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MEDICAL SCIENCES / DAHİLİ TIP BİLİMLERİ

Analysis of Emergency Internal Medicine Hospitalization after the Earthquake in Türkiye: Demographic and Clinical Results of Victims

Türkiye'deki Deprem Sonrası Acil Dahiliye Servisi Yatışlarının Analizi: Mağdurların Demografik ve Klinik Sonuçları

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Abstract

Objectives: On February 6, 2023, a devastating earthquake struck the southeastern part of Türkiye that affected eleven major cities. Thousands of people lost their lives, and many were buried under collapsed buildings. The aim of this study is to examine the demographic characteristics, clinical results, laboratory findings and injuries of the victims who applied to the emergency internal medicine service after the earthquake.

Materials and Methods: In this study, medical records of 60 patients with crush syndrome who applied to Ankara Bilkent City Hospital Emergency Department of Internal Medicine after the earthquake were evaluated retrospectively through the system.

Results: 56.67% of the patients were male, the mean age was 37.35, the mean duration of stay under the rubble was 28.39 hours, and 40 (66.67%) patients had extremity trauma. Twenty-two patients (36.67%) had fasciotomy and 15 (25%) had amputation. Various complications developed in patients; 36 acute kidney injury (AKI) (60%) and 15 (25%) wound infections were detected. Hemodialysis was applied to 32 patients (53.33%) due to AKI. AKI was detected in 17 of the patients who underwent fasciotomy, and wound infection was observed in 9 of them. Wound infection was detected in 13 of the patients with AKI. Mortality developed in 3 patients. In the comparison between patients with and without fasciotomy, it was found that there was a significant difference in terms of length of hospitalization, number of transfusions, AKI, wound infection, hemodialysis, myoglobin on admission value. In patients with acute renal failure; wound infection, hemodialysis, transfusion rates, myoglobin value >1000 (µg/L) at admission and urea at admission, creatinine at admission, creatine kinase rate at admission were higher.

Conclusion: Rapid determination of demographic characteristics, laboratory findings and clinical results of earthquake patients are critical for the development of future disaster preparedness, response and recovery policies.

Keywords: Earthquake, crush syndrome, acute kidney injury, Türkiye

Öz

Amaç: 6 Şubat 2023'te Türkiye'nin güneydoğu bölgesini etkileyen yıkıcı bir deprem meydana geldi ve on bir büyük şehri etkiledi. Binlerce insan hayatını kaybetti ve birçok kişi yıkılan binaların altında kaldı. Bu çalışmanın amacı, deprem sonrasında acil dahiliye servislerine başvuran mağdurların demografik özelliklerini, klinik sonuçlarını, laboratuvar bulgularını ve yaralanmalarını incelemektir.

Gereç ve Yöntem: Bu çalışmada, deprem sonrası Ankara Bilkent Şehir Hastanesi Dahiliye Acil Servisi'ne başvuran ve crush sendromu olan 60 hastanın tıbbi kayıtları sistem üzerinden retrospektif olarak değerlendirildi.

Bulgular: Hastaların %56,67'si erkek, ortalama yaş 37,35, enkaz altında kalma süresi ortalama 28,39 saat ve 40 hastada (%66,67) ekstremite travması vardı. Yirmi iki hastaya (%36,67) fasiyotomi ve 15 hastaya (%25) ampütasyon yapıldı. Hastalarda çeşitli komplikasyonlar gelişti; 36 akut böbrek hasarı (ABH) (%60) ve 15 (%25) yara enfeksiyonu tespit edildi. ABH nedeniyle 32 hastaya (%53,33) hemodiyaliz uygulandı. Fasiyotomi

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yapılan hastaların 17'sinde ABH ve 9'unda yara enfeksiyonu gözlendi. ABH olan hastaların 13'ünde yara enfeksiyonu tespit edildi. Üç hastada mortalite gelişti.

