



The clinical features and outcome of crush patients with acute kidney injury after the Wenchuan earthquake: Differences between elderly and younger adults

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ABSTRACT

Background: On May 12, 2008, a devastating earthquake hit Wenchuan county of China's Sichuan province. Acute kidney injury (AKI) is one of the most lethal but reversible complications of crush syndrome after an earthquake. However, little is known about the epidemiological features of elderly crush patients with AKI. The aim of the present study is to compare clinical features and outcome of crush related AKI between elderly and younger adults in the Wenchuan earthquake.

Materials and methods: A questionnaire was sent to 17 reference hospitals that treated the victims after the earthquake. Clinical and laboratory characteristics of crush patients with AKI were retrospectively analysed.

Results: 228 victims experienced crush related AKI, of which 211 were adults, including 45 elderly (age ≥ 65 years) and 166 younger adults (age, 15–64 years). Compared with the resident population, the percentage of patients was higher amongst elderly (19.7% versus 7.6%, $P < 0.001$). The distribution of gender was similar in elderly and younger adults. Mean systolic blood pressure was higher in elderly groups. Although no statistical differences in number of injury and injury severity score were observed between elderly and younger adults, elderly victims had lower frequency of extremities crush injury; higher incidences of thoracic traumas, limb, rib, and vertebral fractures; lower serum creatinine, potassium and creatinine kinase levels; lower incidence of oliguria or anuria; lower dialysis requirement; underwent less fasciotomies and amputations, received less blood and plasma transfusions. Mortality were 17.8% and 10.2% in elderly and younger adults, respectively ($P = 0.165$). Stratified analysis demonstrated the elderly receiving dialysis had higher mortality rate compared with younger patients (62.5% versus 10.5%, $P < 0.001$). Multivariate logistic regression analysis indicated that need for dialysis and sepsis were independent risk factors for death in the elderly patients.

Conclusions: Elderly crush victims more frequently developed AKI in the Wenchuan earthquake, and they differ from younger adults in injury patterns and treatment modalities. The elderly patients with AKI requiring dialysis were at a relatively high risk of mortality.

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Introduction

At 2:28 p.m. on May 12, 2008, western Sichuan of China was devastated by a deadly earthquake measuring 8.0 Richter scale,

which was named the Wenchuan earthquake after the earthquake's epicentre in Wenchuan County in Sichuan province. It was the deadliest earthquake to hit China since the 1976 Tangshan earthquake,²⁸ which struck 18 cities in Sichuan province, covering an area of more than 1,00,000 square kilometres, caused 69,227 deaths, 17,923 lost, and 96,544 wounded (according to China's State Council Information Official statement on 25 September 2008). Because the medical care facilities were seriously destroyed, most victims were transferred to peripheral hospitals in the early days after the earthquake. Victims mildly injured were distributed into various med-care units, whilst victims severely injured or with special health care needs such as older victims, as well as patients with acute kidney injury (AKI) were sent to large peripheral hospitals in Mianyang City and Chengdu City.

In a forecasted disaster, elderly usually get extensive care, and become victims to a lesser extent. But this was not the case with the unpredictable disaster. Earthquake is the most unpredictable and hazardous type of disaster. More than half of the fatalities were amongst people over 60 years old in the great Hanshin earthquake.²⁹ The same patterns were observed in Guatemalan earthquake and Armenia earthquake, in which higher death rates were also observed in elderly.^{3,11} Earthquake disasters not only result in vast instant deaths because of injuries to vital organs, but also bring along a cluster of heavily wounded, in which crush injuries and prolonged compression of limbs are commonly encountered types of trauma. Crush injury results in crush syndrome with myoglobinuric AKI and series of systematic manifestation including hypovolemia and electrolyte imbalance such as hyperkalemia.^{4,6,25} A series of elegant studies have shown epidemiological features for the crush related AKI after Marmara, Bam and Kashmir earthquakes.^{12,26,33} However, none of these analyses were confined to elderly patients due to relative less number of the elderly victims.

