ORIGINAL ARTICLE

Analysis of thoracic trauma patients transferred to Türkiye's largest hospital after Kahramanmaraş earthquake

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ABSTRACT

BACKGROUND: On February 6, 2023, an earthquake in Türkiye caused massive destruction. Over 50.000 people are known to have lost their lives, and over 100.000 are known to have been maimed. In our study, we aimed to analyze the treatment process of 267

METHODS: The demographic characteristics, the time spent under the rubble, the duration of transfer to the hospital, and the treatment process of patients admitted to our hospital have been evaluated.

RESULTS: There are 125 (46.8%) men and 142 (53.2%) women in the study. The rate of thoracic trauma was 21.8%. Of all the patients, 15.7% (n=42) had pneumothorax, 18% (n=48) had contusion, 28.8% (n=77) had hemothorax, and 73% (n=195) had rib fractures. The mean time spent under the rubble was 17.6±26.5 h, the duration of transfer to the hospital was 138.5±113.6 h, and the hospitalization time was 93.8±152.3 h. The duration of hospitalization and transfer has been statistically longer for the patients who were under the rubble (85.4%) than for those who were not. (14.6%) (p=0.048). There is a statistically weak positive correlation between the time spent under the rubble and the time of transfer (p=0.048).

CONCLUSION: The state, the time spent under the rubble, and the presence of hemothorax and pneumothorax should be effectively evaluated in earthquake-induced thoracic traumas. Considering these criteria in the transfer of patients to the centers operating at full capacity in a short time will minimize morbidity and mortality.

Keywords: Earthquake; thoracic traumas; Türkiye.

INTRODUCTION

On February 6, 2023, two earthquakes occurred in Türkiye, 8 h apart, with magnitudes of 7.7 and 7.6 megawatts (mw) on the Richter scale. It caused enormous destruction in an area of 110.000 square kilometers (km^2), which includes 11 provinces of Türkiye. More than 50.000 dead and hundreds of thousands injured were reported by the official authorities.[1]

One-fourth of trauma-related injuries are in the thoracic region. The incidence of thoracic injuries and related complications increases with the severity of trauma. In earthquakes, injuries usually occur due to exposure to debris.[2,3] A correct initial evaluation of thoracic injuries prevents morbidity and mortality. Surgical interventions should not be delayed, especially when pathologies such as pneumothorax and hemothorax are detected.[3,4]

After the first earthquake, 1225 patients were transferred to our center, which has the highest number of beds in Europe. This study is aimed at analyzing the demographic characteristics and treatment processes of 267 patients who developed thoracic trauma due to the earthquakes.

MATERIALS AND METHODS

Patients with chest trauma who were injured in the earth-

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quake that occurred in Türkiye on February 6th, 2023, and transferred to our hospital have been included in this study. The patients' gender, age, situation, and time spent under the rubble, the duration of transfer to the hospital, the radiology images, the services in which they were treated, the surgical procedures applied, crush syndrome status, thoracic trauma types, and injury severity scores (ISS) have been evaluated retrospectively from the hospital archive. The patients who had already been in the hospital during the earthquake and transferred to our hospital after the earthquake, the patients who had a traffic accident while trying to leave the area on their own, and the patients with missing hospital data have been excluded from the study.

Approval for the protocol of this study was obtained from the ethics committee with decision number E1/3387/2023. Written informed consent was also obtained from the patients and/or their guardians. This study was conducted in accordance with the World Medical Association Declaration of Helsinki.

Study Population

In the literature, it is reported that thoracic injuries with four or more rib fractures affect the occurrence of pulmonary injuries.[5] In the light of the literature and our clinical experience, patients with <3 rib fractures and no other pathology related to chest trauma were planned to be followed up in the emergency department for 6 h. The hospitalization period of patients with rib fractures and/or sternum fractures was determined to be 48 h. In the presence of hemothorax, pneumothorax, and pneumomediastinum, it was planned to follow-up with the patients for at least 72 h. In the presence of a thoracic surgery procedure, the length of the hospital stay was prolonged.

The time elapsed from the time of the earthquake to the removal time was accepted as the time of being under the rubble and was recorded in hours. The time taken until the patients were transferred to our hospital after they were removed from the rubble was calculated as the transfer time and was also recorded in hours. The time from admission to our hospital until the end of the patients' hospitalization was calculated as days and recorded as the hospitalization period.

