

The Experience of the Floating Hospital During the Acute Period of the Earthquake

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Abstract

Aim: Two earthquakes with magnitudes of 7.7 and 7.6, which occurred in Kahramanmaraş on February 6, 2023, have caused distress to residents of Turkey and Syria. With the authorization of the Ministry of Health and the Ministry of Defense, two large armored ships have been positioned in the region as floating field hospitals. In our study, we aim to provide disaster management resources by retrospectively examining the examination records of patients admitted to these floating hospitals due to earthquakes and by researching the organization of hospitals and emergency departments.

Materials and Methods: In this study, data on patients received by 2 floating hospitals in the Gulf of Iskenderun within the first 10 days after they started to work during the acute period of the February 6, 2023 earthquake were evaluated. In this respect, the study is a retrospective study.

Results: According to data obtained from floating hospitals, an average of 400-500 patient applications per day. It has been determined that patients frequently apply as outpatients with green triage, and the most common complaints are upper respiratory tract infections and extremity trauma.

Conclusion: After these earthquakes, people who suffered from them preferred safer field hospitals and floating hospitals. It is estimated that from the 400-500 patient applications per day, the hospital's laboratory tests arrived 2 weeks later and there were no computed tomography or magnetic resonance imaging. Based on this, keeping floating hospitals ready, training personnel who can participate, and keeping them ready in terms of material deficiencies are very valuable in this type of disaster situation.

Keywords: Emergency department, disasters, earthquake, floating hospital

Introduction

Earthquakes pose a threat to human life and lead to the rapid loss of life and property (1). Incidents related to earthquakes have revealed deficiencies in construction, infrastructure, emergency preparedness, and emergency response, resulting in fatal consequences (2). Two earthquakes with magnitudes of 7.7 and 7.6, which occurred on February 6, 2023, in Kahramanmaraş, Turkey and Syria, have caused significant changes in the lives of millions of people. It is estimated that over a million people

have become homeless in Turkey alone due to the collapse or rendering uninhabitable of more than 15.000 buildings. Immediately following the earthquakes, limitations in the training of personnel, adequate equipment and coordination within local intervention teams became evident. The destruction or damage to hospitals during the earthquake rendered access to healthcare services extremely challenging (2).

Our country is situated at the intersection of an active tectonic line, where the European, Asian and African plates meet. The experiences gained from past earthquakes contribute to our



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understanding of future seismic events. In a country surrounded by seas on three sides, concerns about the safety of terrestrial environments, disruptions in land and air transportation, and the management of natural disasters such as earthquakes highlight the potential benefits of maritime transportation and floating hospitals at sea. In this context, with authorization from the Ministry of Health and the armed forces, two large armored ships have been positioned in the region as floating hospitals. These ships have been reconfigured by healthcare personnel to include emergency departments, inpatient wards, and operating rooms, providing essential medical services to the public beyond their primary purposes.

Epidemiological studies conducted by healthcare institutions can significantly contribute to the management and organization of injuries caused by future earthquakes (1). Emergency services must be well-prepared for disasters like earthquakes, ensuring accurate record keeping, systematic triage determination and the availability of adequate resources, equipment and treatment areas. Additionally, comprehensive disaster training, implementable disaster relief plans, and regular drills should be conducted (3).

In our study, we aim to provide disaster management resources by retrospectively examining the medical records of patients who sought treatment at a floating hospital due to an earthquake. We will analyze demographic information, such as age and gender, triage complaints, reasons for hospitalization, surgical interventions and procedures, and evaluate hospital and emergency service organization.

Materials and Methods

Our study is a retrospective analysis of data from two floating hospitals in the Gulf of İskenderun following the February 6, 2023, earthquake. The analysis covers the first 10 days from the start of operations during the acute phase of the earthquake.

Data were obtained from the emergency service, operating room and inpatient record book of the floating hospital. All patients who presented to the floating hospital between February 10, 2023, and February 20, 2023, were triaged, examined in the emergency department, admitted, or underwent surgery had their age, gender, reasons for admission and surgery investigated.

