

Profile and Management of Musculoskeletal Injuries Associated With the Lushan Earthquake in 2013

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ABSTRACT

On April 20, 2013, a 7.0-magnitude earthquake hit Lushan County, Ya'an City, Sichuan Province in southwest China. West China Hospital of Sichuan University, the largest and best hospital in Sichuan Province, is located in the city of Chengdu—about 100 km from the epicenter—and provided medical treatment to a total of 400 seismic patients. In this article, we retrospectively investigated 199 patients with musculoskeletal injuries who were treated in the Department of Orthopedics. Based on the seismic intensity distribution map, injury-occurring locations were divided into 5 grade-related areas: IX, VIII, VII, VI, and \leq V grade-area. The characteristics of seismic injuries were analyzed according to the geographic distribution of victims. We found that the constituent ratio of injury causes significantly differed in different earthquake areas according to the seismic intensity. (*Disaster Med Public Health Preparedness*. 2018;12:408-410)

Key Words: musculoskeletal injury, earthquake, epidemiology

At 8:02 am Beijing time on April 20, 2013, a 7.0-magnitude earthquake hit Lushan County, Ya'an City, Sichuan Province in southwest China. According to the official reports,¹ there were 196 people dead, 21 missing, and 11 470 injured in this disaster. Just 160 km away from Lushan County and about 5 years before this earthquake, an even more devastating earthquake had occurred in Wenchuan County. Based on the experience gained from the Wenchuan earthquake, the Chinese government and various departments responded more quickly this time. Medical rescue teams were dispatched sooner, and wounded persons were transported out of the earthquake areas faster. West China Hospital of Sichuan University, the largest and best hospital in Sichuan Province, is in the city of Chengdu (about 100 km from the epicenter) and provided medical treatment to most severely injured patients. There were a total of 400 seismic patients admitted in West China Hospital from all counties and cities that had been affected by the earthquake.

In this study, we retrospectively investigated 199 patients with musculoskeletal injuries who were admitted to the Department of Orthopedics of West China Hospital. We analyzed the characteristics of seismic injuries according to the geographic distribution of victims, which would provide valuable information for future earthquake disaster relief. This study was approved by the Ethics Committee of the West China Hospital with the informed consent unrequired.

METHODS

Two hours after the earthquake hit, West China Hospital dispatched 1 medical rescue team comprised

of experts and nurses in intensive care, orthopedics, general surgery, neurosurgery, thoracic surgery, pediatric surgery, infection, and nephrology, with 15 ambulances sent to transport injured patients out. The triage of all patients admitted to our hospital was performed by the Emergency Department. A total of 199 patients with musculoskeletal injuries were admitted to the Department of Orthopedics.

After caring for life-threatening injuries, debridements were performed as soon as possible for open injuries. Open fractures were treated with external fixations if long-time fixation was needed. Vacuum sealing drainage (VSD) was used on the surface or in the cavity of the wound that could not be first-phase closed. Patients with close fractures who did not need surgeries were treated conservatively with plaster external fixation or traction therapy and then transferred to the Department of Rehabilitation. Patients with closed fractures who needed surgeries were also given primary conservation treatments before internal fixations. Amputations were preferred to patients with difficult-to-repair Gustilo grade IIIc injury. Fasciotomies were undertaken once compartment syndrome had been discounted. Bacterial culture was undertaken at admission for every patient with an open injury and for patients with questionable wounds in the hospital. The administration of cefazolin sodium or clindamycin began for all patients with open injuries after bacterial cultures. Changes were made on the basis of drug sensitivity test results. When plasma hemoglobin concentration was below 60 g/L, blood transfusion would be given.

We retrospectively reviewed the medical records of these patients, including demographic data, complaints,

diagnoses, injury causes, injury-occurring locations, injury types, injury sites on the body, crush syndrome, and operations. Then we transformed these records into the Access database. All records were reviewed by 2 authors independently. According to age, there were 6 groups: <16, 16–25, 26–40, 41–60, 61–80, and >80. In terms of the seismic intensity, injury-occurring locations were divided into 5 grade-related areas: IX, VIII, VII, VI and \leq V grade-area, based on the seismic intensity distribution map from the China Earthquake Administration and the work of Sun et al.² The characteristics of seismic injuries were analyzed according to the grade-related areas. The injury causes were divided into 3 classifications: high falling injury, blunt trauma or crush-related injury, and injury caused by one's carelessness, such as the sprain or fall of frightened people when running.

RESULTS

The mean age of the 199 seismic victims was 45.6 ± 21.6 years (7–102 years). Children <16 years accounted for 8.0% ($n = 15$), and older people >60 years accounted for 23.6% ($n = 47$). There were 102 males (51.3%) and 97 females (48.7%). There were 41 cases (20.6%) of open fractures and 47 cases (23.6%) of multiple fractures. Out of all 40 patients with combined injuries, there were 5 cases of traumatic shock, 7 cases of paraplegia, 1 case of traumatic pancreatitis, 1 case of intussusception, 3 cases of hemopneumothorax, 6 cases of brain injury, 2 cases of bladder and urethra injury, 3 cases of liver or kidney contusion, 3 cases of respiratory failure, but no cases of multiple organ failure and death. One patient whose legs were pressed under heavy objects for 9 hours had crush syndrome but without severe renal failure. Four patients with lower leg injury had compartment syndrome, and all underwent fasciotomies.

