

Hospital crisis management after a disaster: from the epicenter of 2023 Türkiye-Syria earthquake

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ABSTRACT

BACKGROUND: In such cases where sudden destruction and injury are very high, search and rescue teams and hospitals can be the most important determining factors between people's lives and deaths.

METHODS: This study was conducted retrospectively, after the two catastrophic earthquakes (Türkiye-Syria Earthquakes) by taking the records of the patients who admitted to our hospital. Patients' admission times, diagnoses, demographic data, triage codes, medical interventions, hemodialysis needs, crush syndrome and mortality rates were analyzed.

RESULTS: In the first 5 days after the earthquake, 247 earthquake-related patients were admitted to our hospital. The most intense period of admission to the emergency department was the first 24 h. The most intensive period of surgical procedures was 24–48 h. It was observed that Orthopedic surgical procedures were applied most frequently and the most common cause of mortality was crush syndrome.

CONCLUSION: In terms of preparations for earthquakes, especially in hospitals in the earthquake zone it will be beneficial for each hospital to make hospital disaster plans. For this reason, we thought it would be useful to share our experiences during this disaster.

Keywords: Crush syndrome, disaster, earthquake, emergency medicine, mortality

INTRODUCTION

On February 06, 2023, at 01:17:35 (at 04:17 local time), an earthquake with a magnitude of 7.8 mW occurred at a depth of 10 km (37.166°N 37.042°E) with the epicenter east of Nurdağı/Gaziantep/Türkiye and lasted 103 s. Subsequently, an aftershock with a magnitude of 6.7 mW occurred in the same localization and the aftershocks continued. About 9 h later, a new and different earthquake with a magnitude of 7.5 mW occurred north of the first earthquake.

These two major earthquakes directly or indirectly affected about 23 million people in Türkiye and Syria, according to the World Health Organization. 10 cities in Türkiye were impacted by the earthquake, which was one of the strongest to

hit the region in more than a century. At the time of writing this article, 50,096 people had died, 108068 people were injured in Türkiye. It was known that after the earthquakes in Türkiye, 41,791 buildings were destroyed or severely damaged in need of immediate demolition, and 1,971,589 people were evacuated from the region.^[2] 4 hospitals in the region were demolished during the earthquake and 7 hospitals had to be evacuated due to structural damage.

In such cases where sudden destruction and injury are very high, search and rescue teams and hospitals can be the most important determining factors between people's lives and deaths. It is very possible that a crisis and chaotic environment will occur in hospitals, and therefore Hospital Disaster Plans should be prepared.^[3]

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Our hospital is located in Gaziantep which is exactly the epicenter of the first earthquake. Therefore, we made all kinds of preparations at the beginning of the earthquake in our hospital, which is an important and large health facility for earthquake victims to admit. The purpose of this article is to convey our experiences in terms of managing the extraordinary crisis environment in hospitals in such a major disaster.

MATERIALS AND METHODS

The study was conducted retrospectively on February 6th, after the two catastrophic earthquakes (Türkiye-Syria Earthquakes) by taking the records of the patients who admitted to Medicalpoint Gaziantep hospital, which is located 30 km from the epicenter of the first earthquake in Gaziantep (Fig. 1).^[4] Immediately after the earthquake occurred, a call was made by the hospital management for all physicians and medical staff to come to work under extraordinary conditions. Patient admissions were started in coordination with emergency call centers. In this process, admissions that are not related to the earthquake were excluded from the study. All patients who came by their own means or by ambulance were included in the study. At the time of the earthquake, 146 (60%) of the 245 inpatient beds and 66 (75%) of the 88 intensive care beds of the hospital were occupied. On the 1st day of the earthquake, in order to increase the bed capacity of the hospital and to be able to intervene quickly if necessary, the outpatient clinics located on the same floor as the emergency service were converted into inpatient rooms; The corridors of the clinics were converted into observation areas (Fig. 2). Foreseeing that the first 2 days may be patient and surgical operation intensity; a surgical intervention room was set up within the Emergency Department and depending on the patient density, some of the surgeries were performed here with the surgical team as well as the operating room. In this room, cases of fasciotomy were operated. At what hour of the earthquake the patients admitted, triage tags, in-



Figure 1. Hospital distance to epicenter of earthquake



Figure 2. Outpatient clinic corridors converted for additional inpatient capacity

terventions, complications, the number of patients receiving hemodialysis, the number of patients diagnosed with crush syndrome, the patients followed in the Intensive Care Unit, and those who died were examined. Demographic data of the patients were recorded and analyzed. Soft tissue infection, bleeding, and sepsis were recorded as surgical site-related complications. Patients whose identities are unknown were registered in the system with numbers and special codes.

