressurized liquid ⁽¹⁾. It has irritating odor and intermediate water solubility, which affects the upper and lower respiratory tract. It is used in metal fluxing, disinfection of water supplies and swimming pools, bleaching agents, pulp and paper manufacturing.

The response to chlorine gas exposure depends on: Concentration, duration of exposure, water content of the tissues exposed, and individual susceptibility.

Exposure to chlorine gas can cause mild mucous membrane irritation at 0.2 to 16 parts per million (ppm), eye irritation may occur at 7-8 ppm, throat irritation at 15ppm, and significant cough at 30ppm ⁽²⁾, while after

acute exposure to high concentration (100ppm), laryngeal edema with stridor, acute tracheobronchitis, chemical pneumonitis and non cardiogenic pulmonary edema have been described ⁽³⁾, however exposure to 1000ppm is fatal after a few deep breaths ⁽⁴⁾.

Reactive airway dysfunction syndrome (RADS) can be considered a type of occupational asthma; several cases of RADS have been documented after massive chlorine exposure ⁽⁵⁾.

Methods

At King Hussein Air College (KHAC), during summer August 1999, the water supply unit was using chlorine gas pressurized in cylinders for decontamination of water. The total number of potentially exposed

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personal was 100. Those who were directly exposed were 16 male patients aged 20-32 years, they were brought to KHAC medical clinic (emergency room) concomitantly, during a period of two hours, and we were informed by managerial directors in the college that these patients gave history of exposure to chlorine gas leaking from a cylinder.

Patients were complaining of cough, eye irritation, sneezing, difficulty in breathing, and headache.

The authors used a specially designed record form containing the patient's demographic characteristics including age and gender, physical examination, treatment, and follow-up.

All patients were interviewed by the same physicians, the interview was performed immediately after the accident about the location of exposure, duration of exposure specified by the majority of the cases as (≤ 5 , >5 minutes), intensity of exposure expressed by the patients as (minor, moderate and severe symptoms) as defined by the overall evaluation of the case taking in consideration the most severe clinical features (defined by the International Program on Chemical Safety, the Commission of the European Union and the European Association of Poison Centers and Clinical Toxicologists- IPCS/EC/EAPCCT) ⁽⁶⁾ and the use of protective measures

All patients were treated in the emergency room according to the presenting symptoms, and were followed up at KHAC family practitioner clinic for 3 days, then were referred to King Hussein hospital (chest clinic) for consultation, four patients were appointed for follow-up in the chest clinic, and the rest were followed up in the family practitioner clinic for 4 weeks.

Results

A total of (16) patients were brought to the emergency room by the ambulance with history of chlorine gas inhalation.

The water supply unit employees were 4 patients accounting for (25%) of cases, the rest (n=12) were inspectors and volunteers for help.

Table I shows the most common presenting symptoms, eye irritation and sneezing, which occurred in 75 % of patients respectively, however headache was the least common symptom (25%).

About 75 % of the patients were exposed while they were present in the opened area, which is the area about 50 meters in diameter in close vicinity to the closed area (storage room).

Duration of exposure was for 5 minutes and less. It was present in 56 % of patients as shown in Table I.

Most of the cases (75%) had minor and moderate symptoms as presented by Table I.

Table II demonstrates the most common presenting signs, redness of eyes and congested nasal mucosa (100%). Wheezy chest was present in 25% of the cases.

Four patients were referred for further follow up at chest clinic KHMC and 12 patients were followed

at the KHAC.

Two patients remained with bronchial-like asthma for three months and were treated accordingly. Further follow up to one year showed complete recovery.

The 12 patients followed at the family practitioner clinic were also completely cured.

Table II demonstrates that all the patients have eye, nose, and throat manifestations, while lower respiratory tract was present in 37.5% of the cases, and tachycardia was found in (43 %) of cases. No abnormalities were found in blood pressure and temperature recordings in the emergency room.

Discussion

Chlorine gas is a potent irritant of eyes, mucous membranes, and skin. It can cause pulmonary damage. The location and severity of respiratory tract involvement are functions of both concentration of chlorine and duration of exposure ⁽¹⁾.

The American Association of Poison Control Center data collection system listed 409 cases of chlorine exposure in 1990, that were reported from 72 participating centers serving 77% of the U.S. population ⁽⁷⁾.

In our study, no skin involvement was found, while severity of symptoms was related directly to the duration of exposure.

In this study, the short-term respiratory effects of acute chlorine inhalation lasted for 15-30 days, similar to what was reported by Agabiti N, and coworkers ⁽⁸⁾.

In 2 patients (12.5%), respiratory symptoms persisted up to 1 year, and were treated as reactive airways dysfunction syndrome (RADS), a condition that has been defined as occurring after one single inhalation accident ^(9,10). However; a lower incidence (8.%) of cases was reported by Gautrin *et al* ⁽¹¹⁾ (RADS).

Respiratory findings including wheezes were present in 37.5 % of our cases. In a chlorine gas poisoning accident, which occurred in Turkey and reported by Guloglu *et al* in 2002 ⁽¹²⁾ the wheezes were present in 27.5% of the cases.

The patients with (RADS), were the workers in the water supply unit, where they suffered high intensity and long duration exposure. A similar finding was reported by Leroyer *et al* ⁽⁵⁾.

Management of cases was carried out in our medical center, started by copious irrigation with normal saline to the eyes, supplemental oxygen by mask, salbutamol nebulizer was administered to 50% of cases. Intravenous steroids were given to 25% of cases, the later was advocated by some authors to prevent short-term reactions, and long-term sequelae while others did not recommend them due to insufficient clinical trails ⁽¹¹⁾.

Use of nebulized solution of sodium bicarbonate lacks sufficient clinical evidence so it was not used.

Up to the authors' knowledge, this is the second industrial accident which occurred in Jordan in the last 2

decades, the first one happened in 1990, in the storage section of the chlorine gas factory in Zarqa. No documentation for the previous accident was available to compare with.

Conclusion

Workers in water supply units must be instructed about

the dangers of chlorine gas. The value of using protective masks, and follow the proper management of leaking cylinders. Physicians must act quickly and properly in management of such cases, having in mind the respiratory sequelae of chlorine gas inhalation (hyper reactive airway disease).

Table I. Distribution of patients with Chlorine Gas Poisoning (n=16) according to presenting symptoms, area, duration, and intensity of exposure.

Item	No. of patients	%
Presenting symptoms		
Eye irritation	12	75.0
Sneezing	12	75.0
Cough	8	50.0
Difficult breathing	6	37.5
Retrosternal burn	5	31.5
Headache	4	25.0
Totals do not add to 100% because some patients may have more than one symptom		
Area of exposure		
Closed	4	25.0
Open	12	75.0
Total	16	100.0
Duration of exposure		
≤ 5 minutes	9	56.3
>5 minutes	7	43.7
Total	16	100.0
Intensity of exposure		
Mild	7	43.7
Moderate	5	31.3
Severe	4	25.0
Total	16	100.0

Table II. Distribution of cases according to physical findings.

Signs	Redness of eyes	Congested nasal & throat mucosa	Harsh breathing	Pulse >100/min	Wheezy chest
No. patient	16	16	6	7	4
%	100	100	37.5	43.8	25

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