EuropeAnatolia Health Sciences Journal E-ISSN: 2980-3861

RESEARCH ARTICLE
Volume:2 Issue:2 Year:2024 https://doi.org/10.5281/zenodo.13148911

Thoracic Trauma Experiences of Local Thoracic Surgeons Working in Kahramanmaraş During the Early Period of the Earthquake

Kahramanmaraş'ta Depremin Erken Döneminde Çalışan Yerel Göğüs Cerrahlarının Göğüs Travmaları Deneyimleri

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ABSTRACT

Introduction: Our city received a double blow with two consecutive earthquakes that occurred in our city on February 6, 2023.
Objective: In this study, we aimed to examine our medical interventions and convey the difficulties encountered in the acute phase of the earthquake.
Methods: One hundred fifty one individuals who suffered chest trauma were included in the study. The cohort consisted of earthquake victims who presented to our emergency department with chest injuries within the first seven days, excluding the first 24 hours, after the earthquake. We recorded various parameters such as age, gender, types. Chest injuries, number of ribs, sternum fractures, hemothorax, pneumothorax, lung contusions, lung lacerations, crusting in the main respiratory tract and atelectasis due to foreign objects, additional organ injuries, first interventions, length of hospital stay, need for intensive care, death and morbidity rates. and out-of-province shipments.
Results: We recorded 151 earthquake victims with thoracic injuries, comprising 79 (52.3%) women and 72 (47.7%) men. Among these cases, lung contusions were observed in 120 (79.5%), rib fractures in 106 (70.2%), pneumothorax in 47 (31.1%), hemothorax in 39 (25.8%), and pneumomediastinum in 33 (21.9%).
Conclusion: In scenarios where access to imaging services is not possible, thoracic surgeons must rely on physical examination and thoracentesis to guide their interventions. Teams should organize their work according to workload, designate a safe area for thoracic surgery interventions, and ensure that all necessary equipment is available.

Keywords: Earthquake, Chest Trauma, Hemothorax, Pneumothorax, Lung Contusion.

ÖZET

Giriş: 6 Şubat 2023 tarihinde ilimizde meydana gelen üs tüste iki depremle şehrimiz çifte darbe aldı.
Amaç: Bu çalışmamızda tıbbi müdahalelerimizi inceleyerek depremin akut aşamasında karşılaşılan zorlukları aktarmayı amaçladık.
Yöntem: Çalışmaya göğüs travması geçiren151kişi dahile dildi. Kohort, depremden sonraki ilk 24 saat hariç, ilk yedi gün içinde acil servisimize göğüs yaralanmasıyla başvuran depremzedelerden oluşuyordu. Yaş, cinsiyet, yaralanma türü gibiçeşitli parametrelerle göğüs yaralanmaları, kaburga kırıkları, sternum kırıkları,hemotoraks, pnömotoraks, akciğer kontüzyonları, akciğer laserasyonları, ana solunum yollarında krutlar ve yabancı cisimlere bağlı atelektaziler, ek organ yaralanmaları, ilk müdahaleler, hastanede kalış süresi, yoğun bakım ihtiyacı, ölüm oranları ve il dışına sevk edilen olgular kayıt altına alındı.
Bulgular: Toraks yaralanmalı 79'u (%52,3) kadın ve 72'si (%47,7) erkek 151 deprem mağdurunu kaydettik. Bu olguların 120'sinde (%79,5) akciğer kontüzyonu, 106'sında (%70,2) kaburga kırığı, 47'sinde (%31,1) pnömotoraks, 39'unda (%25,8) hemotoraks, 33'ünde (%21,9) pnömomediastenium görüldü.
Sonuç: Görüntüleme hizmetlerine erişimin mümkün olmadığı senaryolarda göğüs cerrahları müdahalelerini yönlendirmek için fizik muayene ve torasenteze güvenmek zorundadır. Ekipler işlerini iş yoğunluğuna göre düzenlemeli, göğüs cerrahisi müdahaleleri için güvenli bir alan belirlemeli ve gerekli tüm ekipmanın mevcut olmasını sağlamalıdır.

Anahtar Kelimeler: Deprem, Torakstravması, Hemotoraks, Pnömotoraks, Akciğer Kontüzyonu.

INTRODUCTION

Turkey sits squarely on an earthquake-prone zone, a well-established scientific reality. Earthquakes, natural calamities with profound destructive potential, can significantly impact humanity depending on their magnitude and intensity (1). On February 6, 2023, our city experienced a double blow when two consecutive earthquakes struck, both originating from within its vicinity.