The analyses were performed using SPSS 20.0 software. Descriptive statistics were presented as numbers and percentages for categorical variables, and as mean, standard deviation, and median for numerical variables. Kolmogorov-Smirnov test were used to examine normal distribution of the numerical variables. The Chi-square test and Fisher's exact test were used for binary and multiple comparisons. $P < 0.05$ was considered for determining the level of statistical significance. Local ethics committee approval was obtained.

RESULTS

In the first 5 days after the earthquake, there were 247 earthquake-related admissions to our hospital. In the first 24 h, 121 (59%) patients were admitted to Emergency Department. Of these patients, 64 (53%) were treated as outpatients, 28 (23%) were treated as inpatients, and 28 (23%) underwent surgery. Of the operations, 22 (78%) were performed by the Orthopedics and Traumatology team, 3 (10%) by the Thoracic Surgery team, and 2 by the Neurosurgery team. In the first 24 h, 26 (21%) patients were treated in the Intensive Care Unit, 8 (6%) patients needed hemodialysis, and 15 (12%) patients died. In the second 24 h, the number of Emergency Department admissions due to the earthquake was 46 (19%). 35 (76%) of these patients underwent surgery. 25 (71%) of the surgeries were performed by the Orthopedics and Traumatology team and 5 (14%) by the Neurosurgery team. 11 (24%) patients were admitted to Intensive Care Unit. In this

Table 1. Distribution of patients according to the time of admission

Admission Time	Outpatient		Inpatient		ICU		Hemodialyses		Exitus			
	n	%	n	%	n	%	n	%	n	%		
0–6 h	18	7	10	56	1	6	7	39	-	-	-	-
6–12 h	49	20	36	73	6	12	7	14	-	-	4	8
12–18 h	37	15	7	19	23	62	7	19	5	14	7	19
18–24 h	17	7	1	6	11	65	5	29	3	18	4	24
24–48 h	46	19	12	26	23	50	11	24	4	9	6	13
48–72 h	28	11	20	71	4	14	4	14	1	4	-	-
72–96 h	23	9	16	70	4	17	3	13	-	-	-	-
96–120 h	29	12	21	72	5	17	3	10	-	-	-	-
Total	247	100	123	50	77	31	47	19	13	5	21	9

process, 6 (13%) patients died and 4 (8%) patients needed hemodialysis.

On the 3rd Day; 28 (11%) patients were admitted to Emergency Department. Of these patients, 20 (71%) were treated as outpatients, 4 (14%) were treated as inpatients, and 4 (14%) were treated in Intensive Care Unit. Of these patients, 10 (36%) were operated and 8 of the surgeries (80%) were performed by Orthopedics and Traumatology Department. 1 patient treated with hemodialysis and there were no patients who died in this process.

On the 4th day; 23 (9%) earthquake-related patients were admitted to the Emergency Department. Of these patients, 16 (70%) were treated as outpatients, 4 (17%) as inpatients, and 3 (13%) were treated in Intensive Care Unit. 10 (43%) patients underwent surgical intervention, and 8 (80%) surgeries were performed by Orthopedics and Traumatology Department.

There were no hemodialysis patients and no deaths due to Crush syndrome.

On the 5th Day, 29 (12%) patients were admitted to the Emergency Department. While 21 (72%) were treated as outpatients, 5 (17%) were treated as inpatients and 3 patients (10%) were treated in Intensive Care Unit. 8 (27%) patients underwent surgical intervention, and 5 (62%) surgeries were performed by Orthopedics and Traumatology Department. There were no patients in need of any dialysis session or who died during this process (Table 1).

When the patients were evaluated according to the time of admission and triage tags, it was seen that the highest number of admissions with the green triage tag were in the first 6 h (72%) and in the second 6 h (65%). Among the admissions, the highest percentage of red-tag admissions was between 18 and 24 h (53%). Of the current patients, 61 (25%) were green

Table 2. Distribution of patients according to the time of admission

Admission Time	Green		Yellow		Red		Black		Ex		Total	
	n	%	n	%	n	%	n	%	n	%	n	%
0–6 h	6	1	72	13	17	3	0	0	0	0	7	18
6–12 h	19	9	65	31	13	6	6	3	8	4	19	48
12–18 h	11	4	47	18	39	15	0	0	18	7	15	38
18–24 h	24	4	24	4	53	9	6	1	24	4	7	17
2. day	20	9	43	20	35	16	2	1	13	6	19	46
3. day	46	13	43	12	11	3	0	0	0	0	11	28
4. day	39	9	43	10	17	4	0	0	0	0	9	23
5. day	41	12	55	16	3	1	0	0	0	0	12	29
Total	25	61	50	124	23	57	2	5	9	21		247

