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Response of a local hospital to a burn disaster: Contributory factors leading to zero mortality outcomes

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ABSTRACT

Objective: To investigate the outcomes of a local healthcare system in managing a burn mass casualty incident (BMCI).
Methods: Thirty-three victims admitted to the National Taiwan University Hospital within 96h of the explosion were included in the study. Data were recorded on: patient demographics, Baux score, laboratory data, management response, treatment strategies, and outcomes. Case notes from June 27, 2015 to November 2015 were reviewed with a focus on fluid resuscitation, ventilation support, nutrition, infection control, sepsis treatment, and wound closure plan.
Results: Female predominance (mean age: 21.7 years) and lower extremity circumferential flame burns were the characteristics of the burn injury. The mean Baux score was 70±18. The mean burn area was 42% of the total body surface area (TBSA). A total of 79% patients arrived at the hospital within 24h of sustaining injuries. Intensive care unit (ICU) admission criteria were modified to accommodate patients with 40% TBSA of burns, facilities were expanded from 4 ICU beds to 18 beds, and new staff was recruited. A total of 36% patients (n=12/33, 62 ±13 TBSA of burns) required fluid resuscitation. The mean volume of Lactate Ringer administered in the first 24h of burns was 3.34±2.18ml/kg/%TBSA, while the mean volume of fresh frozen plasma administered was 0.60±0.63ml/kg/h. Forty-two percent patients were intubated on the day of admission, and 71% of the intubated patients had inhalation injuries that were confirmed by diagnostic bronchoscopy. The mean intubation period was 17 ±9 days. The incidence of pulmonary edema was 58% (n=7/12), possibly due to sub-optimal monitoring. Of these, 57% (n=4/7) patients progressed to adult respiratory distress syndrome, but were successfully treated with early strict fluid restriction, systemic antibiotics, ventilation support, and bronchial lavage. A total of 94% patients received grafting. The mean grafted area was 4432.3±3891 cm^2. Tube feeding was provided to patients with burns >40% TBSA. All patients tolerated gastric tube feeding without conversion to

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duodenal switch. On admission, all patients received prophylactic antibiotics. Septic shock was noted in 12 patients, but no mortality occurred. The mean hospital stay was 1.5 days per percent burn.

Conclusions: This article highlights the value of precise triage, traffic control, and effective resource allocation in treating a BMCI. Effective supporting systems for facility expansion, staff recruitment, medical supplies and clear-cut treatment strategies for severely burned patients are contributory factors leading to zero mortalities in our series, in addition to young age and minimal inhalation injuries. The need for reevaluation of the safety of cornstarch powder in festival activities is clear.

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1. Introduction

A response to a burn mass casualty incident (BMCI) is challenging, as an organized response is necessary to maintain the standard of care. While the International Federation of the Red Cross and Red Crescent Societies define a disaster as an event that causes more than 10 deaths, affects more than 100 people, or leads to an appeal for assistance by those affected, the Pan American Health Organization and World Health Organization defines a mass casualty incident as any event resulting in a number of victims large enough to disrupt the normal course of emergency and health care services. To improve survival, an organized response that requires a well preparedness plan is necessary. Although this response varies in different countries and regions because of differences in the healthcare system, medical standard of care, social culture, and infrastructure, sharing of response experiences in every event of BMCI is beneficial in plan refinement.

Dust explosions rarely occur outdoors. On June 27, 2015, in Taipei, Taiwan, during an open-air colored cornstarch party in a drained swimming pool, an explosion occurred when an overheated spotlight caused ignition of the colored dust that covered the party-goers and had settled on the floor of the empty pool. An attempt was made to extinguish the flames by using a carbon dioxide extinguisher, but over the next few seconds, large fireballs engulfed the crowd, causing 499 burn injury casualties.

The explosion initiated a system response at all administration levels [1]. Emergency medical technicians were the first responders who performed on-site triage by subjective injury severity assessment. Hundreds of victims were directed to 46 hospitals in 13 cities, thus congesting roads and crowding emergency wards in 4 to 6h. The following report describes the response of a local metropolitan burns center.

2. Methods

The study was based on data collected from 33 patients admitted to the National Taiwan University Hospital (NTUH). A retrospective review of the dust explosion event was performed. Data were collected for the following parameters: patient demographic, burn severity assessment, Baux score [2], laboratory data, management response, treatment strategies, and outcomes. Continuous variable data were expressed as mean and standard deviation. The hospital's Institutional Review Board waived the need for informed consent.

2.1. *Setting*

NTUH is a 2880-bed tertiary referral medical center located in northern Taiwan, which is situated 23.5 km from the disaster site. It has a 4-bed burns center.

3. Results

3.1. *Admissions*

On the disaster night, 17 patients arrived in the emergency ward. Another 17 patients were referred from other hospitals over the following days. The ICU admission criteria was modified to accommodate patients with burn sizes ≧40% total body surface area (TBSA) of burns instead of ≧20% TBSA (ICU admission criteria in non-BMCI burns). Eighteen patients were admitted in ICU care, while 15 patients were admitted in ward. The average emergency stay was 83±26 min (n=17). The patient demographic, laboratory findings, and locations of burns are shown in Table 1.

3.2. *ICU facility expansion, availability of operating rooms, staff management, and medical supplies*

In addition to the original burn ICU setting of 4 beds, 10 beds in respiratory ICU and 4 beds in trauma ICU were converted for burn care. Operating rooms were made available 24 h per day from Mondays to Saturdays. To increase capacity for surgical burn procedures, non-emergent reconstructive cases were diverted. In addition to two plastic surgeons and one resident in the ICU burn team, one attending physician each from the units of respiratory, anesthesiology, and infectious diseases were recruited, with six residents. Two plastic surgeons from private practice volunteered their help in operating rooms, and six retired burns nurses voluntarily attended ICU patients. Stocks of consumable items including antibiotics, topical silver sulfadiazine, blood, synthetic or semisynthetic dressings, allograft, dermatome blades, and cotton gauze were monitored to ensure maintenance of supply. Opened but unused gauze and blades were re-sterilized for use.

3.3. *Critical care*

3.3.1. *Ventilation support*

A total of 42% (n=14/33) patients were intubated on the day of admission (mean burn area: 63% TBSA), and 71% (n=10/14) of

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