



Clinical profile of musculoskeletal injuries associated with the 2008 Wenchuan earthquake in China

Çin'deki 2008 Wenchuan depreminde olan kas iskelet yaralanmalarının klinik profili

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BACKGROUND

The Wenchuan earthquake was an enormous devastating disaster and caused mass casualties. The descriptive analysis presented here serves as a reference not only for present injury intervention but also for future earthquake disaster response.

METHODS

A total of 205 patients with a musculoskeletal injury were admitted in two teaching hospitals. We conducted a retrospective review of medical records to document the injury profile, chief complaints, damage locations and types, subsequent treatment, and prognosis.

RESULTS

Of the 205 patients, fracture was the major type of injury (78.0%). Forty patients were determined to have crush injuries and 19 patients had crush syndromes. Open fractures, multiple fractures and comminuted fractures were common. Fracture-associated neural injuries and trauma-associated infections were also common. Surgical treatments included debridement, bone traction, external fixation, open reduction and internal fixation, and spinal fixation. All the patients were effectively treated with few complications, a low deformity rate and no death.

CONCLUSION

For emergency conditions after a major earthquake, pre-hospital emergency care is highly important. After the patients are transported to the hospital, we should plan individualized treatment according to the patients' respective clinical features, and at the same time, prevent and cure the related complications in a timely manner in order to reduce mortality and disability rates.

Key Words: Earthquake; injury; injury profile; musculoskeletal injury.

AMAÇ

Wenchuan depremi, kitlesel yaralanmalara yol açan çok büyük yıkıcı felaketlere neden olmuştur. Burada sunulan tanımlayıcı analiz, yalnızca mevcut çalışma için değil aynı zamanda daha sonraki deprem felaketi yanıtı için de bir kaynak olarak hizmet etmektedir.

GEREÇ VE YÖNTEM

Kas iskelet yaralanması bulunan toplam 205 hasta, iki eğitim hastanesine kabul edildi. Yaralanma profili, yakınmalar, hasar yerleşimleri ile tipleri, tedavi ve prognoz bilgilerini içeren tıbbi kayıtlar geriye dönük olarak değerlendirildi.

BULGULAR

Hastaların 205'inde majör yaralanma kırık (%78,0) idi. On dokuzunda ezilme sendromu olmak üzere ezilme yaralanması bulunan 40 hasta vardı. Açık kırıklar, çoklu kırıklar ve parçalanmış kırıklar yaygındı. Sinir yaralanmalarıyla birlikte olan kırıklar ve enfeksiyonlarla birlikte olan travma da yaygındı. Yapılan cerrahi tedaviler şöyledi: Debridman, kemik traksiyonu, eksternal fiksasyon, açık redüksiyon, internal fiksasyon ve spinal fiksasyon. Bütün hastalar, birkaç komplikasyon, düşük deformite oranı ile etkin bir şekilde tedavi edildi ve hiçbir ölüm görülmedi.

SONUÇ

Büyük bir depremden sonraki acil durum ile ilgili olarak, hastane öncesi acil bakım çok önemlidir. Hastalar hastaneye nakledildikten sonra, hastaların kendi klinik özelliklerine göre kişiselleştirilmiş tedavi uygulamalı ve aynı zamanda mortalite oranı ile sakatlık oranını azaltmak üzere ilişkili komplikasyonları önlemeli ve zamanında tedavi etmeliyiz.

Anahtar Sözcükler: Deprem; yaralanma; yaralanma profili; kas iskelet yaralanması.

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RESULTS

An earthquake registering 8.0 on the Richter scale struck the eastern Sichuan Province of China on 12 May 2008, and according to a report from the Chinese Ministry of Civil Affairs, a total of 69,142 people were confirmed dead, more than 374,000 were seriously injured, and more than 18,000 were reported missing. The widespread effect of the quake destroyed many cities and countless villages, and most hospitals in the earthquake zone were completely or partially destroyed. More important was that thousands of injuries required immediate treatment. The epicentral region was nearly isolated from the outside world for approximately one month, so the rescue work was very difficult, resulting in a higher mortality rate and disability rate. Nevertheless, we still did our best to rescue every survivor, and have accumulated much valuable experience on the handling of emergencies during the rescue process. It is well known that the medical response to emergency conditions after a catastrophe in developing countries has been poorly documented;^[1] serious disasters should be studied retrospectively so that we can learn how to improve the overall level of emergency medical services. The challenges, problems and needs no longer differ between countries, and creating specialized search and rescue teams might be useful.^[2]

In the present study, to better understand the types of injuries that may occur and provide valuable information for injury intervention, a profile of musculoskeletal trauma care service in two teaching hospitals is briefly outlined and recommendations made.