The study was approved by Muğla Sıtkı Koçman University Medical and Health Sciences Ethics Committee (decision number: 230042-60, date: 03.06.2023).

The inclusion criteria for participants were as follows:

All age groups of patients who presented to the floating hospital after the earthquake.

Exclusion criteria for participants:

Patients with missing data.

Features of Each Floating Hospital

Tank landing ships with a length of 138.75 meters, a width of 19.6 meters, and the capability to remain at sea without resupply for 30 days were converted into floating hospitals immediately after the earthquake. The rear part of the ship approached the shore, establishing a connection with land for patient reception. The initial section served as a triage area, where patient records, complaints, and vital signs were documented. Subsequently, a 120-bed emergency service was set up on the deck connected to triage and was equipped with a delivery room, electrocardiogram room, resuscitation room, ultrasound room, X-ray room, and laboratory room for the initial examinations of patients. The laboratory was set up two weeks after the ship docked at the port, and during the study period, blood tests could not be conducted on-site, and the results had to be followed up by another institution. Patients requiring hospitalization and surgical interventions were transported by elevator to the inpatient service and operating rooms located on the upper floor, with healthcare personnel assisting in the transportation.

Conditions of the Work

Each hospital had a staff of 20 physicians and 60 non-physician healthcare personnel, totaling 80 individuals. Depending on the patient's load, the staff worked in shifts of 2 or 3 per day. Due to accommodation onboard the ship, personnel were available for service 24 hours a day, adapting to fluctuating patient volumes.

Statistical Analysis

All data obtained from the study will be recorded and analyzed using the Statistical Package for Social Sciences for Windows 20 software. Numerical variables will be summarized as mean \pm standard deviation, and categorical variables will be presented as counts and percentages, with frequency analysis. A significance level of $p \leq 0.05$ will be considered statistically significant.

Results

In our study, which included a total of 5251 patients, 2695 (51.32%) were male and 2556 (48.68%) were female, with a mean age of 30.00 ± 21.90 years. Among the included patients, 290 (5.5%) presented on the first day, 222 (4.2%) on the second day, 671 (12.8%) on the third day, and 678 (12.9%) on the fourth day (Table 1). Among the patients, 4702 (89.5%) sought hospital care independently and 549 (10.5%) used ambulances for transportation. The reasons for hospitalization included 1636 (31.3%) upper respiratory tract infections,

598 (11.4%) extremity trauma, 447 (8.5%) pneumonia, 233 (4.4%) depression, and 124 (2.2%) pregnancy and pregnancy-related complications (Table 2).

Among our patients, 3403 (64.8%) were in the green triage category and 94 (1.8%) were in the red category (Table 3). Of our patients, 56 were hospitalized, and one died. Additionally, 234 patients were referred to other hospitals (Table 3).

Of the 96 patients who underwent pseudoanalgesia and surgery in our hospital, 24 received splint application, 22 underwent suturing, 2 underwent appendectomy, 1 underwent cesarean section, and 1 underwent hernia repair (Table 4).

Discussion

Following two earthquakes with magnitudes of 7.7 and 7.6 that occurred in Kahramanmaraş on February 6, 2023, we analyzed data from two floating hospitals stationed between Iskenderun and Dörtüol. The analysis revealed a daily average of 400-500 patient admissions during the first 10 days of the acute phase of the earthquakes. Patients frequently sought outpatient care, with upper respiratory tract infections and extremity trauma being the most common reasons for admission. Additionally, a significant number of patients had green triage codes and were discharged after treatment, whereas those receiving sedoanalgesia/anesthesia often received these interventions due to traumatic conditions. In another retrospective study evaluating the role of floating hospitals during earthquakes, it was emphasized that two United States (US) navy ships most frequently encountered patients with extremity trauma during the Indonesia and Haiti earthquakes (4). The most important reasons for this situation are the traumatic damage caused by earthquakes and the resulting adverse environmental conditions. Failure to meet basic needs such as weather conditions, shelter, hygiene, and clean water after an earthquake may lead to increased upper

respiratory tract infections. At the same time, injuries resulting from material damage or contact with debris frequently cause extremity trauma.

