Nephrology After the Wenchuan Earthquake

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The Wenchuan earthquake on May 12, 2008 was a catastrophic natural disaster and resulted in a massive number of deaths and casualties. After the earthquake, nephrologists played critical roles not only in the restoration of dialysis facilities for regular renal replacement therapy but also in the prevention and treatment of crush syndrome and crush-related acute kidney injury. Brief guidelines, functional action plans and good training were significant factors in nephrologists being able to fulfill their critical roles, but the national network of renal disaster relief was also extremely important. [Hong Kong J Nephrol 2009;11(2):47–9]

Key words: acute kidney injury, earthquake, crush syndrome, nephrologists

The Wenchuan earthquake on May 12, 2008 affected more than 40 million people, and about 90,000 people lost their lives. It was fortunate that the closest large cities, Chengdu, Mianyang and Deyang, were mostly free from major earthquake damage, allowing many patients to be transferred to hospitals there after the first earthquake, where they could be accommodated and treated more effectively.

Crush syndrome and crush-related acute kidney injury (AKI) are the most frequent causes of death, apart from trauma, after earthquakes [1,2]. They are problems that nephrologists must confront in the aftermath of an earthquake. During the Wenchuan earthquake, about 150 patients were receiving renal replacement therapy, and many patients suffered crush syndrome. Here, we report our experience of practicing nephrology after the earthquake.

Immediate Cessation of Ongoing Hemodialysis and Transfer of Patients from Disaster Area to Other Dialysis Centers

Earthquakes are one of the most unpredictable natural disasters, and one can never be too prepared for them [3]. The second session of hemodialysis was ongoing when the Wenchuan earthquake struck at 2:28 PM. It was fortunate that there were only nine relatively small hemodialysis centers in the most severely affected area, with each having fewer than 10 hemodialysis machines; no patient on hemodialysis was killed in any of the hemodialysis centers. The large hemodialysis centers located in Chengdu, Mianyang and Deyang were not affected severely by the earthquake.

During the earthquake, the patients, doctors and nurses went into shock. The immediate focus was on escaping from the shaking machines and building. There
was not enough time to cease treatment according to standard operating procedures. Instead, the blood lines were quickly clamped by forceps so that the patients could escape. While this resulted in the loss of extracorporeal circulating blood, it markedly accelerated the operating procedure. All the patients were immediately transferred to an area of wide open space. At 4:30 PM, a patient on maintenance hemodialysis in the disaster area came spontaneously to our hemodialysis center looking for dialysis support.

A total of 159 patients on maintenance hemodialysis in the disaster area were severely affected, and 82 patients were transferred to other hemodialysis centers because their hemodialysis centers had been completely destroyed. The patients were distributed among eight hemodialysis centers and received free hemodialysis until they could eventually return to the rebuilt dialysis centers. The other 77 patients were treated in local temporary dialysis wards. The treatment of patients requiring peritoneal dialysis was less affected by the earthquake.

**RESOURCE COLLECTION AND DISTRIBUTION**

In the immediate aftermath of the earthquake, the most significant problems that nephrologists were confronted with were crush syndrome and crush-related AKI. To avoid the subsequent “renal disaster” [4], it was recognized that we had to quickly gather data on how many people would require dialysis, so that we could collect and distribute the required dialysis supplies and machines, and send trained doctors and nurses to prevent and treat the renal problems related to the disaster.

According to previous reports, the percentages of crush syndrome and crush-related AKI can vary widely in an affected region and are influenced by many variables (e.g. the severity, type and timing of the disaster; the geologic features; the population density; the quality of the buildings; the effectiveness of rescue activities; the length of time victims spent under the rubble; and the affected region’s health care infrastructure) [2]. The ratio of dialyzed AKI versus the total number of fatalities also varies significantly [2,5]. In the 2005 Kashmir earthquake, this ratio ranged from 0.08% to 2.735% [5]. With appropriate means of evacuation, most injured patients can be hospitalized within the first 3 days of a disaster [2,6].

The numbers of cumulative death at day 1 and day 3 after the earthquake were approximately 12,000 and 20,000, respectively. It is now known that these numbers were a great underestimation because of the mountainous area and lack of accurate information. Nevertheless, we initially estimated that there would be about 200 victims requiring dialysis. We asked for dialysis supplies and machines, as well as trained personnel from our government and corporations dedicated to renal replacement therapy. Other organizations (such as the Renal Disaster Relief Task Force of the International Society of Nephrology, the Hong Kong Society of Nephrology, and the Hong Kong Kidney Foundation, among others) also donated much equipment and supplies. All of these resources were immediately distributed to the dialysis centers designated to treat crush syndrome and crush-related AKI after the Wenchuan earthquake.