In order to score the trauma severity of the patients that were included in this study, ISS was used. The body was divided into six parts in total, and an abbreviated injury scale (AIS) was used for each part. Injury severity at each part was assessed at six levels. It was summed up by squaring the scores of the three parts with the highest AIS scores. The result was the ISS. Scores between 0 and 16 have been considered mild injuries, scores between 16 and 25 as moderate injuries, and scores of 25 and above have been determined to be serious injuries.[6]

Statistical Analysis

The data have been evaluated in the statistical package program of IBM SPSS Statistics Standard Concurrent User V 26 (IBM Corp., Armonk, New York, USA). Descriptive statistics are given as the number of units (n), percentage (%), mean ± standard deviation, and median (minimum and maximum). The normal distribution of the data for numerical variables has been evaluated with the Shapiro–Wilk test of normality. The relationships between categorical variables have been evaluated with Chi-square tests (Pearson chi-square and Fisher exact tests). When the Chi-square results are found to be significant, subgroup analyses are performed with a Bonferroni-corrected two-ratio z-test. The relationships between numerical variables have been evaluated with the Spearman correlation coefficient. For numerical variables, two-group comparisons are made with the Mann-Whitney U test, and three-group comparisons are made with the Kruskal–Wallis analysis. In the Kruskal–Wallis analysis, multiple comparisons are made with the Dunn–Bonferroni test. A $p<0.05$ is considered statistically significant.

RESULTS

There were a total of 267 patients in the study, including 125 (46.8%) males and 142 (53.2%) females. The incidence of thoracic trauma seen was 21.8%. No mortality was observed due to the thoracic trauma. 15.7% (n=42) of the patients had pneumothorax, 18% (n=48) contusion, 28.8% (n=77) hemothorax, and 73% (n=195) rib fractures. Thoracic surgery was not performed on the patients except for a tube thoracostomy (Table 1).

The mean time spent under the rubble was 17.6±26.5 h, and the median time was 7.5 (1–144) h. The median time spent under the rubbles in those with hemothorax was 8.0 (1–144) h, in those with contusion was 8.0 (1–120) h, and in those with pneumomediastinum was 30.0 (1–138) h (Table 2).

The mean transfer time was 138.5±113.6 h, and the median time was 96 (20–528) h. The median transfer time was 98.5 (24–480) h for those with thoracic vertebral fractures, 192.0 (20–384) h for those with sternum fractures, and 241.0 (192–360) h for those with flail chests. Patients with flailing chests had longer transfer times than those without (P = 0.036). The median transfer time of patients who underwent chest tube was 168.0 (24–528) h. The transfer time of the patients followed in the thoracic surgery service has been statistically shorter than the patients followed in other services (p=0.042) (p=0.048) (Table 2).

After the transfer to the hospital, 13.9% (n=37) of the patients were discharged after the evaluation in the emergency department, while 34.1% (n=91) were admitted to the intensive care units. The rate of the patients who underwent tube thoracostomy was 19.5% (n=52).

The mean hospital stay was 93.8±152.3 h, and the median duration was 37.0 (6–1008) h. The median hospital stay was 72.0 (6–696) h for those with thoracic vertebral fractures, 84.0 (24–336) h for those with pneumomediastinum, and 96.0 (6–9129) h for those with pneumothorax. Patients with

Table 1. General information of the patients

	n	%
Gender		
Male	125	46.8
Woman	142	53.2
Age		
x±sd	45.8±19.0	
M (min-max)	8-96	
Under the rubble		
Yes	228	85.4
No	39	14.6
Time spent under the rubble, (hour)		
x±sd	17.6±26.5	
M (min-max)	7.5 (1-144)	
Transport time, (hour)		
x±sd	138.5±113.6	
M (min-max)	96 (20-528)	
Duration of hospitalization, (hour)		
x±sd	93.8±152.3	
M (min-max)	37.0 (6-1008)	
ISS		
x±sd	17.9±14.2	
M (min-max)	14.0 (0-75)	
ISS Subgroup		
0-16	137	51.3
17-25	59	22.1
>25	71	26.6
Surgical Procedure		
No tube thoracostomy	215	80.5
Tube thoracostomy	52	19.5

thoracic vertebral fractures, pneumothorax, and hemothorax had longer hospital stays than those without (p=0.029, p=0.001, p<0.001). The median length of stay in the thoracic surgery service was 113 (6–576) h, and the median length of stay in the intensive care unit was 113 (6–912) h (Table 2).

The duration of hospitalization and transfer time have been statistically longer in the patients who spent time under the rubble (85.4%) than those who were not (14.6%) (p=0.048). There has been a statistically weak positive correlation between the time of the rubble and the time of transfer (p=0.048).

The ISS of patients with rib fractures has been statistically lower than that of those without (p<0.001). ISS has been statistically higher in patients with pneumothorax, hemothorax, and contusion than in those without (p<0.001). There has been no statistical difference between ISS according to the presence of a flail chest, sternum fracture, thoracic vertebral fracture, or pneumomediastinum (p>0.05). Patients with ISS 17–25 have a statistically higher length of stay than those with ISS 0–16 (p=0.001). The percentage of patients with ISS 17–25 and ISS>25 who underwent tube thoracostomy has been statistically higher than those with ISS 0–16 (p<0.001). The ISS values of those who were under the rubble are statistically higher than those who were not. There has been a statistically weak positive correlation between ISS values and the duration of being under the rubble and the length of hospital stay (p<0.001) (Table 2).