Sonuç: Deprem hastalarının demografik özelliklerinin, laboratuvar bulgularının ve klinik sonuçlarının hızlı bir şekilde belirlenmesi, gelecekteki afet hazırlığı, müdahale ve iyileşme politikalarının geliştirilmesi açısından kritiktir.

Anahtar Kelimeler: Deprem, crush sendromu, akut böbrek hasarı, Türkiye

Introduction

On February 6, 2023, the two most devastating earthquakes of the last century occurred in Türkiye. In the early hours of February 6, Türkiye's Kahramanmaraş province experienced its first earthquake measuring 7.7 on the Richter scale. A second earthquake with a magnitude of 7.6 occurred in the same region. More than 16 million people were affected by earthquakes in 11 provinces including Adana, Adıyaman, Diyarbakır, Gaziantep, Hatay, Kahramanmaraş, Kilis, Osmaniye and Şanlıurfa (1). Crush syndrome (CS) can develop as a result of crush injuries due to natural disasters such as earthquakes. Various complications occur as a result of CS. As a result of these complications, mortality and morbidity may develop (2). CS may occur as a result of necrosis in cells secondary to skeletal muscle ischemia and mechanical force (3). The severity of complications is proportional to the amount of injured body part and muscle. As a result of these complications, electrolyte imbalance, metabolic acidosis, acute kidney injury (AKI) may develop (4). In addition to cardiac involvement, patients may also have respiratory failure and pulmonary involvement due to pneumothorax, hemothorax and pulmonary contusion. Acute respiratory distress syndrome is one of the most important pulmonary complications (5,6).

Acute compartment syndrome (ACS) is another life-threatening complication that may require emergency surgery in patients who remained under debris. Pathophysiologically, microvascular circulation and capillary permeability are impaired and ischemia and edema develop in the myofascial compartment. As a result, there is an increase in intracompartmental pressure due to edema and mass increase (7-9).

The literature lacks information on emergency internal medicine services, demographics, laboratory and clinical outcomes among disaster victims (10-12). The aim of this study is to examine the demographic characteristics, laboratory findings, clinical results and injuries of the victims who applied to the emergency internal medicine service after the earthquake. Research findings can contribute to the development of preparedness, response and recovery policies for future disasters.

Materials and Methods

In this study, the medical records of 60 patients with CS hospitalized in the Emergency Internal Medicine Department of Ankara Bilkent City Hospital after the earthquake were evaluated retrospectively through the system. Ethics committee approval for the study was obtained from the Ankara Bilkent City Hospital No. 2 Clinical Research Ethics Committee (approval no.: E2-23-3705, date: 15.03.2023). All patients had crush injuries. Patients with at least one of the systemic complications such as AKI, electrolyte imbalance, rhabdomyolysis [5-fold increase in creatine kinase (CK) values], hypovolemic shock and ACS after crush injuries were evaluated as CS. Similar to the literature, indications for fasciotomy were determined as bullae, pain, ecchymosis, absence of pulse in the extremity, and increased intracompartmental pressure.

Age, length of hospital stay, fasciotomy and amputation surgeries, development of ACS, length of stay under rubble, body parts injured as a result of trauma, need for hemodialysis, laboratory values at admission; Blood gas parameters, Creatinine, urea, lactate dehydrogenase, myoglobin, electrolytes and CK parameters were evaluated. Fasciotomy, amputation, time spent under rubble, mortality, and laboratory parameters in patients with AKI were evaluated.

In our study, 22 patients underwent fasciotomy and 15 patients underwent amputation. Fasciotomy and amputation surgery were not performed simultaneously in any of the patients during their hospitalization. The discharge time was taken into account when evaluating the clinical and laboratory findings.

Statistical Analysis

Statistical analysis was made by Statistical Package for Social Sciences version 25. Normality of variables was analyzed by histogram graphics and Kolmogorov-Smirnov test. In the descriptive findings section of the statistical analysis, categorical variables were presented as number and percentage, and continuous variables were presented as mean ± standard deviation (SD) for normally distributed data and median (minimum, maximum) for non-normally distributed data. Continuous variables were expressed either as mean ± SD or as median and minimum-maximum values according to normality. Categorical variables were compared with the chi-square test. The Mann-Whitney U test was used when evaluating non-normally distributed (non-parametric) variables between two groups. Spearman correlation test was used in the analysis of the measurement data with each other. Cases with a p-value below 0.05 were considered as statistically significant results.