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Received: 05.07.2024, Accepted: 01.08.2024, Published Online: 20.08.2024
Cited: Kozanlı F, et al. Thoracic Trauma Experiences of Local Thoracic Surgeons Working in Kahramanmaraş During the Early Period of the Earthquake. Europeanatolia Health Sciences Journal. 2024;2(2):19-27. https://doi.org/10.5281/zenodo.13148911

The initial tremor, registering a magnitude of 7.8, jolted the Pazarcık district of Kahramanmaraş at 04:17 in the morning. Just hours later, at 13:24, another powerful quake, measuring 7.6, rocked the neighboring Ekinözü district (2, 3). Kahramanmaraş, situated in Turkey's eastern Mediterranean region, serves as a vital nexus connecting southeastern Anatolia with the Mediterranean and central Anatolia.

The dual earthquakes, occurring within a nine-hour span, reverberated across 11 provinces. While estimates suggest the loss of over 55,000 lives, the exact toll remains uncertain (4). Termed the "disaster of the century," these seismic events inflicted severe injuries, resulting in amputations, permanent disabilities, and profound trauma.

Although commonly associated with fatalities, earthquakes also inflict a range of injuries beyond death. These include severe fractures, internal organ damage, crush syndrome, burns, limb injuries, abdominal trauma, head wounds, and thoracic injuries (5).

In this study, we aim to recount the challenges encountered in the initial aftermath of the earthquakes in Kahramanmaraş, the epicenter of the disaster, delving into our response efforts as we grappled with tens of thousands of injured individuals flooding our emergency department on the first day. Our narrative encompasses the coordination of personnel, allocation of resources, innovative solutions, and the inevitable moments of helplessness that enveloped us. By documenting our experiences, including thoracic injury patterns observed during the earthquakes, initial responses to casualties, and subsequent medical interventions, to the extent permitted by available data records, we endeavor to contribute to the existing literature. Moreover, we aspire to provide a blueprint for future disaster management protocols, highlighting both effective strategies and areas for improvement.

METHODS

Our study adheres to Helsinki standards and received approval from the institutional Clinical Research Ethics Committee (Date 15.04.2024, no: 04).

We conducted a retrospective analysis of patients with thoracic traumas admitted to the Faculty of Medicine of xxxxx University, which was the epicenter of the February 6 earthquakes and experienced significant devastation, resulting in numerous fatalities and severe injuries. Regrettably, data recording and communication systems collapsed on February 6, 2024, the first day of the earthquake, preventing the documentation of injured patients brought to the emergency room. Consequently, these patients were excluded from our study. We included 151 individuals with thoracic traumas who could be recorded using the functional data recording system established 24 hours post-earthquake.

Our study did not impose age restrictions and encompassed individuals of all age groups with thoracic traumas. The cohort comprised earthquake victims brought to our emergency department within the first seven days (February 7-14, 2023), excluding the initial 24 hours following the earthquake, who presented with thoracic injuries. Patients not directly affected by the earthquake but admitted to our emergency department for unrelated reasons (e.g., traffic accidents, workplace injuries, falls from heights), as well as those who sustained injuries during the earthquake but lacked thoracic traumas, were not included in our study.

We recorded various parameters, including age, gender, types of thoracic injuries, number of fractured ribs, sternum fractures, hemothorax, pneumothorax, lung contusions, lung lacerations, atelectasis due to crusts and foreign bodies in the main respiratory tract, additional organ injuries (e.g., abdominal, brain, extremity, head injuries), initial interventions, length of hospital stay, requirement for intensive care, mortality and morbidity rates, and referrals outside the province. Data regarding injured patients were extracted from the hospital's electronic data processing system.

Our study also examines the conditions within the emergency department during the initial 24-48 hours following the earthquake, highlighting the chaos, organizational challenges, and difficulties in managing teams and equipment. Additionally, we discuss the interventions performed by local thoracic surgeons during the critical 24-48-hour window, spanning from the influx of casualties until the arrival of external aid teams. We elucidate the primitive measures undertaken under these circumstances, the challenges encountered, and propose coping strategies.

Statistical Analysis

Descriptive statistics were employed to analyze the data, including mean, standard deviation, median, lowest, highest, frequency, and ratio values. The distribution of variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. For the analysis of quantitative independent data, the Mann-Whitney U test was utilized. Qualitative independent data were analyzed using the Chi-square test, with Fisher's exact test employed when the conditions for the Chi-square test were not met. All analyses were conducted using the SPSS 27.0 software.

