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Original article

A descriptive analysis of injury triage, surge of medical demand, and resource use in an university hospital after 8.12 Tianjin Port Explosion, China

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ABSTRACT

Objective: The 8.12 Tianjin Port Explosion in 2015 caused heavy casualties. Pingjin Hospital, an affiliated college hospital in Tianjin, China participated in the rescue activities. This study aims to analyze the emergency medical response to this event and share experience with trauma physicians to optimize the use of medical resource and reduce mortality of critical patients.

Methods: As a trauma centre at the accident city, our hospital treated 298 patients. We retrospectively analyzed the data of emergency medical response, including injury triage, injury type, ICU patient flow, and medical resource use.

Results: There were totally 165 deaths, 8 missing, and 797 non-fatal injuries in this explosion. Our hospital treated 298 casualties in two surges of medical demand. The first one appeared at 1 h after explosion when 147 wounded were received and the second one at 4 h when 31 seriously injured patients were received, among whom 29 were transferred from Tianjin Emergency Center which was responsible for the scene injury triage. After reexamination and triage, only 11 cases were defined as critical ill patients. The over-triage rate reached as high as 62.07%. Seventeen patients underwent surgery and 17 patients were admitted to the intensive care unit.

Conclusions: The present pre-hospital system is incomplete and may induce two surges of medical demand. The first one has a much larger number of casualties than predicted but the injury level is mild; while the second one has less wounded but almost all of them are critical patients. The over-triage rate is high. The hospital emergency response can be improved by an effective re-triage and implementation of a hospital-wide damage control.

1. Introduction

In recent years, disaster events occur frequently and the disaster response plans have been updated accordingly.[1] However, they are only plans. All the data including the occurrence time and severity of the disaster, the condition of medical demand and the surge capacity of the local hospital are assumed.[2] The World Trade Center terrorist attack in 2001,[3,4] Madrid train bombings in 2004[5] and London subway bombings in 2005[6] are all mass casualty incidents, during which the number of wounded, pre-hospital care quality, and trauma nursing capability of local hospitals all go beyond the disaster response plans. Accurate evaluation and triage of mass wounded are the first step to reduce mortality. Over-triage will aggravate medical resource shortage and influence the treatment of critical patients.[7]

A great chemical fire & explosion occurred in Tianjin Port on the evening of August 12, 2015 and caused 165 deaths and 8 missing until September 15, 2015. As a local trauma center, our hospital received 298 wounded from this accident and here we retrospectively analyzed the patient flow and use of medical resource in the emergency department, imaging department, operation room and intensive care unit (ICU) in order to prove that in case of mass

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medical demand surge, the hospital response could be improved via optimization of medical resource and damage control.

2. Materials and methods

2.1. General data

This was a retrospective study focusing on 298 wounded treated in our hospital within 16 h after explosion. This study has been approved by the ethics committee of the hospital. Informed consent has been obtained from the patients or their families before any emergency treatment, monitoring or examination.

Our hospital is a Grade III, Class A hospital (highest level hospital) in east Tianjin, about 50 km (40 min driving distance) from the explosion scene. It has a national medical rescue team with 150 personnel, which has in recent years provided rescue and medical service to multiple disaster rescues.

2.2. Observation parameters

Data of trauma mortality were collected from the hospital database. Injury severity score (ISS)[8] was calculated. The patient with ISS score over 15 or proximal limb amputation was defined as a critical patient. Mortality of critical patients was calculated as: number of dead critical patients/total number of critical patients × 100%. The arrival time, number of patients transferred from emergency department to operation room or ICUs, use of auxiliary examination and requirement of surgery were recorded.

2.3. Statistical analysis

All the data were expressed as constituent ratio or percentage. SPSS 19.0 was adopted for statistic data analysis.

3. Results

3.1. Patients' characteristics

At 23:34 August 12, 2015 the fire & explosion attacked Tianjin Port. Our hospital was notified at 00:10 and a half hour later, i.e. 00:40, 1600 medical staff and another 50 interns and senior medical students from the rescue medicine major were on duty. As of 16:00 August 13, totally 298 patients were received and treated in our hospital. Among them 59 were hospitalized and 237 were handled for the wound. There were 11 wounded defined as critical patients.