Results

In this study, we presented 60 adult CS patients, 34 males and 26 females, aged 18-85 years, who were admitted to our hospital. All patients had crush injuries. The mean duration of being under the rubble was 28.39±32.32 hours. The mean length of hospitalization was 24.58±8.07 days. The distribution and demographic characteristics of the patients according to myoglobin values and time spent under the rubble are shown in Table 1.

According to the areas exposed to trauma; 40 patients (66.67%) for extremity, 4 for hip (6.67%), 7 for vertebra (11.67%), 11 for thorax (18.33%), 1 for cranial (1.67%) were determined in the study. Twenty-two (36.67%) patients underwent fasciotomy and 15 (25%) patients underwent amputation surgery. Various complications developed in patients; 36 patients with AKI (60%), 15 with wound infection (25%) were identified. Thirty-two patients underwent hemodialysis (53.33%) due to AKI. Mortality developed in 3 patients (5%) due to respiratory failure and related complications. Patients distribution by trauma site, operation performed, hemodialysis and mortality was shown in Table 2.

In the comparison between patients with and without fasciotomy, it was found that there was a significant difference in terms of length of hospitalization, number of transfusions, AKI, wound infection, hemodialysis, myoglobin on admission value. Accordingly, length of hospitalization, number of transfusions, AKI, wound infection, hemodialysis rate were found to be higher in patients with fasciotomy ($p<0.05$). Also, the rate of patients with a myoglobin on admission value >1000 (µg/L) were found to be higher (Tables 3, 4).

In the comparison between patients with and without amputation, it was observed that there was a significant difference in terms of length of hospitalization, urea value on admission, creatinine value on admission ($p<0.05$). Accordingly, while length of hospitalization was higher in patients with amputation, urea on admission and creatinine on admission values were lower (Tables 5, 6).

Table 1: Demographic characteristics of patients and their distribution values

		n	%
Gender	Male	34	(56.67)
	Female	26	(43.33)
*Age		37.35±15.13	34.5 (18-85)
*Time under the rubble (h)		28.39±32.32	15 (1-144)
*Length of stay in internal medicine clinic (day)		24.58±8.07	27 (3-36)

n: Number of patients, %: Proportion in the whole population, *n is replaced by mean ± SD, % is replaced by median (minimum-maximum)
SD: Standard deviation

Table 2: Patients distribution by trauma site, operation performed, hemodialysis and mortality

	n	%
Trauma area		
Extremity	40	(66.67)
Hip	4	(6.67)
Vertebra	7	(11.67)
Thorax	11	(18.33)
Cranial	1	(1.67)
Operation performed		
Fasciotomy	22	(36.67)
Amputation	15	(25.00)
Complications		
Acute renal failure	36	(60.00)
Wound infection	15	(25.00)
Hemodialysis and mortality		
Hemodialysis	32	(53.33)
Mortality	3	(5.00)

n: Number of patients, %: Proportion in the whole population

Table 3: Distribution of number of hemodialysis, complications, mortality and laboratory values according to fasciotomy

		Fasciotomy				p-value
		No		Yes		
		n	%	n	%	
Myoglobin on admission (µg/L)	<1000	18	(48.65)	2	(9.09)	**0.002**
	>1000	19	(51.35)	20	(90.91)	
Acute renal failure		19	(50.00)	17	(77.27)	**0.038**
Wound infection		6	(15.79)	9	(40.91)	**0.030**
Hemodialysis		15	(39.47)	17	(77.27)	**0.005**
Mortality		1	(2.63)	2	(9.09)	0.269

