Introduction

On May 12, 2008 at 14:28, a large earthquake measuring 8.0 on the Richter scale struck Wenchuan County in the Sichuan Province of China. According to official records, the earthquake led to 69,226 deaths, 379,640 injuries, and approximately 17,939 people reported missing. The severity and scale of this earthquake had seldom been seen in China or elsewhere in the world. Injured patients were sent to several hospitals in nearby cities.

Of injured victims, aged people are more vulnerable, and have a higher risk of death because they usually also suffer from primary diseases. Until now, no articles have specifically addressed the clinical features of traumatized geriatric patients in the earthquake. West China Hospital of Sichuan University, as the only large-scale and state-level general teaching hospital in the earthquake-affected area, received the vast majority of patients hospitalized with earthquake-related injuries (a total of 2,728 cases, 872 were treated in the

A RETROSPECTIVE STUDY OF GERIATRIC TRAUMA AT A LARGE TEACHING HOSPITAL AFTER THE 2008 WENCHUAN EARTHQUAKE

Jin Wen1, Chen-Lu Yang2†, Ying-Kang Shi3*, You-Ping Li1, Yu-Lin Ji4, Jin Liu4

1The Chinese Evidence-based Medicine Center & Department of Clinical Epidemiology, West China Hospital, Sichuan University, 2West China Medical School, Sichuan University, 3Department of Thoracic & Cardiovascular Surgery, West China Hospital, Sichuan University, and 4Department of Science and Technology, West China Hospital, Sichuan University, Chengdu, China.

SUMMARY

Background: On May 12, 2008, a large earthquake measuring 8.0 on the Richter scale struck Wenchuan County, Sichuan Province, China. To date, there has been no report specifically addressing the clinical features of traumatized geriatric patients in the earthquake. The objective of this study was to review the characteristics of injuries among aged inpatients and provide some experiences of emergency management for traumatized geriatric patients.

Methods: Medical records of earthquake-related geriatric inpatients in West China Hospital were reviewed retrospectively.

Results: Of the 1,856 inpatients, 400 (21.6%) were ≥65 years old. Extremity, trunk and head injuries were present in 240 (60.0%), 102 (25.5%), and 37 (9.2%) patients, respectively. Fracture (68.5%, n = 274) was the most common type of injury. The mortality of earthquake-related geriatric patients was 4.8%, which was higher than that of all earthquake-related patients.

Conclusion: Fracture was the most common type of trauma and the extremities were the predominant sites among geriatrics after the Wenchuan earthquake. The mortality of elderly inpatients was higher than that of other age groups. Considering the difficulty and complexity of managing patients with earthquake-related injuries, a multidisciplinary team of physicians should be organized as soon as possible after an earthquake.

emergency department and 1,856 were hospitalized up until 23 July, 2008. The purpose of this study was to review the clinical characteristics of aged inpatients in the hospital, and provide some experiences of emergency management of traumatized geriatric patients.

Patients and Methods

Informed consent was not necessary for this study which used existing data. The Institutional Review Board of West China Hospital in Sichuan University approved this study.

We retrospectively reviewed the medical records of earthquake-related geriatric inpatients (defined as ≥65 years old) who were transferred to our hospital after the earthquake. The following information was extracted: (1) age; (2) gender; (3) date of admission; (4) diagnosis; (5) location of injury; and (6) type of injury. Locations of injuries were classified as: (1) extremity; (2) trunk; (3) head; and (4) others. Injuries to the extremities were further categorized as: fracture, joint injury, amputation, and minor trauma. Trunk injuries included fracture, visceral injury, and minor trauma. Head injuries constituted craniocerebral injury, skull fracture, ocular injury, and minor trauma. To clarify, minor trauma was defined as soft tissue injury, laceration, or superficial injury. Visceral injury referred to injury to organs in the body cavity and included pneumothorax, hemothorax, and contusion of the lung, spleen or kidney. Craniocerebral injury was defined as injury to the brain, including cerebral hemorrhage, brain contusion, brain infarction and aphasia. Fracture, visceral injury, and craniocerebral injury were diagnosed using computerized tomography scanning or magnetic resonance imaging, along with clinical symptoms. In this study, patients with multiple injuries were counted separately for each type of injury.