RESULTS

“We were the only ones who saw the first 24 hours of the earthquake.” During the initial 24 hours of the earthquake, our ability to record data, access the internet, and communicate with the outside world was severely impaired. As a result, we were not only unable to register hospital admissions for earthquake victims but also isolated from external assistance. What began as a manageable influx of 5 or 10 injured individuals quickly escalated beyond our capacity to count as the minutes passed. Despite all radiology units being operational, they struggled to keep pace with the overwhelming number of patients requiring evaluation.

For those fortunate enough to undergo radiological assessment, radiologists resorted to improvisation, jotting down findings on small notes and affixing them to visible areas of the patient's body. However, confusion ensued regarding who required imaging and for what purpose. Eventually, it became impractical to request further radiological studies from the injured, and those sent for imaging took hours to return due to extensive queues at the radiology unit. Moreover, the available FAST (Focused Assessment with Sonography in Trauma) facilities were insufficient to meet the burgeoning demand.

Faced with these challenges, we had no option but to rely on physical examination to guide our interventions. Thoracentesis was performed in patients deemed necessary based on physical findings, with subsequent decisions for tube thoracostomy made based on the results. Lacking a formal recording system, we endeavored to convey our physical examination findings to other trauma units evaluating potential thoracic injuries by inscribing them on paper and affixing them to the chests of the injured.

In the initial hours following the earthquake, coordination posed significant challenges for us. Following the initial shock, we made a strategic decision to delegate triage responsibilities to emergency medicine specialists and non-surgeons, freeing ourselves to establish a dedicated area within the emergency room for thoracic surgery examinations and interventions. By midday, we divided into two groups to assess both the injured we were treating and those hospitalized before the earthquake.

However, our efforts were interrupted by the occurrence of a second major earthquake while the first group was conducting checks on patients with thoracic trauma and those previously hospitalized throughout the hospital. The subsequent influx of injured individuals overwhelmed our coordination efforts, plunging us back into chaos. Despite initial fear and anxiety, we persevered in treating the injured.

Before the earthquake, we had approximately 1000 chest tubes in our inventory. Within the first 24 hours, we estimate that we inserted chest tubes into around 1000 unregistered injured individuals

suffering from hemothorax, pneumothorax, and hemopneumothorax, depleting our supply of chest tubes. As the majority of the injured individuals we treated as local thoracic surgeons were subsequently transported to different cities via air ambulances, they were unable to be included in the hospital's data recording system at a later time.

Following the initial 24 hours, our data recording system resumed functionality, and injured individuals who presented to our hospital were recorded based on their own statements, without requiring identity cards. For those who lacked identification, were elderly, orphaned children, or had no relatives, law enforcement forces were enlisted to provide protection and assist with registration. Subsequently, volunteer health professionals from outside the province and country also offered support to our hospital.

In the seven days following the initial 24 hours of the earthquake (7-14 February 2023), we recorded 151 earthquake victims with thoracic injuries, comprising 79 (52.3%) women and 72 (47.7%) men. Among these cases, lung contusions were observed in 120 (79.5%), rib fractures in 106 (70.2%), pneumothorax in 47 (31.1%), hemothorax in 39 (25.8%), and pneumomediastinum in 33 (21.9%). The mean number of rib fractures was 2.03 ± 2.62 (range 1 to 10, median 3). Additionally, atelectasis was noted in 19 (12.6%) cases, subcutaneous emphysema in 6 (4%), sternum fractures in 3 (2%), and lung laceration in 1 (0.7%) (Table 1).

Table 1. Victims' Demographicsand Injury Types

		Min-Max	Median	average.±sd/n-%	
Age average.±sd/n-%		6.0-90.0	45.0	45.5	±±18.7
Gender	Female			79	52.3%
	Male			72	47.7%
InjuryType	RibFractures			106	75.9%
	Number of ribfractures	1.00-10.00	3.00	3.03	±2.62
Pneumothorax				47	31.1%
Hemothorax				39	25.8%
Lungcontusion				120	79.5%
Pneumomediastinium				33	21.9%
Otherinjuries				32	21.2%
Atelectasis				19	12.6%
Subcutaneousemphysema				6	4.0%
SternumFracture				3	2.0%
LungLaceration				1	0.7%
Extrathoracicinjuries				73	48.3%
Limbfractures				30	20%
Headinjuries				12	7.9%
Vertebralfractures				9	6%
Legamputation				7	4.7%
Abdominal organ injuries				5	3.3%
Scapulafractures				4	2.6%
Pelvicfractures				2	1.3%
Myocardialcontusion				2	1.3%
MaxillofacialInjury				3	2%
ArmAmputation				1	0.7%
FingerAmputation				1	0.7%

Extrathoracic injuries were present in 73 (48.3%) cases, most commonly accompanied by extremity fractures. Among cases with thoracic injuries, 30 (20%) exhibited various levels of extremity fractures. Notably, cases involving amputations—separate from extremity fractures—included 7 (4.7%) with leg amputations and 1 (0.7%) with arm amputation (Table 1).