MATERIALS AND METHODS

In this study, we recorded the musculoskeletal injuries of patients, a total of 205 cases, who had been transported to the First and Second Affiliated Hospitals of Chongqing Medical University from 13 May to 10 June 2008. All the patients were referred to the two hospitals directly from the earthquake zone by car or train, and most of them received first-aid treatment. Many underwent such emergency operations as early debridement, amputation, thoracic closed drainage, brain decompression procedure, and simple fixation of fracture, but none received definitive treatment. We conducted standardized injury categorizations according to a reported procedure, with modifications. The diagnosis for the injuries was based on the final hospital diagnosis made by the physicians of the hospitals. The severity of injuries was determined by Injury Severity Score (ISS) and mild ($ISS \leq 8$), moderate ($9 \leq ISS \leq 14$) and severe ($ISS \geq 15$) wounds were classified according to the ISS scores.^[3,4] We conducted an injury profile of all patients with musculoskeletal injuries, and recorded the age, gender, fracture site and types, infections, peripheral nerve injuries, and treatments. Finally, the data were analyzed using descriptive statistics.

In the two teaching hospitals, 249 individuals including 205 patients with a musculoskeletal injury were admitted due to injuries resulting from the earthquake. One hundred and twenty-nine patients with a musculoskeletal injury were treated in the First Affiliated Hospital, and 76 cases in the Second Affiliated Hospital. The mean age of the patients was 39.7 years (range: 6-85 years) (Fig. 1), and the mean time from rescue to first medical aid was 16.5 hours (h) (range: 0.3 h-4.8 days [d]). Eighty-six patients (42%) were male and 119 (58%) were female. Thirty-two percent ($n=63$) (36 females and 27 males) were over the age of 60. Of the 205 patients, 44.5% had an ISS score <8 , 42.3% had an ISS score between 9 and 14, and 13.2% had an ISS score >15 .

Profile of Injuries

Among the 205 patients with musculoskeletal injuries, 160 patients (78%) had fractures, 18 patients (8.6%) had compartment syndrome and 21 (10%) had major soft tissue injury. Forty patients had crush injuries, 19 patients crush syndromes and 10 patients post-amputation before admission to the two affiliated hospitals. Fifteen patients had concurrent hemopneumothorax and 9 patients had concurrent abdominal injury. Ten patients suffered from acute renal failure, 8 patients from head injury, and 12 patients had paraplegia, which was associated with vertebral fractures in all. Fifty-five patients had open fractures, 112 multiple fractures and 51 comminuted fractures. Table 1 shows the distribution of fractures based on anatomical site.

Peripheral Nerve Injury

Forty-one (20%) patients had peripheral nerve injuries, of a total of 61 cases of peripheral nerve. These included radial nerve (14 cases), ulnar nerve (11 cases), common peroneal nerve (11 cases), median nerve (4 cases), brachial plexus nerve (1 case), femoral nerve (7 cases), obturator nerve (3 cases), and sciatic nerve (10 cases) injuries. All the radial nerve injuries were associated with fractures (9 with humeral shaft fractures). Eight cases of sciatic nerve injury were associated with lower limb fractures or dislocations.

