A medical approach to the 2020 Elazig earthquake

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Abstract
Objective: Besides their direct effects, earthquakes may cause death by Crush syndrome and renal factors. In this study we aimed to evaluate the medical results of 2020 Elazig earthquake.

Methods: We obtained the medical data from the National Medical Rescue Team (UMKE) and hospital records.

Results: There were 1063 injured, 45 victims who were pulled out from the rubble and 41 deaths due to 2020 Elazig earthquake. Of the hospitalized patients 33% were treated with Crush/ compartment syndrome diagnosis.

Conclusion: Catastrophic effects and collapsing buildings due to earthquakes, threat human life. In Elazig earthquake, none of the 48 hospitalized patients required dialysis probably due to early treatment and transfer to the hospital. Renal care and treatment such as fluid replacement, dialysis are as important as traumatological services in earthquakes in terms of increasing survival.

Keywords: Elazig, earthquake, crush syndrome

Introduction
Earthquakes are one of the most common causes of crush injury in the form of muscle/tissue damage caused by long-term (>4 hours) traumatic/mechanical pressure trauma to the trunk or extremities. Compressive forces act as a result of direct muscle/ tissue trauma and ischemia-reperfusion injury. The systemic presentation with AKI and other organ dysfunctions as a result of crush damage is defined as Crush syndrome. Etiology includes earthquakes, accidents, explosions, and various traumas [1, 2].

In rhabdomyolysis, in which skeletal muscle integrity is compromised, muscle intracellular components, including myoglobin, creatine phosphokinase (CK), aldolase, and lactate dehydrogenase, as well as electrolytes, are released into the bloodstream and extracellular space. As a result, electrolyte imbalances, acute kidney injury (AKI) and disseminated intravascular coagulation may result in serious life-threatening conditions [3].

In the last 10 years, earthquakes greater than 6.6 on the Richter magnitude scale have occurred in the cities of Van, Elazig and Izmir in Turkey and have caused serious damage. The aim of this study is to evaluate the 24 January 2020 Elazig earthquake from a medical point of view and to present the data of this mass disaster to the international information database.

Materials and Methods
The data of the cases requiring outpatient/inpatient treatment/ medical support due to the 6.8 magnitude earthquake that occurred in Elazig on January 24, 2020 were evaluated based on hospital records and the data of the National Medical Rescue Team (UMKE). For this purpose, applications to hospitals in Elazig due to this earthquake and the information obtained by accessing UMKE records were examined and evaluated detailedy. This retrospective study was conducted by adhering to ethical principles with ethical committee approval.

Results
Due to the 6.8 magnitude and 20.4 seconds lasting earthquake that occurred in Elazig, Turkey on January 24, 2020; we have reached the information that there are 1063 injured, 45 victims who were pulled out from the rubble and 41 deaths. Of the 48 hospitalized patients, 16 (33%) were treated with the diagnosis of Crush/ compartment syndrome and 11 (22%) with extremity fractures.
A total of 2700 mobile rescue/health personnel from 77 provinces were assigned for the Elazig earthquake, and a total of 9 medical endpoints (disaster medical aid centers) were established in the first 4 days and health services were started to be provided. The highest creatinine (Cr$_{\text{max}}$), creatine kinase (CK$_{\text{max}}$) and potassium (K$^{+}_{\text{max}}$) values detected during the course of hospitalization of 12 patients who were hospitalized in Firat University Hospital are presented in the table 1.

### Table 1: The highest Cr, CK and K$^{+}$ values of the patients hospitalized in Firat University Hospital after the earthquake.

| Patient | Cr$_{\text{max}}$ | CK$_{\text{max}}$ | K$^{+}_{\text{max}}$ |
|---------|------------------|------------------|------------------|
| 1       | 0.78             | 1790             | 5.1              |
| 2       | 0.91             | 1028             | 4.2              |
| 3       | 0.95             | 675              | 5.2              |
| 4       | 0.97             | 2028             | 4.2              |
| 5       | 1.04             | 2143             | 4.7              |
| 6       | 0.76             | 387              | 4.9              |
| 7       | 0.55             | -                | 5.9              |
| 8       | 0.69             | 51740            | 5.7              |
| 9       | 0.56             | 2380             | 5.1              |
| 10      | 0.48             | 46               | 5.2              |
| 11      | 0.79             | 184              | 4.3              |
| 12      | 0.69             | -                | 5.6              |

**Discussion:** Earth's crustal movements and ruptures, called earthquakes, are natural events that are almost a normal part of human life. According to the data of the Turkish Disaster and Emergency Agency (AFAD), more than 30 thousand seismic movements were recorded throughout Turkey in 2020[4]. In the earthquake that occurred in Elazig on January 24, 2020, more than a thousand people were injured and 41 deaths were recorded. Of the cases requiring hospitalization, 33% (16/48) were followed up and treated with the diagnosis of Crush/compartment syndrome and 22% (11/48) with extremity fracture [5].

On the other hand, 5302 hospitalizations and 639 Crush Syndrome cases were recorded in the 1999 Turkey/Marmara earthquake. Higher numbers of deaths, injuries and Crush syndrome cases in the Marmara earthquake can be attributed to the fact that the earthquake was seismically larger, lasted longer, and perhaps there were more limited intervention possibilities compared to today [6].

