



Medical Aspects of Earthquakes in Iran

Hamid Reza Rasouli¹, Hamid Reza Zahedi², Mohsen Abbasi Farajzadeh^{2,*}, Ali Aliakbar Esfahani² and Fathollah Ahmadpour^{1,**}

¹Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

²Marine Medicine Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran

*Corresponding author: Marine Medicine Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran. Tel: +98-2188053766, Email: mohsen10_fam@yahoo.com

**Corresponding author: Trauma Research Center, Baqiyatallah University of Medical Sciences, Tehran, Iran, Tel: +98-2188053766, Email: ahmadpour66@yahoo.com

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Abstract

Context: The aim of the study was to review medical aspects of earthquakes in Iran in order to help clinicians obtain a better understanding of this natural disaster and select better therapeutic methods.

Methods: Two authors independently searched articles through scientific databases, such as PubMed, MEDLINE, Wiley, EMBASE, ISI Web of Knowledge, and Scopus. The keywords that were applied to search these articles included: Earthquake, disaster, Iran, physical phenomena, geological phenomena, health, trauma, medicine, wounds, and injuries. Two researchers independently assessed titles and abstracts of all studies and then included them based on the relevance.

Results: Fourteen studies were included in the current study. Fractures were the most common injury. The results showed hospitals, relief agencies, and municipal services should be built in a manner appropriate for earthquake conditions. A gender-sensitive approach for planning and management of trauma patients after a disaster could allow better and more effective healthcare delivery.

Conclusions: This review of earthquakes that occurred in Iran aimed to provide a better understanding of this natural disaster, and allow selection of better therapeutic methods, which is important in disaster management.

Keywords: Earthquake, Disaster, Iran

1. Context

Iran has experienced several earthquakes areas in the past few decades, which caused massive and irreparable human and economic losses and damage (1-5).

For example, the northern Iranian earthquake in the province of Gilan, during year 1989, caused the death of around 40 thousand people (2, 3). In the Bam earthquake, in December 2003, more than 30 to 50 thousand deaths occurred; also, more than 300 people died in the Azerbaijan earthquake in April 2012 (3-9).

Natural disasters have a different distribution of incidence in various regions of the world. Also, there are several geographical regions with populations that are frequently exposed to trauma experiences, such as combats, organized violence, terrorism, and natural disasters (6, 7).

Studies have reported that various types of traumatic events, methodological differences in dealing with the trauma, living situations, and psychological circumstances are due to diversity in trajectories for different populations (5-7).

It is of great importance to study various aspects of

earthquakes in Iran. The aim of the current study was to review major studies about earthquakes in Iran in order to help clinicians obtain a better understanding of this natural disaster in this specific territory, so that they could select better therapeutic methods.

2. Methods

Articles were searched through scientific sources, such as PubMed, MEDLINE, Wiley, EMBASE, ISI Web of Knowledge, and Scopus by two authors, independently. The keywords that were applied to search these articles included earthquake, disaster, Iran, physical phenomena, geological phenomena, health, trauma, medicine, wounds, and injuries. Two researchers independently assessed titles and abstracts of all studies and then included them based on their relevance.

3. Results

Fourteen studies were included in the current study. Table 1 depicts author's name, year, and details of all in-

cluded studies. Fractures were the most common of injuries and orthopedic surgeries were the most common operational procedures performed. Outcomes showed that hospitals, relief agencies, and municipal services should be built, according to earthquake conditions. Providing a gender-sensitive approach for planning and management of traumatic events after disasters can allow more effective healthcare delivery.

Karamouzian et al. evaluated the neurological consequences in patients with spinal cord injury in the Bam earthquake. They reported that 23.9% victims with category A impairment, according to ASIA Impairment Scale at the time of the earthquake, had better neurological results. Fracture-dislocation patients had worse results. They concluded that spinal cord injuries in earthquakes have better neurological results than other causes of spinal cord injury (8).

Sanadgol et al. evaluated fluid therapy on inhibition of acute renal failure in pediatric victims. They administered the therapeutic regimen to 31 pediatric crash patients in the Bam earthquake. They recommended six or 12 to 14 liters of fluids for the prevention of acute renal failure in crush syndrome for adult patients. In pediatric patients, it appears that delivered to expect rate is a valid marker for the development of IV fluid therapy. Delivered to expect ratio of greater than 4.8 was adequate for the prevention of acute renal failure in pediatric victims. They concluded that immediate IV volume replacement could prevent acute renal failure and dialysis requirement (10).