Table 3. Surgical operations

Admission Time	Surgical operation								Total	%
	Emerg.	Ort.	NS	PRS	CVS	Ped. S.	Thor. S.			
0–24 h	121	22	2	3	-	1	3	28	23	
24–48 h	46	25	5	2	3	-	-	35	76	
48–72 h	28	8	-	1	1	-	-	10	36	
72–96 h	23	8	1	-	-	1	-	10	43	
96–120 h	29	5	2	1	-	-	-	8	28	
Total	247	68	10	7	4	2	3	91	37	

ICU: Intensive care unit; Ex: Exitus; h: Hour; Emerg.: Emergency department; Ort.: Orthopedics and traumatology; PRS: Plastic and reconstructive surgery; NS: Neurosurgery; CVS: Cardiovascular surgery; Ped. S.: Pediatric surgery; Thor. S.: Thoracic surgery.

and 124 were yellow (50%), 57 (23%) were red, and 5 (2%) were black triage tagged (Table 2).

The highest number of admissions was between 6 and 12 h after the earthquake (19%).

During this period, 247 patients were treated in our hospital. The mean age of the patients was 37 ± 20.8 (0–98). The mortality rate in patients over 65 years of age was found to be significantly higher than those under 65 years of age ($P < 0.05$). We had 138 (56%) female and 109 (44%) male patients and 47 (19%) patients were children. There was no gender difference in deaths due to Crush syndrome ($P = 0.8$). Of these patients, 123 (50%) were treated as an outpatient. 77 (31%) patients were treated as inpatients. 47 (19%) patients were treated in Intensive Care Unit. 13 (5%) patients needed hemodialysis due to crush syndrome and 21 (9%) patients died. 16 (76%) patients died due to crush syndrome, 3 (14%) patients due to head trauma, and 2 (10%) patients due to solid organ injuries. 91 (37%) of the patients were operated. 68 (75%) of the operations were performed by the Orthopedics and Traumatology team (Table 3). Emergency fasciotomy was performed on 31 patients and 43 extremities. The surgeries of 16 (52%) of these patients were performed in the Emergency Department. It was found that there was no significant difference in terms of complications between performing the surgery in the Emergency room or operating room in patients who underwent fasciotomy ($P = 0.458$).

DISCUSSION

After natural disasters such as earthquakes, there is a sudden increase in the workload of hospitals. The most important challenges for Emergency Services are accurate identification, accurate data entry, correct triage tag assignment, sufficient resources, adequate staff, sufficient equipment, and sufficient treatment space.^[5] After the admission of a large number of patients and injured people to the Emergency Department at the same time, effective triage and sufficient number of employees are required in order to use the resources and facilities effectively. After the earthquake that occurred on

February 06, 2023 at 04:17 local time, approximately 30 min later, a call was made by our hospital management for all physicians and medical staff of hospital in order to come to the hospital. We think that it is possible for physicians and allied health personnel to come to our hospital so quickly right after the earthquake, that the city center is less affected by the earthquake, and that the 1st° relatives of the employees are moved to a safe environment with this low impact.

After a major earthquake that occurred; one of the most important problems preventing hospital employees who know that the aftershocks will continue to respond effectively to disasters is personal safety concerns.^[6-9] After the first earthquake, the damage assessment of the hospital building was carried out by the technical team in our hospital and it was reported that there was no problem and the hospital employees were notified. In case of disasters such as earthquakes, which are likely to continue, eliminating the concerns of hospital staff about their personal safety will ensure to work effectively.

In the studies carried out in the literature; In line with our study, it is seen that hospital admissions are the most intense in the first 24–36 h and the number of admissions and surgical interventions decreases in the ongoing period.^[10-13] In our hospital, in accordance with the literature, the day with the highest number of admissions was the 1st day and the day with the highest intensity of surgical interventions was the 2nd day, and then it was seen that the intensity decreased. Therefore, in the 1st days of the disaster; We recommend postponing non-emergency interventions in order to use hospital capacity, resources and staff effectively.

The bed capacity of the hospital and the occupancy rate at the time of the disaster; are another important challenges that can be encountered in disaster management.^[14] For natural disasters, it will be beneficial for each hospital to make hospital disaster plans, determinations, and plans in advance so that additional capacities and transformations can be made quickly when necessary. In our hospital, both in terms of close follow-up and rapid intervention of the patients and

due to the fact that most of the hospital capacity is full; The outpatient clinic rooms located on the same floor as the emergency room, were converted into inpatient rooms and the corridors were converted into observation rooms.