DISCUSSION

Thoracic trauma is the third cause of death after cardiovascular diseases in all age groups. It has been reported that one out of every four trauma patients died due to thoracic trauma or related complications. The incidence of reported thoracic traumas varies between 10 and 15%. Studies on earthquakes are generally single-centered studies. Despite this, the reported incidence of thoracic trauma is similar to that of trauma

Table 2. Distribution of thoracic traumas according to ISS subgroups and relationship with time spent under the rubble, transport time and duration of hospitalization

Thoracic trauma	ISS			Time spent under the rubble		Transport time		Duration of hospitalization	
	0–16 n	16–25 n	>25 n	p	M (min-max)	p	M (min-max)	p	M (min-max)	p
Rib fracture	108	45	42	0.008	7.0 (1–120)	0.210	96.0 (20–528)	0.803	48.0 (6–912)	0.424
Hemothorax	20	25	32	<0.001	8.0 (1–144)	0.658	96.0 (24–528)	0.966	72.0 (6–1008)	<0.001
Contusion	18	11	19	0.049	8.0 (1–120)	0.926	96.5 (24–408)	0.505	48.0 (6–912)	0.174
Pneumothorax	14	10	18	0.018	7.0 (1–38)	0.873	83.0 (24–528)	0.409	96.0 (6–912)	0.001
Thoracic vertebral fracture	17	10	13	0.474	5.0 (1–97)	0.077	98.5 (24–480)	0.982	72.0 (6–696)	0.029
Pneumomediastinum	8	3	5	0.889	30.0 (1–138)	0.031	84.0 (24–336)	0.609	24.0 (6–912)	0.898
Sternum fracture	7	2	1	0.435	4.0 (1–22)	0.046	192.0 (20–384)	0.171	39.0 (6–504)	0.817
Flail chest	1	1	1	>0.999	3.0 (2–5)	0.211	241.0 (192–360)	0.036	48.0 (6–53)	0.685

studies other than earthquakes.[2-4,7] In our study, the incidence of thoracic traumas (21.8%) was higher when compared to the literature. The fact that our hospital is suitable for providing effective health services in such natural disaster situations might have caused it to be preferred primarily for transfers and the high incidence of thoracic trauma in our study.

It is known that the natural disasters with the worst results in terms of morbidity and mortality rates are earthquakes. In earthquakes, the death toll increases due to the collapse of buildings and long periods of staying under the rubble. In addition, the delay of medical services after the earthquake and long transfer times to the nearest active hospitals also increase the number of deaths.[4,7-11] In our study, no mortality rate was observed in thoracic trauma. Except for our mortality rate, the median time to stay under the rubble and the median transfer times were similar to the studies in the literature. The earthquake had a huge impact over 11 provinces, and this large scale caused serious disruptions to roads and air transport in the region. It is thought that this is the main reason for earthquake victims to stay under the rubble longer, and their transfer to the hospitals was longer too. Despite the transportation problems right after the earthquakes, thousands of volunteer doctors went to the area from the very 1st h of the earthquake. It is considered that the provision of effective health services from the first moment of the earthquake with limited opportunities plays an active role in the absence of mortality in patients transferred to our hospital.

The evaluation of vascular and pulmonary structures is at the forefront of the initial evaluation of thoracic traumas; however, the evaluation of pathologies of the chest wall should also not be ignored. The main pathology in thoracic traumas has been reported as rib fractures in many publications. It has been stated that it is the most important indicator of mortality and morbidity.[12-14] Bone fractures are most commonly observed in traumas due to earthquakes. It is seen that the time of occurrence of earthquakes changes the type and frequency of bone fractures. For instance, standing or sitting positions during an earthquake during the daytime might cause more vertebral and extremity fractures.[13,14] In this study, rib fractures are the most common, consistent with the literature. The fact that the earthquakes occurred at night and most of the earthquake victims were caught in the supine position might be the reason why rib fractures are the most common pathology.

Traumas that exceed the thoracic wall barrier can cause serious damage to the pulmonary structures. Pneumothorax can be observed in 40–50% of blunt traumas. Hemothorax, or hemopneumothorax, is observed in one of every three patients. The incidence of contusion varies between 17 and 75%.[7] In our study, rib fractures, hemothorax, and contusions, respectively, have been the most common ones, consistent with the literature. The incidence of pneumothorax has been observed less than in the literature.