Mohebbi et al. assessed injuries in Bam-earthquake transferred patients to 12 referral hospitals of Tehran. The gender distribution of 854 victims was 54.7% males. The average age of the victims was 29.0 years. Aircraft transport was the major transportation procedure (65%) for rescue of victims. About 54% of the victims needed primary medical aid before transfer to the destination for healthcare. The most common fractures were of the lower extremities (25%). The most primary medical care (39.9%) was limb fixation at emergency departments. The average ISS was 6.7 ± 5.2 . Orthopedic surgeries were the most common operational procedures (75%). Finally, they estimated mortality rate of 1.6% (4).

Salimi et al. evaluated extremity injury of victims in the Bam earthquake. They analyzed data from 486 patients transported to hospitals of Tehran University of Medical Sciences. They reported that 274 patients had extremity injuries, 49.6% of which were male and 77.7% were under 40 years of age. Fractures were the most common injuries (58.4%). In all victims, the most common sites of injury were lower extremities (67.5%). Pelvic and rib fractures and abdominal injuries were the most commonly correlated injuries. The average ISS was 6.2 ± 4.0 , and 61% of the vic-

tims had ISS < 7. Amputation and death occurred in 2.9% and 2.5% of cases, respectively (11).

Sagheb et al. analyzed clinical and laboratory data of the kidney of 801 patients in Bam earthquake, who had been transferred to Shiraz Hospitals. They reported 20 patients with mean age of 36.2 ± 14.8 years, 15 of which were males with acute renal failure. The mortality rate was 2.6% and in patients with acute renal failure, the mortality rate was 15%. Seventy-nine dialysis sessions were conducted for 15 patients with average of $5.2, 3.3 \pm 1$ concourses. They concluded that in victims of the earthquake, when under rubble and peak, serum CK level can help determine morbidity, and early therapy may reduce kidney morbidity (12).

Ghodsi et al. analyzed the data of trauma patients with thoracic injury in the Bam earthquake, who were transported to hospitals of Tehran University of Medical Sciences. They reported that 526 trauma patients had been transported to hospitals, 53 of which sustained a thoracic injury with 39.6% being female and 28.3% having isolated chest injuries. Rib fracture (36.4%) and hemo/pneumothorax (25.5%) were the most common injuries. Multiple-trauma patients with chest injury had greater ISS compared to patients with an isolated chest injury. They reported that the majority of these victims can be saved with tube thoracostomy (13).

Iraj et al. assessed prophylactic fluid therapy on acute kidney injury for victims of Bam earthquake. They included patients over 15 years old of Bam earthquake. They evaluated the correlation between formation of AKI with multiple factors, including the level of serum creatinine phosphokinase (CPK), the Time of being under the rubbles (TUR), the volume of Intravenous fluid received per day (VFR), and the Delayed onset of Fluid Therapy (DFT). The results demonstrated a significant correlation between the intensity of the trauma and DFT. Furthermore, the increase of the VFRs correlated with the decrease in the need for dialysis and AKI (14).

Kakaei et al. evaluated impact of Focused Assessment with Sonography in Trauma (FAST) to assess a large crowd in Iranian earthquake trauma patients. The existence of blunt abdominal trauma was evaluated in all earthquake injured patients. At first, the injured people were estimated with a physical examination and then sonography for trauma was used to recognize blunt abdominal trauma. They reported usefulness and importance of FAST as an initial diagnostic tool for detection of blunt abdominal trauma, therefore, FAST can be considered in the setting of disaster management. The FAST effectively guides emergency physicians and surgeons in the reorganization of at-risk patients for further consideration. Ultimately, FAST is recommended in the assessment of earthquake trauma patients yet possible false-negative outcomes must

be considered (15).

Kakaei et al. analyzed management of triage for injured patients in Iranian earthquakes. They designed a disaster management team that divided traumatic patients to two groups based on the need for emergent care. Then, needy patients to emergent care were exposed to direct observation at the emergency department, in contrast, people, who did not require emergent care, were admitted to general wards of a hospital for treatment. Ultimately, they emphasized on triage of patients in disastrous events, and triages in these events, especially earthquake, could reduce significant morbidity and mortality because the patients in need of emergent care should be exposed to direct observation in the specialized emergency department, by skilled physicians (16).

Kalantar Motamedi et al. reviewed various aspects of major earthquakes in medical management in the past decade, such as the type of injuries, destruction and effectiveness of relief efforts, and management procedures. The data from various earthquakes were gathered, including Sichuan (China), Bam (Iran), Kashmir (Pakistan), Port-au-Prince (Haiti), and Ica (Peru). The results highlighted the importance of international aid, field hospital availability, and air transfer in earthquakes. The most common infection was respiratory infection in all five earthquakes. They concluded that hospitals, relief agencies, and municipal services should be built, according to preparation for earthquake conditions (17).