Table 2. Reasons of the application

Reason for application	Number of patients (n)	Percentage (%)
URTI	1636	31.1
Extremity trauma	598	11.4
Pneumonia	447	8.5
Myalgia	368	7.0
Depression	233	4.4
Gastroenteritis	222	4.2
Stomach pain	205	3.9
Dermatological problems	196	3.7
Injection/dressing	163	3.1
Pregnancy and complications	124	2.2
Chest pain	113	2.2
Toothache	101	1.9
Eye problems	86	1.6
Ear pain	81	1.5
Asthma attack	77	1.5
Hypertension	76	1.4
COPD attack	75	1.4
Urinary tract infection	57	1.1
Headache	56	1.1
Dizziness	46	0.9
Cut	38	0.7
Diabetes mellitus complications	33	0.6
Palpitations	32	0.6
Chest trauma	30	0.6
Multitrauma	24	0.5
Lower back pain	22	0.4
Skin burn	21	0.4
Vertebral injury	19	0.4
Head trauma	15	0.3
Care patient	11	0.2
Epileptic seizure	9	0.2
Stroke (cerebrovascular accident)	7	0.1
Chronic renal failure/dialysis need	4	0.1
Inguinal hernia	3	0.1
DVT	1	0.0
Malignancy	1	0.0

URTI: Upper respiratory tract infection, COPD: Chronic obstructive pulmonary disease, DVT: Deep vein thrombosis

Table 1. Demographic characteristics of patients		
Application day	Number of patients (n)	Percentage (%)
1 st day	290	5.5
2 nd day	222	4.2
3 rd day	671	12.8
4 th day	678	12.9
5 th day	594	11.3
6 th day	572	10.9
7 th day	499	9.5
8 th day	462	8.8
9 th day	434	8.3
10 th day	423	8.1
11 th day	406	7.7

Despite the presence of the seismically isolated Dörtyol State Hospital and several field hospitals near our location, the number of admissions exceeded expectations. This could be attributed to people's reluctance to enter hospitals, even if they are structurally sound. However, during the initial two weeks in the floating hospital, the limitations in laboratory testing and imaging might have led to the admission of patients with less severe symptoms.

In our country, earthquakes have caused great destruction, loss of life, injury, permanent disabilities, and chronic diseases. As experienced in the August 17, 1999 earthquake in the Marmara Region, transportation disruptions due to damage to airports, bridges, viaducts, and highways in the earthquakes that occurred on February 6, 2023 caused delays and interruptions

Table 3. Triage, referral, hospitalization and discharge status of patients

Triage	Number of patients (n)	Percentage (%)
Green	3403	64.8
Yellow	1754	33.4
Red	94	1.8
Latest status	Number of patients	Percentage (%)
Referral to another hospital	234	4.5
Hospitalization	56	1.1
Discharge	4960	94.5
Death	1	0.0

Table 4. Patients receiving interventional treatment

Interventional procedures	Number of patients (n)	Percentage (%)
No operation	5155	98.2
Application of a cast	24	0.05
Incision suturing	22	0.05
Wound debridement	11	0.02
Abscess drainage	9	0.02
Fasciotomy	4	0.01
Patellar dislocation	4	0.01
Burn debridement	4	0.01
Shoulder reduction	4	0.01
Chest tube insertion	2	0.00
Tendon repair	2	0.00
Appendectomy	2	0.00
Cesarean section	1	0.00
Hernia repair	1	0.00
Childbirth	1	0.00
Pilonidal sinus surgery	1	0.00
Arterial incision repair	1	0.00

in transportation to disaster areas. It is of utmost importance for rescue and evacuation operations, including emergency and advanced first aid for the injured, to be initiated rapidly from the moment the earthquake strikes (5). The earthquake that occurred in Haiti in 2012 caused similar massive destruction, and the country's healthcare system almost collapsed. During this period, a floating hospital belonging to the US army provided effective patient care and humanitarian aid (6).

