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Evaluation of blast injury patients from the 2015 Tianjin explosions in China

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ARTICLE INFO

Article history:

Accepted 13 March 2016

Keywords:

Blast injury

Tianjin explosions

Burn

ABSTRACT

Objectives: To perform a descriptive analysis of blast injury patients from the Tianjin explosions that occurred August 12, 2015 and provide a reference for triage and treatment of patients in similar situations in the future.

Methods: The medical records of patients with blast injuries admitted to our hospital following the 2015 Tianjin explosions were retrospectively reviewed. The results were compared with the literature for other recent mass casualty events.

Results: The 75 patients with blast injuries included 58 men (77.3%) and 17 women (22.7%), who had an average age of 36.39 ± 12.3 years. Multidimensional injuries affecting almost every organ system were observed in these patients. The distribution of the types of blast injuries included 36 (48.0%) with primary blast injuries, 63 (84.0%) with secondary injuries, 33 (44.0%) with tertiary injuries and 32 (42.6%) with quaternary injuries. A total of 52 (69.3%) patients suffered more than two types of blast injury. Burns affecting different areas and different depths were present in 41.3% of the patients with blast injuries, and these were divided into the following four groups: a minor group (18.7%), a moderate group (10.7%), a severe group (5.3%), and an extra severe group (6.7%). The total body surface area (TBSA) affected by the burn ranged from 1% to 75%. Additionally, 6.7% of the patients were diagnosed with an inhalational injury, and 2.7% of the patients were diagnosed with chemical poisoning. There were significant differences in the department distribution (especially in the burn unit and ophthalmology department) and ICU treatment between civilians and firefighters.

Conclusion: Various types of injury, with overlapping injuries present in many patients, were observed in the victims after the Tianjin explosions. An evaluation of the distribution of blast injuries is important for optimizing strategies to triage and treat survivors after mass casualty events.

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<http://dx.doi.org/10.1016/j.burns.2016.03.004>

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1. Introduction

A large explosion in Tianjin occurred on August 12, 2015 at approximately 23:30 and was followed by a chain of explosions that killed 173 people (eight missing) and injured more than 700 [1,2]. The location of the explosions was a container storage station at the port of Tianjin where there were over 40 types of hazardous chemicals being stored according to related reports. These chemicals included potassium nitrate, sodium nitrate and sodium cyanide [3]. The complex and very toxic chemicals (including cyanide materials) made these explosions much more complicated than any other common explosion with regard to the condition of the injured patients. All victims were transferred to nearby hospitals, including Taida Hospital, Tanggu Hospital, Dongli Community Hospital, Affiliated Hospital of Logistic University of the Chinese People's Armed Police Force (PAP), Tianjin Third Central Hospital, and Tianjin Medical University General Hospital (Fig. 1). As a military general hospital whose preponderant discipline is rescue medicine, we integrated the rescue center, ICU center, wound center, burn center and blood-purification center, then set up the first clinical rescue center within China. A large number of patients were initially treated at our hospital after the explosions, and several patients with extra severe burns were also transferred from other hospitals to ours for further treatment.

Blast injury is a complex type of physical trauma resulting from direct or indirect exposure to an explosion [4]. Pathophysiologically, blast injuries are identified as primary, secondary, tertiary, or quaternary. Primary blast injuries occur when the blast overpressure reaches the person and transmitted forces exert their effect on the body, causing direct tissue damage. Secondary blast injuries are caused by flying fragments that are physically displaced by the blast overpressure or blast winds. Tertiary blast injuries are caused by displacement of the entire body, either from blast winds or structural collapse. Quaternary blast injuries are caused by the explosion but not categorized as primary, secondary, or tertiary injury [5-7].

Blast injuries can result from various types of explosions caused by incidents ranging from industrial or recreational

incidents to terrorist attacks [6]. Previously, the majority of blast injuries happened on the battlefield, however, with the complex changes in the domestic and international situation, explosions in civilian settings, such as bombing attacks, are taking place at an increasing rate [6-8]. Therefore, it is of crucial importance for first-aid personnel and emergency physicians to familiarize themselves with the myriad injuries caused by blasts [9]. In this report, we provide a descriptive analysis of the patients registered at the Affiliated Hospital of Logistics University of the Chinese PAP following the 2015 Tianjin Explosions and present the distribution of the four types of blast injury.

2. Material and methods

2.1. Study design

At 23:30 on August 12, 2015, a series of explosions occurred at a container storage station at the port of Tianjin, China. Within the first 7 days (August 13-19) after the explosions, 322 patients registered at the Affiliated Hospital of Logistics University of the Chinese PAP. Patient information was collected from the hospital registry systems. The time course of all these patients' arrival was recorded (Fig. 2). By 16:00 August 13, 298 patients had registered at our hospital, and the total number reached 322 during the 7-day period following the explosions. Among them, 231 patients with minor wounds left after simple emergency treatment, 90 patients were admitted to the hospital, and one patient died upon arrival in emergency department. Among the 90 patients admitted to the hospital, 75 patients with blast injuries were screened out for this study according to the following inclusion criteria: (1) patients with any type of blast injury (from primary to quaternary), (2) the cause of blast injury was the 2015 Tianjin explosions, and (3) the age of the patient was above 18.

This study retrospectively investigated the records of these selected patients. We collected the demographic data for the patients with blast injuries. Sociodemographic data such as the age, gender, occupation, and clinical characteristics including the department distribution, diagnosis (type of blast



Fig. 1 – Map of the area and the location of the hospitals received patients. The explosion happened at the point with five-pointed star. All the hospitals receiving wounded victims are shown as red cross.

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