Mann-Whitney U test/chi-square test
Bold values: Statistically significant parameters (p<0.005)
n: Number of patients, %: Proportion in the whole population

Table 4: Comparison of demographic characteristics of patients, length of stay in internal medicine clinic (day), number of transfusions, complications and laboratory values according to fasciotomy

	Fasciotomy				p-value
	No		Yes		
	Mean ± SD	Median (Min.-Max.)	Mean ± SD	Median (Min.-Max.)	
Age	39.53±16.74	37.5 (19-85)	33.59±11.21	33 (18-66)	0.225
Time under the rubble (h)	31.2±32.46	22 (1-144)	23.55±32.23	12 (4-144)	0.222
Length of stay in internal medicine clinic (day)	22.11±8.72	23.5 (3-36)	28.86±4.31	30 (17-36)	**0.004**
Transfusions	3.32±7.09	0 (0-30)	15.91±23.07	8.5 (0-80)	**0.003**
On Admission					
Urea (mg/dL)	89.22±85.76	50.07 (12.84-393)	92.83±57.15	90.95 (14.9-241)	0.421
Creatinine (mg/dL)	2.57±2.87	0.99 (0.23-10.65)	3.38±1.93	3.64 (0.35-7.11)	0.092
Creatine kinase (U/L)	20314.45±26733.5	8380.5 (508-114208)	43802.05±70486.02	9324 (340-287071)	0.311

Mann-Whitney U test
Bold values: Statistically significant parameters (p<0.005)
SD: Standard deviation, Min.: Minimum, Max.: Maximum

Table 5: Distribution of complications. Hemodialysis, mortality and laboratory values according to amputation

		Amputation				p-value
		No		Yes		
		n	%	n	%	
Mortality		2	(4.44)	1	(6.67)	0.732
Acute renal failure		29	(64.44)	7	(46.67)	0.224
Hemodialysis		26	(57.78)	6	(40.00)	0.232
Wound infection		10	(22.22)	5	(33.33)	0.389
Myoglobin on admission (µg/L)	<1000	17	(38.64)	3	(20.00)	0.188
	>1000	27	(61.36)	12	(80.00)	

Mann-Whitney U test/chi-square test
n: Number of patients, %: Proportion in the whole population

Table 6: Comparison of demographic characteristics of patients, length of stay in internal medicine clinic, number of transfusions, complications and laboratory values according to amputation

	Amputation				p-value
	No		Yes		
	Mean ± SD	Median	Mean ± SD	Median	
Age	37.51±16.15	34 (18-85)	36.87±12.02	35 (19-66)	0.745
Time under the rubble (h)	29.06±35.85	14 (1-144)	26.4±18.92	24 (2-60)	0.489
Length of stay in internal medicine clinic (day)	22.89±8.15	25 (3-36)	29.67±5.38	30 (14-36)	**0.004**
Transfusions	6.69±15.83	1 (0-80)	11.67±16.79	3 (0-60)	0.21
Urea (mg/dL)	104.39±81.28	102.7 (12.84-393)	49.01±33.49	40.6 (12.84-128)	**0.016**
Creatinine (mg/dL)	3.26±2.73	2.99 (0.27-10.65)	1.69±1.63	0.67 (0.23-4.92)	**0.036**
Creatine kinase (U/L)	29026.27±52533.28	8258 (340-287071)	28627.47±34880.41	15486 (1182-114208)	0.361

Mann-Whitney U test
Bold values: Statistically significant parameters (p<0.005)
SD: Standard deviation

In the comparison made according to the development of AKI; it was found that there was a significant difference in terms of wound infection, hemodialysis, myoglobin on admission, number of transfusions, urea on admission, creatinine on admission, CK on admission, lactate dehydrogenase on admission, potassium on admission, pH on admission, HCO3 on admission, calcium on admission values (p<0.05). Accordingly, in patients with AKI; wound infection, hemodialysis, transfusion rates, the rate of patients with a myoglobin on admission value >1000 (µg/L), and urea on admission, creatinine on admission, CK on admission values were higher. Comparison and distribution of demographic characteristics of CS patients, time spent under the rubble, length of hospitalization, number of traumatized extremities, number of hemodialysis, number of transfusions, wound infection, mortality and laboratory values according to AKI is shown in Tables 7, 8.