Every region in our country is at risk of earthquakes and hosts active fault lines. Recent discussions in the public domain and statements by reputable professors in earthquake-related scientific fields suggest that serious consideration should be given to earthquakes, especially in İstanbul and other parts of our country in the future.

In the earthquakes we have experienced, both land and air transportation have suffered significant damage, nearly grinding to a halt. The impairment of hospitals and other health facilities due to earthquake damage, coupled with healthcare professionals, including city workers who are victims of earthquakes, and the disruption of urban transportation due to debris and damaged infrastructure, underscore the importance of maritime transportation in critical aspects, such as rescue efforts, vital interventions for the injured, and logistical support during these disasters.

In the studies on floating hospitals in the literature, these ships are war-class ships. However, in difficult conditions, such as natural disasters, they can be converted into hospitals to provide health services. The use of floating hospitals during natural disasters has created a sense of confidence among disaster victims. Instead of going to hospital buildings to receive healthcare, people preferred tent field hospitals or floating hospitals, which they considered safer (6-8). Laboratory tests were conducted in a floating hospital two weeks after the earthquake. However, computed tomography and magnetic resonance imaging were not performed. Even under these conditions, there were approximately 400-500 patient applications daily. It is clear that the earthquake victims preferred the floating hospital rather than Dörtyol State Hospital, which is a health institution equipped with seismic isolators, examination laboratories, and physicians, located close to the floating hospital. These data demonstrate that it is extremely important for floating hospitals to be ready and medically equipped and to plan and organize the personnel who can participate in floating hospitals during these types of disasters and crisis periods.

This research, which includes the determination and interpretation of data from the floating hospital, is the first study conducted in our country and reveals the demographic data,

admission complaints, referral, hospitalization, and surgical status of patients admitted to the floating hospital at Role 2 level during the acute period after the earthquake. As a result, the obtained data will guide medical intervention strategies, such as preparing the role level of floating hospitals and appropriate health equipment in advance, planning the number of health personnel, providing the necessary health equipment in advance, and establishing health services more effectively in case of a disaster.

Study Limitations

One of the main limitations of our study was the unreliability of demographic data for patients treated after the earthquake. Additionally, due to the time taken for field hospital ships to reach the disaster site, patients who presented immediately after the earthquake were not included in our study. Consequently, the patients evaluated in our study were those with minor injuries and those affected by environmental conditions, rather than those with major traumas from the acute impact of the earthquake.

Conclusion

This research, which includes the determination and interpretation of the data of the floating hospital, is the first study conducted in our country and reveals the demographic data, admission complaints, referral, hospitalization, and surgery status of the patients admitted to the floating hospital at Role 2 level in the acute period after the earthquake. As a result, the data obtained will guide medical intervention strategies such as preparing the role level of floating hospitals and appropriate health equipment in advance, planning the number of health personnel, providing the necessary health equipment in advance, and establishing health services more effectively in case of disaster.

Ethics

Ethics Committee Approval: The study was approved by Muğla Sıtkı Koçman University Medical and Health Sciences Ethics Committee (decision number: 230042-60, date: 03.06.2023).

Informed Consent: This retrospective study.

Authorship Contributions

Surgical and Medical Practices: A.D., M.G.K., Concept: A.D., M.G.K., Ö.F.K., Design: A.D., M.G.K., E.A., Data Collection or Processing: A.D., M.G.K., Ö.F.K., Analysis or Interpretation: A.D., M.G.K., E.A., Literature Search: A.D., M.G.K., Ö.F.K., Writing: A.D., M.G.K., E.A.

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