Medical interventions included tube thoracostomy in 39 (25.8%) cases, rigid bronchoscopy in 4 (2.6%), and emergency thoracotomy in 1 (0.7%) (Table 2). Furthermore, intensive care was required in 37 (24.5%) cases, with a mean length of hospital stay of 3.25 ± 2.69 (range 1 to 17, median 2) days (Table 2).

Table 2. Treatment Options, Hospital Stays, Intensive Care Needsand Conclucion

		Min-Max			Median	Average .±sd/n-%		
Treatment								
Medicaltreatment						106		70.2%
TubeThoracostomy						39		25.8%
RigidBronchoscopy						4		2.6%
Thoracotomy						1		0.7%
Laparotomy						1		0.7%
NeedforIntensiveCare								
						37		24.5%
HospitalizationDuration	< 5 days					111		73.5%
	≥ 5 days					40		26.5%
Duration of Hospitalization		1.00	-	17.00	2.00	3.25	±	2.69
Out-of-provinceshipment								
						43		30.5%
Conclusion	Exitus					10		6.6%
	Out-of-provinceshipment					43		28.5%
	Recovering in ourcenter					98		64.9%

Our mortality rate stood at 6.2%, accounting for 10 cases, while our out-of-province referral rate reached 28.5%, totaling 45 cases. Among patients requiring intensive care, the number of rib fractures, pneumothorax rate, hemothorax rate, lung contusion rate, and extrathoracic injury rate were all significantly higher ($p<0.05$) compared to those not requiring intensive care. Additionally, the mortality rate and out-of-province referral rate were significantly higher ($p<0.05$) in the intensive care group compared to the non-intensive care group (Table 3).

In the healed group, the number of rib fractures was significantly lower ($p<0.05$) compared to the non-healed group. Additionally, the hemothorax rate in the healed group was significantly lower ($p<0.05$) than in the non-healed group. Moreover, the requirement for intensive care in the healed group was significantly lower ($p<0.05$) compared to the non-healed group. Conversely, the length of hospital stay in the healed group was significantly higher ($p<0.05$) than in the non-healed group. Furthermore, the rates of pneumothorax and hemothorax were significantly higher ($p<0.05$) in the group with out-of-province referral compared to the group without out-of-province referral.

Table 3. Characteristics of Victims'Who do and do not Need Intensive Care

		ICU* (-)				ICU* (+)				P	
		Av .±sd/n-%			Median	Av .±sd/n-%			Median		
Age		44.7	±	18.7	43.0	48.0	±	18.9	50.0	0.294	m
Gender	Female	56		49.1%		23		62.2%		0.168	X^2
	Male	58		50.9%		14		37.8%			
Number of RibFractures		2.72	±	2.36	3.00	4.00	±	3.13	4.00	***0.024***	m
Pneumothorax										***0.025***	X^2
		30		26.3%		17		45.9%			
Hemothorax										***0.000***	X^2
		19		16.7%		20		54.1%			
LungContusion										***0.002***	X^2
		84		73.7%		36		97.3%			
Pneumomediastinium										0.676	X^2
		24		21.1%		9		24.3%			
ExtrathoracicInjury										***0.002***	X^2
		47		41.2%		26		70.3%			
Duration of Hospitalization	<5 days	86		75.4%		25		67.6%		0.346	X^2
	≥ 5 days	28		24.6%		12		32.4%			
Duration of Hospitalization		3.23	±	2.51	3.00	3.32	±	3.22	1.00	0.416	m
Recovering in ourcenter										***0.000***	X^2
		87		76.3%		11		29.7%			
Out-of-provinceshipment										***0.000***	X^2
		25		22.3%		18		62.1%			

*Intensivecareunit

DISCUSSION

Thoracic injuries represent the most prevalent form of injuries resulting from earthquakes, as documented in previous studies (6-8). Given the occurrence of the Kahramanmaraş-centered earthquakes during winter, characterized by snowy conditions, hypothermia compounded the trauma and injuries associated with the earthquake. Our hospital, located at the epicenter of the earthquake, akin to Hu's study, serves as the largest and sole tertiary healthcare institution in the region (9). The devastation wrought by the earthquakes left all private hospitals in Kahramanmaraş in ruins, severely damaged the major city hospital, and rendered the smaller city hospital incapable of providing adequate service due to deficiencies in equipment, infrastructure, and building space. Consequently, KahramanmaraşSütçü İmam University Faculty of Medicine hospital emerged as the primary healthcare facility serving the region (10).