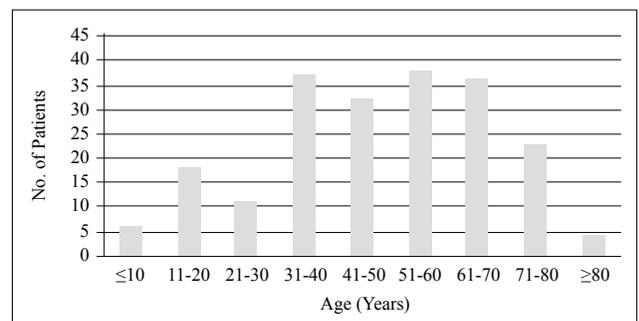


Fig. 1. Age distribution of patients admitted to the two teaching hospitals.

Table 1. Distribution of fractures based on anatomical site

Localization	Frequency	Percent
Upper limb fractures	63	18.1%
Humerus	23	6.6%
Radius	16	4.6%
Ulna	14	4.0%
Metacarpus&bones of fingers	10	2.9%
Lower limb fractures	176	50.4%
Acetabulum	6	1.7%
Femur	38	10.9%
Pelvic bones	3	0.9%
Tibiofibula	81	23.2%
Ankle	19	5.4%
Calcaneus	13	3.7%
Talus	6	1.7%
Metatarsal bone	5	1.4%
Bone of toe	5	1.4%
Spine	50	14.3%
Pelvis	20	5.7%
Scapula	7	2%
Ribs	25	7.2%
Clavicle	8	2.3%

Infection

There were 71 patients (34.6%) with infection among the 205 patients with musculoskeletal injuries. These included 12 cases with bacillus aerogenes capsulatus, 11 cases with *Staphylococcus aureus*, 14 cases with *Escherichia coli*, 2 cases of tetanus bacillus, 9 cases with *Pseudomonas aeruginosa*, and 17 other kinds of bacteria in 23 cases. Most of them were combined anaerobic infections, and there was no case of sepsis.

Surgical Treatment

The surgical methods included debridement, bone traction, external fixation, open reduction and internal fixation, and spinal fixation. Table 2 shows the detailed documentation.

Prognosis

All 205 patients with musculoskeletal injuries survived after treatments. The average length of stay in

the hospital was 29 days (range: 1-108 days). Anemia, acute renal failure and acidosis were corrected in the first 3-5 days. Definitive operations were performed after 3 days on average (range: 0-8 days) after admission. Out of the 64 patients with infected wounds, 63 achieved good healing and 1 recovered after a re-amputation operation. Those with radial nerve, ulnar nerve and obturator nerve injury had a better recovery, followed by those with femoral nerve and sciatic nerve injury, while those with lumbosacral plexus, partial brachial plexus and median nerve injury had the poorest outcome. Patients with paraplegia improved by two Frankel levels.

DISCUSSION

Earthquakes are the most destructive of the natural disasters. Over 500,000 earthquakes are reported each year worldwide, and every year 8,000 people die and 26,000 are injured due to earthquakes.^[5] They always occur suddenly, can cause enormous destructive and heavy casualties, and also trigger many complex social problems.^[6] Scientists worldwide have long been studying earthquakes, but our understanding remains obviously inadequate. Dealing with casualties in settings of disaster is one of the challenging topics in trauma management. Efforts of medical experts throughout the world have been given to target how to remove the wounded from danger as soon as possible, give them better access to treatment, and obtain the best functional recovery after the disaster.

Though the overall burden of injury is expected to increase during the coming decades, particularly in developing countries,^[7,8] given the fast economic development in China, the injury rates and injury-related mortality have decreased over the past 20 years.^[9] However, as is well known, there were a great number of deaths and disabilities as a result of the large Wenchuan earthquake. On the basis of our report, we thought that, in addition to the strong destructiveness of the Wenchuan earthquake, the following reasons also contributed to the high mortality and disability rates: most medical centers in the disaster zone were

Table 2. Numbers of different procedures performed in patients

Surgical treatment	Number of procedures	Percent
Debridement	117	47.6%
Once	18	
Twice	52	
Three times or more	47	
Bone traction	27	10.9%
External fixation	32	13.0%
Open reduction and internal fixation	51	20.7%
Spinal fixation	19	7.8%
Anterior fixation	16	
Posterior fixation	3	

damaged, and the first-aid teams experienced long delays reaching patients (mean: 16.5 hours). This shows the lack of coordination and irregularities that exist in the first hours of a catastrophe and the lack of appropriate systems for addressing the needs in such situations. In other words, the pre-hospital trauma care services and the emergency medical center (first-aid station) in China require further development.