Statistical analyses were performed using descriptive methods and SPSS version 15.0 (SPSS Inc., Chicago, IL, USA). Categorical variables are presented as frequencies and percentages, and continuous variables as mean, standard deviation (SD) or median values.

Results

Of the 1,856 inpatients transferred to our hospital, 400 (21.6%) were geriatric patients, 166 (41.5%) male and 234 (58.5%) female, with a mean age of 76.57 years (range, 65–103 yr; median, 84 yr).

The extremities were the most common location of injury (60.0%, n=240), followed by the trunk (25.5%, n=102) and head (9.2%, n=37) (Figure 1). Fracture accounted for 68.5% (n=274) of the injuries in the elderly patients, followed by minor trauma (9.2%, n=37), and craniocerebral injury (6.2%, n=25); 20 (5.0%) developed infection (7 had gangrene). Of the fractures, 70.8% occurred in the extremities, 15.3% in the spine, and 8.8% in the ribs (Figure 2).

Of those patients with injuries to the extremities, 194 (80.3%) had fractures, 25 (10.4%) had minor trauma, and 10 (4.2%) were transferred to our hospital after amputation. Of these injuries, 179 (74.6%) and 66 (27.5%) occurred in the lower and upper extremities, respectively.

Of those patients with trunk injuries, 82 (80.4%) had fractures, while 22 (21.6%) had visceral injury and 4 (3.9%) had minor trunk trauma. Spine fracture accounted for the largest proportion (41.2%, n=42) of the trunk fractures. Thoracic visceral injury was the most common type (18.6%, n=19) among visceral injuries (Table). Of the 42 patients with spine fracture, 20 (47.6%) occurred in the lumbar spine, 10 (23.8%) in the thoracic spine, 6 (14.3%) in both thoracic and lumbar spine, and 4 (9.5%) in the cervical spine. The remaining two patients’ (4.8%) injury sites were not clear.
Of those patients with head injuries, 25 (67.6%) were craniocerebral injuries, 8 (21.6%) were minor head injuries, 4 (10.8%) were skull bone fractures, and 2 (5.4%) were ocular injuries.

The overall mortality of the hospitalized patients was 1.6% ($n = 30$), while the corresponding figure of geriatric inpatients was 4.8% ($n = 19$) (geriatric vs. non-geriatric: $\chi^2$ value = 29.82, $p = 0.000$). Of the elderly patients who died, 14 (78.9%) had chronic diseases (e.g., hypertension).

There were three peaks in the transfer of elderly patients to the hospital, namely the third day, the fifth day, and the eighth day after the earthquake. The cumulative numbers of admitted earthquake-related geriatric patients were 71 (17.8%), 166 (41.5%), and 311 (77.8%) on the third day, first week, and second week after the earthquake, respectively. In contrast, on the first day of earthquake, only four aged patients were admitted to hospital (Figure 3).

**Discussion**

This study revealed that the extremities were the most common location of geriatric trauma in the Wenchuan earthquake, followed by the trunk and head. The mortality of geriatric patients was 4.8%, which was greater than in the other age groups. The time of admission of earthquake-related geriatric patients to the hospital showed three peaks: on the third, fifth, and eighth days after the earthquake.

Fractures accounted for 68.5% of all types of earthquake-related injuries. The most common location of fracture in geriatric patients was the extremities (70.8%). Tanaka et al.\(^3\) demonstrated similar results in the 1995 Hanshin–Awaji earthquake. In their report, fractures constituted 54.8% of all injuries, and were most common in the extremities (37.2%). As for the location of injury, the extremities made up the largest portion (60.0%), followed by the trunk (25.5%), and the head (9.2%) in the current study. This is consistent with other studies\(^4\)–\(^8\). However, none of the previous reports specifically addressed the features of geriatric patient trauma.