Wound infection was more common in patients with AKI. AKI was more common in patients who underwent fasciotomy, unlike amputation.

Discussion

Various complications are seen in earthquake victims with CS. Few studies in the literature contain detailed data on patients with CS. Due to the lack of complete and accurate data during the earthquake, adequate studies on CS could not be carried out. After the 1988 Armenian earthquake and the Hanshin-Awaji earthquake, the hospital records of the patients with CS could not be kept fully and accurately (13-16). Unlike the literature, in our study, the clinical and laboratory data of the patients who applied to our hospital due to the need for further examination and treatment were recorded in detail. In our study, it was found that the age range of patients with ACS and crush injuries was similar to the literature (17,18).

In the literature, intracompartmental pressure measurement is recommended for the diagnosis of ACS. In this way, it has been stated that the development of ACS can be observed in the early period and surgical intervention can be applied at the

Table 7: Distribution of number of hemodialysis, complications, surgeries, mortality and laboratory values according to AKI

	Acute renal failure				p-value
	No		Yes		
	n	%	n	%	
Fasciotomy	5	(20.83)	17	(47.22)	**0.038**
Amputation	8	(33.33)	7	(19.44)	0.224
Wound infection	2	(8.33)	13	(36.11)	**0.015**
Hemodialysis	1	(4.17)	31	(86.11)	**<0.001**
Myoglobin on admission (µg/L)	<1000 12	(52.17)	8	(22.22)	**0.018**
	>1000 11	(47.83)	28	(77.78)	
Mortality	0	(0.00)	3	(8.33)	0.147

Mann-Whitney U test/chi-square test
Bold values: Statistically significant parameters (p<0.005)
n: Number of patients, %: Proportion in the whole population
AKI: Acute kidney injury

Table 8: Comparison of demographic characteristics of patients, time spent under the rubble, length of stay in internal medicine clinic, number of traumatized extremities, number of hemodialysis, number of transfusions and laboratory values according to AKI

	Acute renal failure				p-value
	No		Yes		
	Mean ± SD	Median (Min.-Max.)	Mean ± SD	Median (Min.-Max.)	
Age	35.75±12.13	33.5 (19-66)	38.42±16.92	35 (18-85)	0.803
Time under the rubble (h)	38.44±37.05	36 (1-144)	21.69±27.26	12.5 (1-144)	0.108
Length of stay in internal medicine clinic (day)	24.04±8.59	26.5 (3-35)	24.94±7.8	27 (10-36)	0.757
Total number of traumatized extremities	1.77±0.83	2 (1-4)	1.59±0.69	2 (1-4)	0.514
Transfusions	2.17±5.76	0 (0-26)	11.78±19.39	3.5 (0-80)	**0.001**
On admission					
Urea (mg/dL)	32.14±11.54	30.6 (14.9-51.36)	132.12±71.89	124.5 (20-393)	**<0.001**
Creatinine (mg/dL)	0.63±0.18	0.64 (0.24-1)	4.45±2.18	4 (1.17-10.65)	**<0.001**
Creatine kinase (U/L)	14335±19415.44	3950.5 (508-76368)	38837.58±58851.85	10646 (340-287071)	**0.030**
pH	7.46±0.05	7.46 (7.38-7.57)	7.38±0.1	7.4 (7-7.54)	**<0.001**
HCO_3 (mmol/L)	25.45±3.02	25.9 (18.3-30.1)	20.34±5.6	21.2 (6.6-29.1)	**<0.001**
Calcium (mg/dL)	8.43±0.44	8.43 (7.66-9.53)	8.16±0.69	8.17 (6.88-10.32)	**0.039**
Potassium (mEq/L)	4.12±0.47	4.15 (3.1-5.2)	4.92±1.25	4.57 (3.2-7.8)	**0.017**

Mann-Whitney U test
Bold values: Statistically significant parameters (p<0.005)
AKI: Acute kidney injury, SD: Standard deviation, Min.: Minimum, Max.: Maximum

right time (19). One of the main problem which encountered in the earthquake zone is the pressure measurement. Therefore, in areas with earthquake risk, portable compartment pressure measurement devices can prevent fasciotomy and amputation operations in patients whose surgical indications cannot be determined exactly.