Till September 15, 2015, 3 patients died and the critical patient mortality was 27.27%. The first patient suffered from hemorrhagic shock and cardiac arrest due to severe trauma in the evacuation to our hospital, who was sent to the emergency resuscitation room for cardiopulmonary resuscitation, but died in ICU later. The second patient was at the state of hemorrhagic shock, hypothermia and metabolic acidosis on admission to our hospital, who was transferred to ICU during fluid resuscitation for emergency surgery, but died after 2 h. The third patient was a severely burned patient (third degree, 75% burn surface area) and died of multiple organ dysfunction syndrome 15 days after admission.

3.2. Triage and transfer of the wounded

As the number of the wounded was not clear, the outpatient surgery and some internal medicine departments were set as a temporary trauma treatment unit, which was responsible by several treatment groups and each of the group consisted of one surgeon and one nurse. Emergency department was mainly responsible for the rapid examination, injury triage, and assignment of patients needing no hospitalization. Besides 4 trauma resuscitation units under the charge of the emergency department were open and each of them included two attending or higher level surgeons and two nurses. The necessity of special examinations (e.g. X-ray, CT, MRI, Ultrasound) and prioritized operation was proposed by the treatment group and jointly decided by the directors of the resuscitation unit and trauma treatment unit.

The first wounded was received at 00:10, and peaked between 00:10–01:10 when 147 patients were treated. All of them were dispatched by individuals or agencies other than 120 ambulances and none of them have undergone the process of triage. At 03:30, the wounded transferred from other hospitals or the ambulance arrived (Fig. 1). The hospitalization after injury triage was shown in Fig. 2. From the first medical demand surge, 262 patients were handled and 24 of them were hospitalized. The hospitalization rate per hundred outpatient and emergency patients was 9.16. For the second medical demand surge, there were 31 wounded and 30 of them were hospitalized including 28 burn patients. The hospitalization rate was 96.77. The rest 5 wounded patients were all burn patients arrived at 05:15–16:00 next day and all of them were hospitalized. The hospitalization rate was 100%.

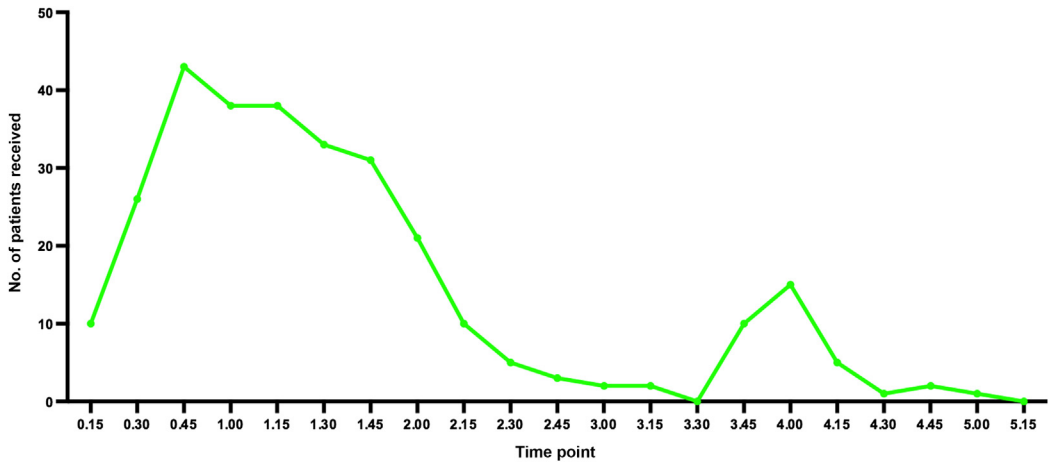

Fig. 1. Number of patients received at different time points (0.15 means 00:15 August 13, 2015). Two surges of medical demand appeared: the first surge at 0:15–3:15, with 262 patients received, and the second surge at 3:30–5:00, with 31 patients received.