In Emergency Departments, where chaos may prevail after a disaster, the collection of patient and death records and their accuracy can be challenging.^[15] Patients who admit without identity or patients who are unconscious and unable to access identity information are frequently encountered situations after disasters. Although the method of selecting random alias developed by Robinson et al.^[16] for unidentified patients and later revised by Blank-Reid and Kaplan.^[17] exists, it is thought that it may be inadequate after such major disasters. In our hospital, we used a sequential number system as “unknown 00001” for these patients. In addition to these, in children whose families died in the earthquake or who were brought to the hospital separately from their families and whose treatment was carried out, it is vital to monitor the fate of the children as well as their identity information. It is known that there were missing children after the 1999 Marmara earthquake, and some of them may have been abducted.^[18-20] Of the 47 pediatric patients in our hospital, 2 died. All of the 45 children whose treatment was completed were released to their families and there were no children missing.

Crush syndrome is the most frequent cause of mortality in hospitals after earthquakes.^[21-24] Most of our patients have died due to crush syndrome. In the literature it is known that there is a relationship between mortality rates due to crush syndrome that develops after an earthquake and an increase in age.^[21,25,26] In our study, the mortality rate in patients over 65 years of age was found to be significantly higher than those under 65 years of age. There was no gender difference in deaths due to Crush syndrome. Although Uz et al.^[5] reported that there was a relationship between the duration of being under the wreckage and the mortality rate, no relationship was found in our study.

After the earthquake, injuries related to Orthopedics and Traumatology Departments are most frequently seen in hospitals.^[10,11,27-29] Orthopedics injuries were present in 97 (39%) of the patients who admitted to our hospital. Of the 91 earthquake-related operations performed in our hospital, 68 (75%) were performed by the Orthopedics and Traumatology team. In cases where there are such sudden accumulations, it may be necessary to make patient distributions according to the type of injury by the Emergency Call Center by considering the number of hospitals, physicians and medical personnel, taking cognizance of the hospitals that are able to serve, and if there is more density in a certain hospital or team, it may be necessary to assign Surgery, Emergency and Anesthesia team from the less busy hospitals.

Conclusion

In terms of preparations for earthquakes, especially in hospitals in the earthquake zone; It should be considered that

the occupancy rate of the hospital may be high at the time of the incident, the additional capacity and availabilities of the hospitals should be evaluated, and the hospital disaster plan including action plans should be ready when necessary. Thus, in case of earthquake or any other disaster; it will be possible to make an effective intervention by a team prepared for the possible incident.

In crisis management in hospitals after the earthquake; As a first step, it should be known that the aftershocks may continue. Along with damage assessment and evaluation in terms of resistance to possible aftershocks should be done rapidly. Since the 1st h after a disaster, especially the first 24 h, will be the most intense period; the working order should be organized accordingly, non-urgent surgical procedures and interventions should be postponed to the next days and shift system should be implemented at the earliest possible time. In order to increase the intervention capacity, surgical procedures that can be performed in the emergency department should be distinguished and applied when necessary.

Ethics Committee Approval: This study was approved by the Gaziantep Hospital Clinical Research Ethics Committee (Date: 07.04.2023, Decision No: 2023/72).

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ORJİNAL ÇALIŞMA - ÖZ

Türkiye-Suriye deprem merkezinden afet sonrası hastane kriz yönetimi

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AMAÇ: Deprem gibi aniden gelişen yıkımın ve yaralanmaların çok yüksek olduğu durumlarda arama kurtarma ekipleri ve hastaneler insanların yaşamla ölümü arasında en önemli belirleyici faktörler olabilmektedir. Çalışmamızda 2023 Kahramanmaraş merkezli depremler sonrası hastanemize başvuran depremezdelerin analizlerini ve tecrübelerimizi paylaşmayı amaçladık.

GEREÇ VE YÖNTEM: Kahramanmaraş depremleri nedeniyle hastanemize getirilen veya başvuran yaralıların tıbbi veri kayıtlarını geriye dönük olarak inceledik. Hastaların başvuru zamanları, tanıları, demografik verileri, triaj kodları, tıbbi müdahaleler, hemodiyaliz ihtiyaçları, ezilme sendromu ve mortalite oranları incelendi.

BULGULAR: Hastanemize deprem sonrası ilk 5 günde depremle ilişkili 247 hasta başvurusu oldu. Acil servise başvurunun en yoğun olduğu dönem ilk 24 saattir. Cerrahi işlemlerin en yoğun uygulandığı dönem 24-48 saat aralığıydı. En sık olarak Ortopedik cerrahi işlemlerin uygulandığı görüldü. En sık mortalite nedeni ezilme sendromuydu.

TARTIŞMA: Depremlere hazırlıklar açısından özellikle deprem bölgesinde olan hastanelerde; hastane afet planı hazır olmalıdır ve bu amaçla tecrübelerin paylaşımı önem taşımaktadır.

Anahtar sözcükler: Acil tıp; afet; deprem; ezilme sendromu; mortalite.

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