Fasciotomy was performed on 22 crush injury patients. Similar to the study of Safari et al. (20), no significant relationship was found between age, gender, and duration of being under the rubble in terms of fasciotomy. Unlike Huang et al. (21) our study found no significant relationship between CK level and fasciotomy. We recommend that CK level not be used as a guide when determining patients undergoing fasciotomy. In our study, similar to the literature, wound infections were significantly higher in patients with fasciotomy. It is recommended to avoid unnecessary fasciotomy surgeries in crush injury patients whose indications are not established due to the increased risk of infection (22,23). In the literature, the amputation rate after fasciotomy ranges from 11% to 38.7% (24-27). In our study, amputation was not performed in patients who underwent fasciotomy. Hyperkalemia in patients with CS causes severe cardiac arrhythmias and may result in mortality if patients are not treated (28,29). In our study, no mortality due to hyperkalemia was observed due to close follow-up and rapid hemodialysis application.

Another important complication in patients with crush injury is AKI due to rhabdomyolysis. In our study, we found that increased CK values significantly increased the possibility of developing AKI. 60% of the patients with elevated CK levels had AKI. This rate was 0.5% for the Iran earthquake, 3.3% for the Hanshin-Awaji earthquake and 2.7% for the Marmara earthquake (16,30,31). The rate was %18.3 in the study by Kantarcı et al. (32) after the 1999 Marmara earthquake. We thought that the reason for the high rate in our study compared to the literature was that our hospital was a tertiary level hospital and patients who required advanced treatment in terms of kidney replacement were referred to our hospital.

The reason for this was that hydration was started in the early period as soon as the survivors were removed from the rubble, and the awareness of health care professionals about treatment increased due to previous earthquakes. Contrary to the literature, we found a low mortality rate in patients with CS (8.33%). In similar studies in the literature, mortality rates were 40% in the Iran earthquake, 24.7% in the Hanshin-Awaji earthquake, and 15.2% in the Marmara earthquake, respectively. We thought that the reason for this was good management of complications and a multidisciplinary approach (16,29,30).

In our study, wound infection was more common in patients with AKI. Similar to the study of Zhang et al. (33), we found that wound infection is an important complication after fasciotomy. We thought that toxic metabolites, acidosis, and electrolyte imbalances contributed to the development of wound infections, especially in patients with AKI. We thought that the high incidence of wound infection was due to renal failure and

acidosis as a complication of fasciotomy. In the study of Childs et al. (34), similar to our study, it was found that the development of AKI increased the risk of infection. The number of transfusions was found to be significantly higher in patients who underwent fasciotomy and developed AKI ($p<0.001$). Similarly, it has been determined in the literature that the need for transfusion will increase due to the complications of CS. In addition, in the study of Kazancioglu et al. (35) it was stated that obtaining sufficient amounts of blood products is important in patients with CS. We recommend starting adequate blood supply immediately after the earthquake.

Rapid determination of demographic characteristics, laboratory findings and clinical results of earthquake patients are critical for the development of future disaster preparedness, response and recovery policies.

Study Limitations

The limitations of our study were that the patients were not followed up after discharge and the number of patients was low. In addition, the short follow-up period of the patients and the fact that they were followed only in the internal medicine clinic were also limitations.

Conclusion

We found that fasciotomy and amputation prolonged hospital stay in earthquake victims with CS. In addition, healthcare professionals should be more careful in terms of wound infection in patients with AKI.