**GUIDELINES FOR CRUSH SYNDROME, HYPERKALEMIA AND AKI**

Numerous victims were sent to hospitals in the space of only a few days, so many doctors of other specialties had to take part in renal rescue activities. Some of them were not familiar with crush syndrome, AKI and the relevant complications. Consequently, brief guidelines for the prevention, diagnosis and treatment of crush syndrome, hyperkalemia and AKI had to be distributed to every doctor, including the first-line rescuers. We summarized several guidelines to deal with these conditions: brief guidelines for the diagnosis and treatment of crush syndrome; brief guidelines for the diagnosis and treatment of hyperkalemia. The document *Treatment of Crush Casualties Following Mass Disasters*, endorsed by the Renal Disaster Relief Task Force of the International Society of Nephrology and Médecins Sans Frontières, was translated into Chinese and distributed to every hospital as a matter of urgency.

Many of the first-line rescuers, including volunteers and soldiers, did not have previous experience or the skills necessary for rescue after disaster on such a massive scale. Prompt instructions from experts play a crucial role in effective and correct rescue. For example, we know that if a victim is found alive in the field, an immediate attempt should be made to find a vein in any of the limbs so that isotonic saline can be infused. However, this was not well known by the first-line rescuers. It is important that knowledge is effectively transferred to every rescuer in the immediate aftermath of a disaster, especially within the first 3 days. Any means of communication, such as TV, radio, newspapers and official document releases, should be employed to transfer essential information and skills to as many of the rescuers as possible. This was something that could have been done better after the Wenchuan earthquake.

**SCREENING AND TREATMENT OF PATIENTS WITH CRUSH SYNDROME OR AKI**

Earthquake victims were admitted to various departments after they were transferred to hospitals. It is essential that nephrologists screen all patients to determine...
who has crush syndrome or AKI. In our hospital, patient screening was performed twice a day. When a patient with crush syndrome or AKI was found, the appropriate treatment was discussed between the doctor-in-charge and the nephrologist; the patient was then followed-up by both until s/he was rehabilitated or dead. During the follow-up period, the action plans for diagnosis and treatment were discussed on a daily basis.

For patients with crush syndrome, the main complications are AKI, sepsis, acute respiratory distress syndrome, disseminated intravascular coagulation, bleeding, hypovolemic shock, cardiac failure, arrhythmia, electrolyte disturbances, and psychological trauma [2,7–9]. All of these complications need to be recognized, and prevented if possible or treated in a timely manner. In our hospital, we encountered all of these problems in the patients with crush syndrome.

The AKI component of crush syndrome is often fatal if left untreated, but, on a positive note, it is one of the few life-threatening disaster complications that can be prevented or reversed if appropriate medical treatment, fluid resuscitation, and/or dialysis are applied [2,5]. Early prevention, detection and timely treatment of AKI are key steps in reducing in-hospital mortality [2,5]. Patients with AKI are easily detected according to the AKI Network diagnostic criteria for urine output and serum creatinine [10].

A total of 2,316 victims were admitted to our hospital. Of the 1,827 victims we managed to screen, 149 (8.2%) patients were diagnosed with crush syndrome, 62 of whom had AKI. Thirty-two patients received renal replacement therapy. The different therapeutic modalities employed to treat AKI patients included intermittent hemodialysis, continuous venovenous hemofiltration, continuous venovenous hemodialysis, and peritoneal dialysis. Continuous venovenous hemofiltration was also used during operations to maintain homeostasis. The actual numbers of people with crush syndrome and dialyzed AKI were much lower than our estimations. We believe that one of the main reasons for this was that rescuers could not reach many of the severely affected areas quickly because of the mountains and conditions that made transportation difficult. Many of the victims died before rescuers could reach them.

**SPECIAL LESSONS FROM THE EARTHQUAKE**

Some valuable lessons were learned after the earthquake. First, nephrologists played an important role in the management of crush syndrome and crush-related AKI. Second, brief guidelines for crush syndrome and crush-related AKI should be established and distributed to every nephrologist. Functional action plans should be developed and all the parties involved trained and put through practice drills so that the plans can be smoothly implemented in the event of an unexpected severe disaster. Such guidelines and action plans should be updated regularly. It should be remembered that “You can never be too prepared for earthquakes” [3]. Third, establishment of intra- and interhospital domestic and international networks is essential if we are to successfully organize effective disaster relief rescue efforts [3]. In China, it is imperative that we establish a national network of renal disaster relief.

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**REFERENCES**