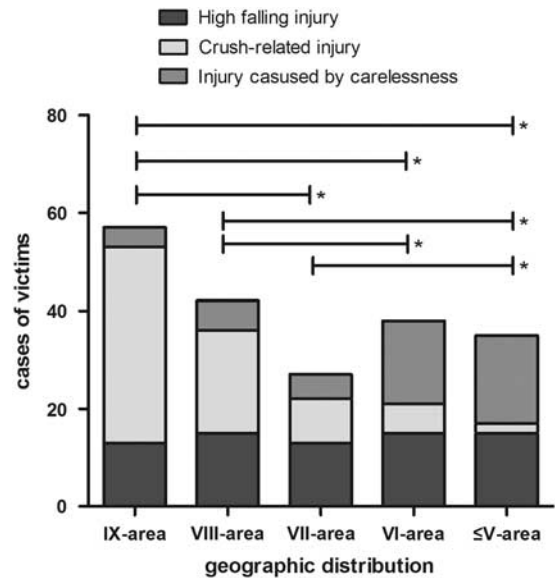
There were 78 cases (39.2%) of blunt trauma or crush-related injury as the most frequent injury cause. The constituent ratio of injury causes was significantly different among 5 grade-areas of injury-occurring locations ($P < 0.001$) (Figure 1). However, between any two adjacent grade-areas, there was no significant difference. With the decrease of the seismic intensity, there was a significant decline in the ratio of cases of blunt trauma or crush-related injury ($P < 0.001$). There was also a significant difference in the ratio of cases of injury caused by one's carelessness among 5 grade-areas ($P < 0.001$), while no significant difference in the ratio of cases of high falling injury ($P = 0.138$).

DISCUSSION

Generally, the most common type of earthquake injury is musculoskeletal system injury, which has been proven in many previous reports.^{3–6} In our study, of 400 earthquake patients hospitalized, there were at least 199 patients with soft tissue injury and fracture. Except when combined with other vital organ injuries, most musculoskeletal system injuries are treated in the Department of Orthopedics. Orthopedists often

FIGURE 1

Geographic distribution of victims. There was no significant difference in the constituent ratio of injury causes between any two adjacent grade-related areas, while there was significant difference between any 2 nonadjacent areas.



*mean $P < 0.05$

played a very important role in disaster relief. It is meaningful work to document the musculoskeletal injuries associated with earthquakes to draw lessons and sum up experiences after each earthquake, especially for medical and health agencies in frequent earthquake areas. Analyzing the characteristics of every earthquake and profiles of injuries associated with earthquake—and then searching the relationship between them—will provide support in taking precautions against earthquakes and planning for future earthquake disaster relief.

Compared with the Wenchuan earthquake,^{6–8} the injury causes showed a great change in the Lushan earthquake. In the Wenchuan earthquake, there were 79.6% of seismic victims with blunt trauma or crush-related injury,⁹ while in the Lushan earthquake, the ratio of cases of blunt trauma or crush-related injury was 39.2%, less than the ratio of the other injury causes (60.8%). The smaller magnitude might account for this to a great extent. There was a great ratio of cases of high falling injury (35.7%) and injuries caused by carelessness (25.1%), even for those in an area far from the epicenter. Given that most victims in the Lushan earthquake had also experienced the Wenchuan earthquake, we guessed that most people overreacted with great fear when facing another earthquake disaster. As a result of the change of injury causes, there were fewer patients with open fractures (20.6%) and more older people injured in the Lushan

earthquake. Seen from another angle, these results might indirectly reflect the lack of the general public's self-rescue knowledge and the deficiency of the government in natural disaster education. In addition to enhancing the earthquake resistance of buildings, the government should reinforce the education and training of the public against natural disasters and in how to self-rescue in an emergency.

This study showed that the constituent ratios of injury causes differed according to geographic distribution of the earthquake victims. Near the epicenter, there were more cases of blunt trauma or crush-related injury, which were mainly caused by collapsing buildings. In this study, in the IX grade-area, which was nearest the epicenter, cases of blunt trauma or crush-related injury accounted for 70.2% of victims, while only 5.7% were in the $\leq V$ grade-area. However, there might be many other factors that have an influence on this result, such as economic level, building heights and construction, demography in different areas, and so on. This is a limitation of this article. In spite of this, the results still present injury characteristics according to geographic distribution and suggest that it is important to provide rational and targeted medicine service in earthquake disasters.

There are some aspects of treatment for earthquake patients that we need to improve. After the earthquake occurred, in order to treat as many patients as possible in a short time, we preferred the easy and effective treatment plan rather than the best one. Part of the patients with early close fractures without soft tissue edema could be treated by emergency surgery, but we preferred primary conservative treatment and later surgery for these people. Moreover, as for all open fractures that needed long-time fixation, we preferred external fixations, while some patients with relatively clean wounds could be treated by primary internal fixation. Finally, there were fewer earthquake patients admitted to our hospital than expected; consequently, 19 cases treated by external fixations underwent second internal fixations. As a result of our treatment plan, there were longer hospital stays and higher costs. Therefore, we recommend that when an earthquake occurs, medical institutions should make a treatment plan for earthquake patients based on the preliminary assessment of the casualties, in consideration of the magnitude of the earthquake and the population density in the earthquake areas.

In conclusion, the constituent ratio of injury causes significantly differed in different earthquake areas according to the seismic intensity, although many other factors might be involved. Each earthquake has unique situations. We should make a treatment plan based on the preliminary assessment of each earthquake. Although at present we cannot prevent or

define an earthquake, we can study it and fight against it using our intelligence and wisdom. Every earthquake is a brick in our experience-building. Knowledge and experience from the investigation of each disaster will greatly help in future disaster relief.

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Supplementary material

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