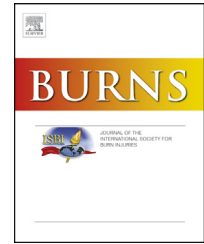


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Mass chemical casualties: Treatment of 41 patients with burns by anhydrous ammonia

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ARTICLE INFO

Article history:

Accepted 17 February 2015

Keywords:

Ammonia burns

Inhalation injury

Emergency management

Triage

Evacuation

ABSTRACT

Background: This article reports a chemical burn incident that occurred on 31 August 2013 in Shanghai. We describe situations at the scene, emergency management, triage, evacuation, and follow-up of the victims.

Method: The scene of the incident and information on the 41 victims of this industrial chemical incident were investigated. The emergency management, triage, evacuation, and hospitalization data of the patients were summarized.

Results: At the time of the incident, 58 employees were working in a closed refrigerator workshop, 41 of whom sustained burns following the leakage of anhydrous ammonia. Ten victims died of severe inhalation injury at the scene, and another five victims died during the process of evacuation to the nearest hospital. After receiving information on the incident, a contingency plan for the burn disaster was launched immediately, and a first-aid group and an emergency and triage group were dispatched by the Changhai Hospital to the scene to aid the medical organization, emergency management, triage, and evacuation. All casualties were first rushed to the nearest hospital by ambulance. The six most serious patients with inhalation injuries were evacuated to the Changhai Hospital and admitted to the burn intensive care unit (BICU) for further treatment, one of whom died of respiratory failure and pulmonary infection.

Conclusion: This mass casualty incident of anhydrous ammonia leakage caused potential devastating effects to the society, especially to the victims and their families. Early first-aid organization, emergency management, triage, and evacuation were of paramount importance, especially rapid evaluation of the severity of inhalation injury, and subsequent corresponding medical treatment. The prognosis of ammonia burns was poor and the sequelae were severe. Management and treatment lessons were drawn from this mass casualty chemical burn incident.

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<http://dx.doi.org/10.1016/j.burns.2015.02.016>

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1. Introduction

Ammonia burns are injuries clinically worth emphasizing characterized by significant morbidity and severe sequelae. As an important chemical, anhydrous ammonia is widely used in the refrigeration, fertilizer, and explosive industries [1]. It is a colorless gas with a pungent odor at room temperature. Anhydrous ammonia is usually pressurized under high pressure into a liquid for storage and transport. When liquid anhydrous ammonia is released into the atmosphere, it immediately starts to evaporate and lower the ambient temperature. Anhydrous ammonia is extremely soluble in water and then turns into ammonium hydroxide, which causes skin burn, eye injury, inhalation injury, and pulmonary blast injury to people in the vicinity [2]. Inhalation injury from anhydrous ammonia is a complex clinical problem, which can result in acute lung injury, progressive pulmonary dysfunction, infection, and even death [3,4].

There are many incidents involving anhydrous ammonia and associated with significant morbidity and mortality [5]. Retrospective analyses of these incidents have highlighted the need for the three most important aspects of incident management. First, communication systems are designed to facilitate immediate management in the event of an incident. Second, a predesigned plan of action, mobilizing resources and places for both emergency management and secondary receiving sites such as hospitals, is made available. Third, the implementation of appropriate assessment, triage, and life-saving first aid for victims in the field, with subsequent referral to designated tertiary centers for specialist management, is required [6]. However, the low frequency of ammonia incidents leads to a lack of experience in the medical organization at the scene, emergency management, triage, evacuation, and hospital treatment. The purpose of this article is to share and accumulate the experience, in order to aid the management and treatment of this kind of mass chemical burn casualties. The events of this incident provide a unique opportunity to draw lessons from observations of that day and its aftermath, to increase awareness of key management issues arising in mass chemical casualties.

2. Patients and methods of data analysis

The purpose of this article was to accumulate and share our experience on emergency management, triage, and evacuation of this incident. Therefore, the flowchart of the medical communication after the incident is the mainline of this study. When the ambulance dispatch center (ADC) received reports about the mass chemical incident, they immediately both dispatched ambulances nearby with crews to the incident site and reported to the Shanghai Municipal Health Bureau, which informed the Shanghai Burn Center of the Changhai Hospital, and the Dachang Hospital, a district-level hospital nearest to the incident location. One burn specialist and one ENT doctor assigned by the burn center arrived at the scene and started to organize on-the-spot first aid about 35 min after the incident (Fig. 1). An emergency and triage group was dispatched from

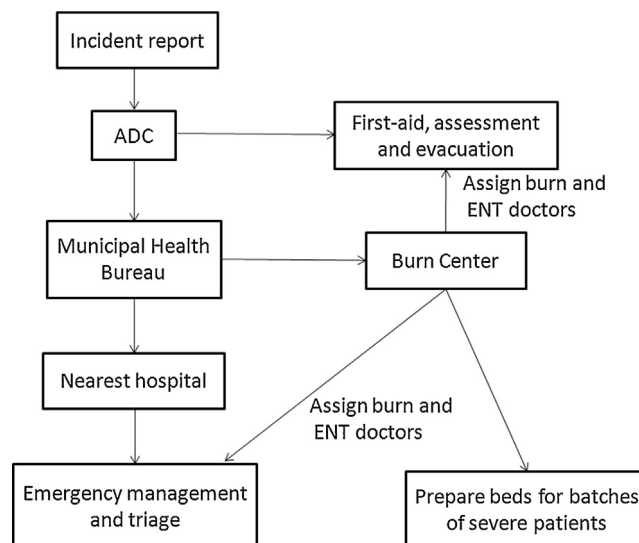


Fig. 1 – Flowchart of the medical communication after the incident occurred. When the ambulance dispatch center (ADC) received reports about the mass chemical incident, they immediately both dispatched ambulances nearby with crews to the incident site and reported to the Shanghai Municipal Health Bureau, which informed the Shanghai Burn Center of the Changhai Hospital, and the Dachang Hospital, the hospital nearest to the incident location. One burn specialist and one ENT doctor assigned by the burn center arrived at the scene and started to organize on-the-spot first aid. An emergency and triage group was dispatched to the Dachang hospital for direct subsequent emergency management, triage, and evacuation. Furthermore, the burn center prepared beds for receiving batches of severely injured patients.

the Dachang Hospital for direct subsequent emergency management, triage, and evacuation.

All data from 41 victims were included in the analysis. The final diagnoses of the hospitalized patients were based on their first clinical visit, hospital histories during hospitalization, and their discharge diagnoses. To reflect more details of the incident and patient data, the emergency management and hospitalization data of the patients were included in the analysis. Furthermore, the rehabilitation status of the five patients treated in the burn intensive care unit (BICU) was followed up for >1 year after the incident, and therapeutic outcomes were evaluated. This work was reviewed and approved by the ethics committee of the Changhai Hospital. All the data were expressed as mean \pm standard deviation.

3. Results

3.1. The scene of the incident

The incident occurred on 31 August 2013, a Saturday, at 10:50 a.m. in Baoshan District, Shanghai. Fifty-eight employees were working in a closed refrigerator workshop, about 450 m² in area. One nut of pipelines containing anhydrous ammonia

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