The most common causes of death in mass crush injuries are the direct effects of trauma and Crush syndrome. Of those trapped under the debris 80% die within minutes (due to traumatic asphyxia, traumatic brain injury, severe hemorrhagic shock), 10% survive with minor injuries, 20-70% of 10% develop rhabdomyolysis- Crush Syndrome and 20% of these results in mortality (due to AKI, multiorgan failure, hyperkalemia). On the field; while the person is still under the rubble, fluid therapy should be started immediately by the most appropriate route available [7].

Rescue activities in earthquakes should not be less than 5 days, considering the duration and the number of people who can be rescued [8]. Rhabdomyolysis causes AKI due to decreased renal perfusion, vasoconstrictor cytokine release, acute tubular necrosis due to myoglobinuria, tubule obstruction (heme pigment-induced cast nephropathy) and some other factors (hyperphosphatemia, hyperkalemia, hyperuricemia, nephrotoxic drugs, free oxygen radicals, iron ions, infections, shock, heart failure, arrhythmias etc.) [9].

**Table 2:** The highest Cr, CK and K$^{+}$ values of the patients hospitalized in Firat University Hospital after the earthquake.

| Patient | Cr$_{\text{max}}$ | CK$_{\text{max}}$ | K$^{+}_{\text{max}}$ |
|---------|------------------|------------------|------------------|
| 1       | 0.78             | 1790             | 5.1              |
| 2       | 0.91             | 1028             | 4.2              |
| 3       | 0.95             | 675              | 5.2              |
| 4       | 0.97             | 2028             | 4.2              |
| 5       | 1.04             | 2143             | 4.7              |
| 6       | 0.76             | 387              | 4.9              |
| 7       | 0.55             | -                | 5.9              |
| 8       | 0.69             | 51740            | 5.7              |
| 9       | 0.56             | 2380             | 5.1              |
| 10      | 0.48             | 46               | 5.2              |
| 11      | 0.79             | 184              | 4.3              |
| 12      | 0.69             | -                | 5.6              |

**Conclusion**

Earthquakes are mass disasters and can be fatal both by their direct effects and as a result of crush injuries. Renal care and treatment are as important as traumatological services in earthquakes in terms of increasing survival. Appropriate fluid replacement, close monitoring of renal functions and, dialysis applications should be performed when necessary and, Nephrologists should be a component of the multidisciplinary medical team in disasters.

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**Conflicts of interest:** No.

**References**

1. Bywaters EGL, Beall D: Crush injuries with impairment of renal function. Br Med J 1941;1:427–432.
2. Sever MS, Vanholder R. Recommendations for the
management of crush victims in mass disasters. Nephrol Dial Transplant 2012;27(Supl 1):1-79.

3. Gürel A. Ürolojik ve Nefrolojik Aciller- Rabdomiyoliz. In: Akbas EM, editor.Dahili Aciller. Akademişyen Kitabevi 2020, 439-446.

4. https://deprem.afad.gov.tr/genelisratistikler

5. https://www.afad.gov.tr/basin-duyurusu-8-elazigda-meydana-gelen-68-buyuklugundeki-deprem-hakkinda

6. Sever MS, Erek E, Vanholder R, Akoglu E, Yavuz M, Ergin H, et al. Clinical findings in the renal victims of a catastrophic disaster: the Marmara earthquake. Nephrol Dial Transplant 2002;17:1942-1949.

7. Godat LN, Doucet JJ. Severe Crush injuries in adults 2022.https://www.uptodate.com/contents/severe-crush-injury-in-adults.

8. Sever MS, Erek E, Vanholder R, Akoglu E, Yavuz M, Ergin H, et al. The Marmara earthquake: Epidemiological analysis of the victims with nephrological problems. Kidney International. 2001;60:1114-1123.

9. Gibney RTN, Sever MS, Vanholder RC. Disaster nephrology: Crush injury and beyond. Kidney International 2014;85:1049-1057.

10. Sever MS, Erek E, Vanholder R, Özener C, Yavuz M, Kayacan MS, et al. Lessons learned from the Marmara disaster: Time period under the rubble. Crit Care Med. 2002;11:2443-2449.

11. Hatamizadeh P, Najafi I, Vanholder R, Farokhi FR, Sanadgil H, Seyrafsian S, et al. Epidemiologic aspects of the Bam earthquake in Iran: the nephrologic perspective. Am J Kidney Dis. 2006;47:428-438.

12. Oda J, Tanaka H, Yoshioka T, Iwai A, Yamamura H, Ishikawa K, et al. Analysis of 372 patients with Crush syndrome caused by the Hanshin-Awaji earthquake. J Trauma. 1997;42:470-475.

13. Sever MS, Erek E, Vanholder R, Koc M, Yavuz M, Ergin H, et al. Treatment Modalities and Outcome of the Renal Victims of the Marmara Earthquake. Nephron 2002; 92:64-71.

14. Better OS, Stein JH. Early management of shock and prophylaxis of acute renal failure in traumatic rhabdomyolysis. N Engl J Med. 1990;322:825-829.

15. Gunal AI, Celiker H, Dogukan A, Ozalp G, Kirciman E, Simsekli H, et al. Early and vigorous fluid resuscitation prevents acute renal failure in the crush victims of catastrophic earthquakes. J Am Soc Nephrol. 2004;15:1862-1867.

16. Sever MS, Erek E, Vanholder R, Yurugen B, Kantarci G, Yavuz M, et al. Renal replacement therapies in the aftermath of the catastrophic Marmara earthquake.Kidney Int. 2002;62:2264-2271.