Our report showed that, as noticed above, the rate of musculoskeletal injuries was higher than that of other systems in the major earthquake. A previous report declared that in the first few days, the medical teams concentrated on treating injuries caused directly by the earthquake.^[10] Surgical and orthopedic staff are the main medical disciplines needed at this stage.^[10-17] Thus, we believe that surgical and orthopedic staff must be prepared for requested changes to their mode of activity and for extreme conditions.

Since there are large numbers of victims following a major earthquake, better epidemiological knowledge of the profiling of injury types caused by earthquakes will be very important in improving disaster relief.^[18-23] In this study, we focused on the profile of musculoskeletal injuries and summarized their characteristics as follows: 1) Most cases had fractures; limb fractures were predominant, followed by spinal fractures. The number of lower limb fractures was more than of upper limb fractures; 2) Multiple fractures and comminuted fractures accounted for a substantial proportion of all patients with fractures (multiple fractures for 70%; 112/160); 3) Many patients in our report had accompanying infections, up to 34.6%, and the proportion was much higher than in the 1999 earthquake in Marmara, Turkey, which measured 7.4 on the Richter scale.^[24] Infections with gram-negative bacteria and anaerobic bacteria occupied a large proportion; and 4) The incidence of peripheral nerve injuries was as high as 20%, and lower limb nerve injuries were seen most frequently among all peripheral nerve injuries. Paraplegia was present in 30% of nerve injury cases.

Based on the above-mentioned clinical features, we suggest that:

1) Facing a major natural disaster, pre-hospital emergency care is very important; thus, the emergency medical centers should be spread out over respective national vast geographic regions, and the pre-hospital emergency medical service system should also be enhanced by training more people (both health professionals and lay people).

2) Because many patients present with fractures as a result of a major earthquake, orthopedic surgical equipment and medication may be the most critically needed immediately after earthquakes. We should assemble orthopedic-related medication and surgical

equipment, and allocate them promptly after a major earthquake.

3) Open wounds should be operated early and thorough debridement performed. These are the most important infection control measures, together with thorough hemostasis, removal of all necrotic and inactive tissue, decompression fasciotomy, removal of foreign body, and maintenance of unobstructed drainage, etc.

Debridement procedures may be repeated as often as necessary to obtain a clean wound, especially for infections with bacillus aerogenes capsulatus and bacillus tetani. At the same time, anti-infective therapy is also necessary. Additionally, hyperbaric oxygen treatment would be good for patients with anaerobic bacterial infection.

4) We should strengthen systemic support treatment, including maintaining fluid and electrolyte balance, correcting metabolic disorders, correcting anemia and low protein deficiency, maintaining essential organ function and nutritional support, ensuring open airway, urethra and infusion channel in critical patients.

5) We should treat trauma-related complications, such as deep venous thrombosis and stress ulcer, in a timely manner. The focal points of treating seismic injuries can be divided into two main stages: a) prophase: save lives of trauma patients; and b) ana-phase: treat trauma-related complications. We must therefore attach importance to the late treatment of complications to reduce mortality and disability.

6) All treatments for injured patients must comply with the rule of the ABCDE approach. The degree of threat to life posed by each injury is determined by considering the order of priorities, as revealed by the primary survey of the patient, and applying those same principles to groups of patients. Thus, a patient with an airway or breathing problem has priority over a patient with circulatory or neurological disability.

7) More than one-third of the patients were over 60 years of age, generally with additional underlying diseases, such as hypertension, diabetes, etc., various complications, and even with impaired organ functions, thus indicating that these age groups would require the greatest occupancy and medical resources.

In conclusion, it is obviously not feasible at present to prevent the occurrence of an earthquake or to predict the time, location and severity of earthquake damage and the resultant injuries; however, analysis profile of the injuries and clinical features of patients with musculoskeletal injuries associated with the Wenchuan earthquake will positively impact rescue efforts and treatment of musculoskeletal injuries caused by possible future natural disasters.

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