The aim of the present study is to compare epidemiological and clinical features of crush related AKI between elderly and younger adults in the Wenchuan earthquake. The study protocol was approved by the Ethic Committee of the Chinese PLA General Hospital, and the need for an informed consent was waived.

Patients and methods

Data collection

The Wenchuan earthquake-related AKI Study Group designed a questionnaire in accordance with the recommendations of the ISN's Renal Disaster Relief Task Force (RDRTF). The questionnaire was sent to 17 hospitals, in which the casualties were accepted and dialysis was available.

Amongst a total of 286 feedback questionnaires, 242 from 10 hospitals met the criteria of crush related AKI. Double registrations were found in 14 patients who were transferred from hospitals near the centre of the earthquake to peripheral large-scale general hospitals. To avoid repetition, duplicate records were combined as one.

Definitions

Crush related AKI was defined as crush injury and one of the following characteristics: urine output <400 mL/d, blood urea nitrogen >14.3 mmol/L, serum creatinine >176.8 mol/L, serum uric acid >475.8 mol/L, serum potassium >6 mEq/L, phosphorus >2.6 mmol/L or calcium <2 mmol/L.²⁶

Based on the diagnoses in the hospitals, injury severity was measured by the injury severity score (ISS).^{8,18} The mild (ISS ≤ 8), moderate (ISS, 9–15) and severe (ISS ≥ 16) wounds were classified according to the ISS scores.

Statistical analysis

Descriptive statistics of all numeric variables, including means, standard deviations, together with the proportions of all categorical variables were calculated. Measurement data between the groups were compared by means of Student's *t*-test or Mann-Whitney Test according to whether or not they conform to normal distribution. Differences between group proportions were examined with Chi-square test. For the analysis of the prediction of death, Student's *t*-test and Chi-square test were performed. Different logistic regression models were then built, and possible predictors were examined. Data were analysed by standard statistical software (SPSS Version 13.0, Chicago, IL, USA).

Results

General features

Amongst the 10,845 injured patients hospitalised in ten reference hospitals during the earthquake, crush related AKI occurred in 228(2.1%) patients. Of these, 45(19.7%) patients were old adults aged 65 years or older (Table 1). There was a significant difference in the age distribution of the patients as compared with that of the resident population ($P < 0.001$) (Table 1). The study was limited to adult patients who were at least 15 years old. 17 paediatric patients were excluded. Of the 228 patients, 211 adult patients aged between 15 and 96 years, 118(55.9%) were male.

Clinical findings at admission

Clinical findings at admission for crush related AKI in elderly compared with younger adults are listed in Table 2. The distribution of gender was similar in both groups. Mean systolic blood pressure was higher in elderly than in younger adults. No significant differences were found in temperature, heart rate, and time spent under the ruins between the two groups. Incidence of oliguria or anuria was lower in old patients than younger ones (9.8% versus 41.2%, $P < 0.001$). Serum creatinine, potassium, phosphorus, and creatinine kinase values were significantly lower, whilst serum calcium level was greater in older patients. There were no statistically significant differences for blood urea nitrogen or uric acid levels between the two groups.

Type of trauma and medical complications

Most of patients suffered from multiple injuries. There were no differences in the number of injuries and mean ISS between elderly and younger adults. Taken as a whole, the most common trauma was limb crush injury (82.9%), followed by fractures (49.8%) and thoracic traumas (22.3%). Although the old patients had less extremity crush injuries, they had more thoracic traumas, more limb, rib, and vertebral fractures compared with the younger ones. There were no significant differences between the two groups with regard to abdominal or cerebral trauma (Table 3). Of the 45 elderly patients, 26.8% had an ISS score below 8, 41.5% had an ISS score between 9 and 15, and 29.3% had an ISS score above 16, whilst the percentages were 28.2%, 45.9% and 25.9% in 166 younger patients,

Table 1

Comparison between percentages of the resident population of the affected area and crush victims with acute kidney injury in various age groups.

Age group (years)	Total population (%)	Victims (%)	P-value
≤14	18,600,386(22.5)	17(7.5)	<0.001
15–64	57,518,477(69.9)	166(72.8)	0.330
≥65	6,229,433(7.6)	45(19.7)	<0.001

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