Effective initial evaluation of patients prevents morbidity and mortality in thoracic traumas. Especially rib fractures, hemothorax, contusions, and pneumothorax, which are missed in the early period or not followed up adequately, can cause serious problems in the late period. The incidence of occult pneumothorax among thoracic traumas has been reported to be between 2 and 20%. The incidence of hemothorax requiring surgical intervention in the late period has been reported to be 7.3–12%[15] In this study, patients with pneumothorax and hemothorax had statistically longer hospital stays than those without. The hospitalization period of the patients who underwent tube thoracostomy due to these pathologies has been statistically longer than that of the patients who did not. It can be stated that effective evaluation of rib fractures, hemothorax, contusion, and pneumothorax after the earthquake and transfer of patients at the appropriate time will prevent possible mortality and morbidities.

In our study, it has been determined that the state and time of being under the rubble of the patients are associated with high ISS and long hospitalization times. Due to the heterogeneous nature of trauma patients, ISS is used in studies to classify traumas according to their severity.[6] It is thought that using the state and time of being under the rubble of the patients in the initial evaluation will speed up the transfer to hospitals outside the earthquake zone and provide more accurate access to health services.

In our study, patients with thoracic trauma were mostly hospitalized in intensive care units. The number of patients admitted to the thoracic surgery service was in second place. The median length of stay was the same for both services. Among the patients admitted to the thoracic surgery service, those with mild and moderate injuries were more common, but the transfer time to the hospital was shorter. It is thought that the general condition of these patients is more suitable for transfer, so they are brought to our hospital at an early time. It might be planned to reduce the density of hospitals in the earthquake area by transferring patients whose condition was not critical earlier.

The limitations of the study are that it is a single-centered study and a retrospective study. In addition, the lack of data on the management of thoracic trauma in the earthquake zone is among the limitations. The fact that our study includes the highest number of thoracic trauma patients after an earthquake when compared to the studies in the literature makes it valuable.

CONCLUSION

We think that the severity of thoracic trauma is influenced by the duration of time spent under the rubble. As the severity of trauma increases, significant pulmonary injuries such as hemothorax and pneumothorax may occur more frequently. It should be kept in mind that these injuries may lead to longer hospitalization times. We believe that earthquake victims with thoracic trauma, especially those with pulmonary inju-

ries, should be transported to well-equipped hospitals in a shorter period of time in order to provide effective and accurate health care services.

Ethics Committee Approval: This study was approved by the Ankara City Hospital Ethics Committee (Date: 22.03.2023, Decision No: E1/3387/2023).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Kahramanmaraş depremi sonrası Türkiye'nin en büyük hastanesine nakledilen toraks travmalı hastalarının analizi

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AMAÇ: 6 Şubat 2023 tarihinde Türkiye'de meydana gelen deprem büyük bir yıkıma yol açtı. Depremde 50.000'den fazla kişinin hayatını kaybettiği ve 100.000'den fazla kişinin sakat kaldığı bilinmektedir. Çalışmamızda hastanemize sevk edilen 1225 depremzede arasından toraks travması geçiren 267 hastanın tedavi sürecini analiz etmeyi amaçladık.

GEREÇ VE YÖNTEM: Hastanemize başvuran hastaların demografik özellikleri, enkaz altında geçirdikleri süre, hastaneye nakil süreleri ve tedavi süreçleri değerlendirilmiştir.

BULGULAR: Çalışmaya 125 (%46.8) erkek ve 142 (%53.2) kadın katıldı. Toraks travması görülme oranı %21.8'di. Tüm hastaların %15.7'sinde (n=42) pnömotoraks, %18'inde (n=48) kontüzyon, %28.8'inde (n=77) hemotoraks ve %73'ünde (n=195) kaburga kırığı vardı. Enkaz altında geçirilen ortalama süre 17.6±26.5 saat, hastaneye nakil süresi 138.5±113.6 saat ve hastanede yatış süresi 93.8±152.3 saatti. Hastanede yatış ve nakil süresi enkaz altında kalan hastalarda (%85.4) kalmayanlara (14.6%) göre istatistiksel olarak daha uzundu (p=0.048). Enkaz altında kalma süresi ile nakil süresi arasında istatistiksel olarak zayıf pozitif bir korelasyon vardı (p=0.048).

SONUÇ: Depreme bağlı toraks travmalarında enkaz altında kalma durumu ve süresi, hemotoraks ve pnömotoraks varlığı etkin bir şekilde değerlendirilmelidir. Hastaların kısa sürede tam kapasite ile çalışan merkezlere sevkinde bu kriterlerin göz önünde bulundurulması morbidite ve mortaliteyi en aza indirecektir.

Anahtar sözcükler: Deprem; toraks travmaları; Türkiye.

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