Although the extremities were the most common location of fracture, such injuries seldom resulted in

---

**Table:** Types of injury in the trunk

<table>
<thead>
<tr>
<th>Injury type</th>
<th>$n$ (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture</td>
<td>82 (80.4)</td>
</tr>
<tr>
<td>Spine fracture</td>
<td>42 (41.2)</td>
</tr>
<tr>
<td>Rib fracture</td>
<td>24 (23.5)</td>
</tr>
<tr>
<td>Pelvic fracture</td>
<td>16 (15.7)</td>
</tr>
<tr>
<td>Visceral injury</td>
<td>22 (21.6)</td>
</tr>
<tr>
<td>Thoracic visceral injury</td>
<td>19 (18.6)</td>
</tr>
<tr>
<td>Abdominal visceral injury</td>
<td>3 (2.9)</td>
</tr>
<tr>
<td>Minor trunk trauma</td>
<td>4 (3.9)</td>
</tr>
<tr>
<td>Unclear</td>
<td>1 (1.0)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>102 (100.0)</td>
</tr>
</tbody>
</table>

---

**Figure 3.** Time of admission of injured elderly patients after the earthquake.
death directly. In contrast, many other parts of the body were injured proportionally less, but more severely so when injured; some of these were life-threatening (e.g., thoracic visceral injury or craniocerebral injury). This reflects the difficulty and complexity of the management of earthquake-related injuries in aged patients.

Elderly people are the most vulnerable population in a disaster. During an earthquake, this group usually has higher mortality because of the following features: (1) underlying chronic diseases such as hypertension, which has been demonstrated as a risk factor of earthquake-related death among hospitalized patients\textsuperscript{1}; and (2) lower mobility compared to younger groups\textsuperscript{9}. According to our study, the earthquake-related mortality of elderly patients was greater than that of nonelderly patients. This is consistent with other studies\textsuperscript{3,6,10–13}. The medical records showed that 13 (68.4\%) of the geriatric patients who died had established major diseases (e.g., metabolic diseases such as diabetes; tumor; cardiovascular diseases such as hypertension; or chronic organ dysfunction such as chronic renal failure), which suggests that clinicians should not only focus on trauma but also pay attention to the patients’ primary diseases\textsuperscript{14}.

The number of aged patients transferred to the hospital peaked three times. The first two peaks could be the result of unavailability of transport because of breakdown of the infrastructure after the earthquake, and the last peak could be secondary transfer from frontline hospitals because of poor resources. Within the first 72 hours, the golden hour of rescue in a disaster, West China Hospital received less than 20\% of aged patients. Only 40\% were admitted within 1 week after the earthquake. This phenomenon could be explained as a result of the high magnitude earthquake happening in a mountainous area and causing severe damage to roads, thus making rescue efforts difficult. It is also understandable that crush injuries and secondary wound infection were very common among the earthquake victims while escaping from ruins after the earthquake. A study has demonstrated that secondary wound infection was associated with earthquake-related deaths\textsuperscript{1}.

There were some limitations in our study. Firstly, the study was a retrospective design, which might introduce some biases (e.g., unclear records, incomplete data). However, this may be the only practical way to perform studies during an emergency situation. Other studies had also underlined the difficulty of keeping records in similar situations\textsuperscript{15,16}. Secondly, because the data was collected in a more distant hospital (West China Hospital), the types of injury may vary from those in the frontline hospital near the epicenter of the earthquake. Finally, we failed to follow up the mortality of discharged patients, thus the mortality of earthquake-related patients might be underestimated. Nevertheless, this study provided invaluable information of earthquake-related geriatric injuries for physicians involved in trauma management of aged patients during a disaster.

In conclusion, fracture was the most common type of trauma and the extremities were the most vulnerable location of geriatric trauma during the Wenchuan earthquake. The mortality of geriatric patients was higher than that of other age groups. Considering the difficulty and complexity of management of earthquake-related injuries in aged patients, a multidisciplinary team of physicians should be organized as soon as possible after the earthquake.

Acknowledgments

The National High Technology Research and Development Program ("863" Program) of China (Grant No. 2008AA022503 and 2008AA022501), China Postdoctoral Science Foundation (Grant No. 20090461341), and the Scientific Research Starting Foundation for Young Teachers in Sichuan University (Grant No. 2009-SCU11172) financially supported this study. The authors are grateful to the foundations for their support of this work.

References