Dehghani Firoozabadi et al. evaluated earthquake-associated genitourinary system trauma in the Bam earthquake. Two hundred and fifty-six patients were referred to Kerman hospitals for genitourinary system trauma; urologic damage was demonstrated in 28 cases. Urethral disruption was the most common urologic injury and ureteral injury was the least common urologic injury (3).

Nakhaei et al. performed a study with the aim of providing better knowledge and medical management for females after disasters. They studied conditions affecting Iranian female's after a disaster, such as an earthquake. Three main issues were identified, including women in the community, family, and individual impacts of the disaster. Therefore, clarification of women's needs after a disaster can help mainstream gender-sensitive approaches in planning response and recovery efforts (18).

Elmi et al. evaluated types, distribution, and demographic characteristics of 686 orthopedic injuries from earthquakes of East Azerbaijan in order to achieve proper future planning. Lower extremities were the most common sites of injury, especially open fractures. They recommended that the government should organize education programs for the population on exposure to earthquakes because people still require more education (19).

Ghabili et al. reported spinal injuries in the East Azerbaijan earthquake. Twenty-six cases of 923 admitted patients had neurosurgical complications. They evaluated the severity of spinal injury, anatomical location of the injury, and the associated neurological deficit. The lumbar spine was the most common site of injury; neurological deficits were the least common injuries. Ultimately, they reported that nerve injuries were less common in East Azerbaijan earthquake patients compared to previous similar earthquakes. However, this may be due to the different types of earthquakes that occurred in the middle of the day or had less power (20).

4. Discussion

Earthquakes are managed in a variety of ways, according to different countries and regions (16). Natural disasters have threatened more than three million people worldwide during the past few decades, and at least 800 million people have been affected, and has caused more than \$500 billion of economic damages (21-23).

Kakaei et al. (15) reported on the usefulness and importance of FAST as an initial diagnostic tool for detection of blunt abdominal trauma, therefore, FAST can be considered in the setting of disaster management; they supposed that conducting FAST could reduce the number of further examinations, such as unnecessary CTs, therefore, conducting FAST is an initial screening with high speed. Previous studies confirmed usefulness and importance of FAST as an initial diagnostic tool for detection of blunt abdominal trauma, which led to the identification of other diseases in addition to blunt abdominal trauma, for example, pneumothorax has been distinguished in blunt chest trauma by thoracic ultrasound when performed by trained individuals (24). In addition, sonography can disclose more spine fractures than radiography (25). Therefore, ultrasound is a useful and important tool for assessment of a huge mass of injured people that can be one main disaster management episode.

The management of triage of injured people is one of the main disaster management episodes, therefore, it has been illustrated that triage of patients in disastrous events, and triages in these events, especially earthquakes, can reduce significant morbidity and mortality, because people in need of emergent care should be exposed to direct observation at specialized emergency departments by skilled physicians.

One of the main episodes for disaster management is building of hospitals, relief agencies, and municipal services, according to earthquake conditions. The availability of hospitals is very important in disaster management af-

ter earthquakes, and this issue is associated with building of the hospital and construction standards (26).

Trauma cases were triaged during the night after the crisis in the Bam earthquake because two major hospitals of Bam were damaged and field hospitals were established the next day (27).

On the other hand, some institutions have highly specialized physicians, surgeons, cardiovascular experts, ophthalmic experts, etc. to offer help, yet many of these professionals cannot work effectively because either the local people do not have such requirements or they do not have access to specialized equipment for treatment (28).

One of the other views on crisis management is providing better knowledge and medical management for women after disasters; the ability of women to recover from natural disasters depends to a large extent on disaster planners and healthcare providers, focusing on the importance of women (29-32).

Comparison of victims aged 0 to 19 years old and victims 60 to 79 year olds indicated that intensity of trauma injuries as a result of earth quakes was 10.9 times more in younger people than older ones (33). There was no significant difference between male and female victims, yet the mean age of victims was significantly different (11). The results of previous studies demonstrated that three main issues present women's status after earthquakes, including women in the community, women, and family, and individual impacts of the disaster. Therefore, providing a gender-sensitive approach to planning and management of traumatic people after disasters can help better and more effective healthcare delivery.

4.1. Conclusions

The management of triage of injured people in one of the main disaster management episodes, thus, it has been illustrated that triage of patients in disastrous events could reduce significant morbidity and mortality, because patients in need of emergent care should be exposed to direct observation at specialized emergency departments, by skilled physicians.

One of the main episodes for disaster management is building of hospitals, relief agencies, and municipal services according to earthquake conditions. One of the other views on crisis management is providing better knowledge and medical management for women after disasters. On the other hand, making gender-sensitive approaches for planning and management of trauma patients after disaster can help better and more effective healthcare delivery.

Subsequently, this study demonstrated review of all studies about earthquakes and is useful for clinicians to gain a better understanding of this natural disaster and allows better selection of the therapeutic process.

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