Although the number of cases totaled 151 in our study, initial casualty admissions within the first 24 hours went unrecorded. Nonetheless, this figure is comparable to the study by Hu et al. and exceeds the caseload reported in studies conducted by Yi Su, Yoshimura, and Ghodsin (6, 9, 12, 13). Kahramanmaraş, our city of residence, stands at the epicenter of earthquakes and endured some of the most extensive destruction (14). While the initial 24-hour casualty count could not be recorded, we attribute the high number of injured individuals to our city's status as the epicenter and one of the worst-affected areas.

Lung contusions emerged as the most prevalent form of thoracic injury in our study, surpassing the literature data (15, 16). In a prior study conducted at our center between 2017 and 2019, examining cases of blunt thoracic trauma before the earthquake, lung contusions accounted for 38% of injuries. However, following the earthquake, this rate surged to 75.9% (17). We attribute this approximately twofold increase in lung contusions to the altered trauma mechanisms experienced by individuals trapped under rubble for extended periods, subjected to immense pressure. This increased load likely contributed to the elevated incidence of lung contusions observed in our study population.

While rib fractures are typically cited as the most common thoracic injuries in earthquake-related incidents according to literature, our study found them to be the second most common, with a lower incidence compared to our previous research involving non-earthquake-related trauma mechanisms (18). It is understood that a higher number of rib fractures, particularly those resulting in flail chest, can be life-threatening, associated with mortality rates ranging from 10% to 20%, and often coincide with multiple organ injuries (18, 19). We are of the opinion that cases with extensive rib fractures and flail chest may have succumbed to their injuries before reaching the hospital.

Interestingly, rates of hemothorax and pneumothorax were lower in our study compared to previous research conducted in our region (17, 18). Furthermore, the number of cases requiring chest tube insertion decreased significantly after the initial 24 hours. We attribute this decline to the possibility that individuals with hemothorax, pneumothorax, and hemopneumothorax who were extricated from the rubble more than 24 hours later and warranted chest tube placement may have perished before being rescued. In our study, chest tubes were utilized in 39% of cases due to hemothorax, pneumothorax, and hemopneumothorax, aligning with findings from previous literature on earthquake victims (16).

Notably, our study reported instances of rigid bronchoscopy, a procedure not commonly encountered in similar literature studies. Unlike other studies, we found that rigid bronchoscopy was required in 4 (2.6%) cases (9, 15, 16, 20). These individuals were rescued from the rubble 100 hours or more after the initial event and presented with respiratory distress and atelectasis attributed to inhalation of dust and debris generated by the demolition in their vicinity.

Similar to injuries observed in the 2008 earthquake in China's Sichuan province, extremity fractures were the most common accompanying thoracic trauma in our study (9, 16).

Our hospital's length of stay was shorter than reported in the literature (16). We attribute this shorter duration to the transfer of severely injured cases and earthquake victims requiring complex treatment to larger hospitals in other cities via air ambulance.

The incidence of cases requiring intensive care in our study was 37 (24.5%), lower than the literature data (20). This disparity may be attributed to the transfer of severely injured cases out of the province. Our findings indicated that lung contusion, hemothorax, pneumothorax, and extrathoracic injuries significantly influenced the requirement for intensive care.

The mortality rate in our study was 10 (6.2%), with varying findings reported in similar literature studies (6, 15, 19). We attribute these discrepancies to differences in earthquake-affected regions and building structures (21). The majority of destroyed buildings in our city are located in vulnerable areas and lack earthquake resistance, which may explain differences in mortality rates (10). Another study conducted in our country reported no mortality (20). However, the center of this study serves as the referral center for injured individuals in our region. We speculate that victims may have perished before reaching this referral center.

CONCLUSION

Thoracic traumas can pose life-threatening risks during earthquakes, especially in regions like Kahramanmaraş, where devastation spans multiple provinces. Given the potential delays in professional assistance teams reaching the area, thoracic surgeons operating in affected regions must prioritize immediate medical attention without awaiting external aid. In situations where communication networks and data recording systems are disabled, local health professionals must swiftly devise alternative communication methods.

In scenarios where access to imaging services is unavailable, thoracic surgeons must rely on physical examination and thoracentesis to guide their interventions. In such circumstances, specialists in critical units like thoracic surgery should refrain from participating in triage activities. Instead, teams should organize their efforts based on workload, designating a secure area as a dedicated site for thoracic surgery interventions and ensuring that all necessary equipment is readily available.

It is imperative to recognize the critical significance of every intervention during such crises.

DESCRIPTIONS

No financial support.

No conflict of interest.

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