As a result of this study, demographic information, laboratory findings, epidemiological information about treatment and outcome will be valuable in improving disaster relief.

Ethics

Ethics Committee Approval: Ethics committee approval for the study was obtained from the Ankara Bilkent City Hospital No. 2 Clinical Research Ethics Committee (approval no.: E2-23-3705, date: 15.03.2023).

Informed Consent: Informed consent not available due to retrospective design.

Footnotes

Authorship Contributions

Surgical and Medical Practices: O.Z., B.G., M.G., M.D.G., F.Ş.S., M.D., E.S.Ş., O.İ., E.C.Y., F.D., İ.A., Concept: O.Z., B.G., M.G., M.D.G., F.Ş.S., M.D., E.S.Ş., O.İ., E.C.Y., F.D., İ.A., Design: O.Z., B.G., M.G., M.D.G., F.Ş.S., M.D., E.S.Ş., O.İ., E.C.Y., F.D., İ.A., Data Collection and/ or Processing: O.Z., B.G., M.G., M.D.G., F.Ş.S., M.D., E.S.Ş., O.İ., E.C.Y., F.D., İ.A., Analysis and/or Interpretation: O.Z., B.G., M.G., M.D.G., F.Ş.S., M.D., E.S.Ş., O.İ., E.C.Y., F.D., İ.A., Literature Search: O.Z., B.G., M.G., M.D.G., F.Ş.S., M.D., E.S.Ş., O.İ., E.C.Y., F.D., İ.A., Writing: O.Z., B.G., M.G., M.D.G., F.Ş.S., M.D., E.S.Ş., O.İ., E.C.Y., F.D., İ.A.

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References

1. World Health Organization. Emergencies Türkiye and Syria Earthquakes. https://www.who.int/europe/emergencies/situations/turkiye-and-syria-earthquakes. Accessed March 1, 2023.
2. Liu S, He C. Related factors associated with earthquake inpatient mortality. Disaster Med Public Health Prep. 2022;16:65-70.
3. Heppenstall RB, Scott R, Sapega A, et al. A comparative study of the tolerance of skeletal muscle to ischemia. Tourniquet application compared with acute compartment syndrome. J Bone Joint Surg Am. 1986;68:820-828.
4. Michaelson M. Crush injury and crush syndrome. World J Surg. 1992;16:899-903.
5. Gonzalez D. Crush syndrome. Crit Care Med. 2005;33(1 Suppl):S34-S41.
6. Reis ND, Better OS. Mechanical muscle-crush injury and acute muscle-crush compartment syndrome: with special reference to earthquake casualties. J Bone Joint Surg Br. 2005;87:450-453.
7. Via AG, Oliva F, Spoliti M, et al. Acute compartment syndrome. Muscles Ligaments Tendons J. 2015;5:18-22.
8. Schmidt AH. Acute compartment syndrome. Injury. 2017;48 Suppl 1:S22-S25.
9. McQueen MM, Gaston P, Court-Brown CM. Acute compartment syndrome. Who is at risk?. J Bone Joint Surg Br. 2000;82:200-203.
10. Bulut M, Fedakar R, Akkose S, et al. Medical experience of a university hospital in Turkey after the 1999 Marmara earthquake. Emerg Med J. 2005;22:494-498.
11. Kang P, Zhang L, Liang W, et al. Medical evacuation management and clinical characteristics of 3,255 inpatients after the 2010 Yushu earthquake in China. J Trauma Acute Care Surg. 2012;72:1626-1633.
12. Sever MS, Erek E, Vanholder R, et al. The Marmara earthquake: epidemiological analysis of the victims with nephrological problems. Kidney Int. 2001;60:1114-1123.
13. Richards NT, Tattersall J, McCann M, et al. Dialysis for acute renal failure due to crush injuries after the Armenian earthquake BMJ. 1989;298:443-445.
14. Tattersall JE, Richards NT, McCann M, et al. Acute haemodialysis during the Armenian earthquake disaster. Injury. 1990;21:25-33.
15. Armenian HK, Melkonian A, Noji EK, et al. Deaths and injuries due to the earthquake in Armenia: a cohort approach. Int J Epidemiol. 1997;26:806-813.
16. Oda J, Tanaka H, Yoshioka T, et al. Analysis of 372 patients with Crush syndrome caused by the Hanshin-Awaji earthquake. J Trauma. 1997;42:470-476.
17. Tanida N. What happened to elderly people in the great Hanshin earthquake. BMJ. 1996;313:1133-1135.
18. Frink M, Hildebrand F, Krettek C, et al. Compartment syndrome of the lower leg and foot. Clin Orthop Relat Res. 2010;468:940-950.
19. McQueen MM, Duckworth AD, Aitken SA, et al. The estimated sensitivity and specificity of compartment pressure monitoring for acute compartment syndrome. J Bone Joint Surg Am. 2013;95:673-677.
20. Safari S, Najafi I, Hosseini M, et al. Outcomes of fasciotomy in patients with crush-induced acute kidney injury after Bam earthquake. Iran J Kidney Dis. 2011;5:25-28.
21. Huang KC, Lee TS, Lin YM, et al. Clinical features and outcome of crush syndrome caused by the Chi-Chi earthquake. J Formos Med Assoc. 2002;101:249-256.

22. Rush DS, Frame SB, Bell RM, et al. Does open fasciotomy contribute to morbidity and mortality after acute lower extremity ischemia and revascularization?. J Vasc Surg. 1989;10:343-350.
23. Görmeli G, Görmeli CA, Güner S, et al. [Article in Turkish] [A clinical analysis of patients undergoing fasciotomy who experienced the 2011 Van earthquake]. Eklem Hastalik Cerrahisi. 2012;23:156-160.
24. Duman H, Kulahci Y, Sengezer M. Fasciotomy in crush injury resulting from prolonged pressure in an earthquake in Turkey. Emerg Med J. 2003;20:251-252.
25. Li W, Qian J, Liu X, et al. Management of severe crush injury in a front-line tent ICU after 2008 Wenchuan earthquake in China: an experience with 32 cases. Crit Care. 2009;13:R178.
26. Guner S, Guner SI, Isik Y, et al. Review of Van earthquakes form an orthopaedic perspective: a multicentre retrospective study. Int Orthop. 2013;37:119-124.
27. Togawa S, Yamami N, Nakayama H, et al. The validity of the mangled extremity severity score in the assessment of upper limb injuries. J Bone Joint Surg Br. 2005;87:1516-1519.
28. Greenberg A. Hyperkalemia: treatment options. Semin Nephrol. 1998;18:46-57.
29. Parham WA, Mehdirad AA, Biermann KM, et al. Hyperkalemia revisited. Tex Heart Inst J. 2006;33:40-47.
30. Atef MR, Nadjatfi I, Boroumand B, et al. Acute renal failure in earthquake victims in Iran: epidemiology and management. Q J Med. 1994;87:35-40.
31. Erek E, Sever MS, Serdengeçti K, et al. An overview of morbidity and mortality in patients with acute renal failure due to crush syndrome: the Marmara earthquake experience. Nephrol Dial Transplant. 2002;17:33-40.
32. Kantarci G, Vanholder R, Tuglular S, et al. Acute renal failure due to crush syndrome during Marmara earthquake. Am J Kidney Dis. 2002;40:682-689.
33. Zhang H, Zeng JW, Wang GL, et al. Infectious complications in patients with crush syndrome following the Wenchuan earthquake. Chin J Traumatol. 2013;16:10-15.
34. Childs BR, Verhotz DR, Moore TA, et al. Presentation coagulopathy and persistent acidosis predict complications in orthopaedic trauma patients. J Orthop Trauma. 2017;31:617-623.
35. Kazancioglu R, Pinarbasi B, Esen BA, et al. The need for blood products in patients with crush syndrome. Am J Disaster Med. 2010;5:295-301.