Turkish Journal of Trauma & Emergency Surgery
Original Article
Ulus Travma Acil Cerrahi Derg 2013;19 (3):251-255
Klinik Çalışma
doi: 10.5505/tjtes.2013.12268

Analysis of burn cases observed after the 2011 Van earthquake

Van'da yaşanan 2011 depremi sonrası gözlenen yanık olgularının analizi

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BACKGROUND
The purpose of this study was to determine the epidemiological features of cases that were registered for burns and treated at a hospital after the Van earthquake to compare burn cases from the previous year and to determine the factors that influenced mortality.

METHODS
Patients who were admitted to the Van Region Training and Research Hospital within the 3-month period after the earthquake were categorized as group 1; patients who were admitted within the same time interval in the previous year were categorized as group 2.

RESULTS
There were 121 patients in Group 1 and 89 patients in Group 2. It was determined that there were 36% more burn cases in Group 1. Flame burns were observed 4.8 times more often in Group 1 compared to Group 1 (p=0.002). Exitus was observed in 25.4% of cases in Group 1 and in 7% of cases in Group 2 (p=0.0069).

CONCLUSION
It was determined that the number of burn cases registered after the earthquake, the number of flame burns, the percentage of burns and the rate of mortality were higher than the data before the earthquake.

Key Words: Burn; earthquake; emergency service; tent.

AMAÇ
Bu çalışma, Van'da yaşanan deprem sonrasında yanık nedeniyle başvuran ve hastanede tedavi edilen olguların epidemiyolojik özelliklerini belirlemek ve bir önceki yılın aynı aylarında başvuran yanık olgularıyla karşılaştırarak mortaliteye etkili olan faktörleri saptamak için planlandı.

GEREÇ VE YÖNTEM
Van Bölge Eğitim ve Araştırma Hastanesi'ne depremden sonra üç aylık periyotta başvuran hastalar grup 1, bir yıl önce aynı tarih aralığında başvuran hastalar grup 2 olarak belirlendi.

BULGULAR
Grup 1'de 121 hasta, grup 2'de ise 89 hasta vardı. Grup 1'deki yanık olgularının %36 oranında arttığı saptandı. Alev yanıkları grup 1'de grup 2'ye göre 4,8 kat daha fazla gözlendi (p=0,002). Grup 1'de olguların %25,4'ünde, grup 2'de %7'sinde ölüm görüldü (p=0,0069).

SONUÇ
Deprem sonrasında başvuran yanık olguları sayısı, alev yanıklarının sayısı, yanık yüzdesi ve mortalite oranını, deprem öncesine göre yüksek olduğu saptandı.

Anahtar Sözcükler: Yanık; deprem; acil servis; çadır.

Earthquakes are among the natural disasters that cause the greatest numbers of deaths and injuries, both around the world and in Turkey.[1-3] A large part of our country is within a first-degree seismic zone, and nearly 100.000 people have lost their lives due to earthquakes in the last century.[2-4] In addition to these deaths, there has been failure to take precautions to avoid these preventable occasions; the existence of old settlements in areas that are prone to destructive earthquakes, conurbanization, the building of earthquake-

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Table 1. Distribution of patients according to age and sex

	0-15 age (n)	15-30 age (n)	30-45 age (n)	45-80 age (n)	Mean age Mean±SD	Female (%)	Male (%)	Total (n)
Group 1	51	22	20	26	14.87±14.68	52.38	47.62	121
Group 2	32	24	16	17	19.42±16.81	47.37	52.63	89

prone houses, the inability of first responders to arrive at accident scenes promptly, and fires have prevented any reductions in the deaths and injury rates due to earthquakes.[5-7]

The Van earthquake was of a destructive magnitude (7.2 Mw) and struck eastern Turkey, near the city of Van, on Sunday, the 23rd of October, 2011 at 13:41 local time. It occurred at a shallow depth of 19 km. There were 604 casualties caused by this earthquake. Seventeen days after the earthquake (on the 9th of November, 2011), another earthquake on a different fault line occurred at 21:23 local time, triggered by the first earthquake. It was centered at Edremit, which is southwest of Van and 10 km from our hospital. The magnitude was 5.6 (Mw), and it occurred at a depth of 5 km. Because many people had immigrated to other cities and others had settled into tents, there were only 40 casualties. While 222 people were rescued alive from the wreckage of both earthquakes, nearly 6000 people were injured. A total of 72.242 houses were determined to be destroyed or were heavily damaged.[8]

Among the most important reasons for the morbidity and mortality observed after earthquakes are fires.[7-13] Determination of the reasons for these fires and of risk groups could help to decrease the morbidity and mortality that occur due to earthquakes. Therefore, in the current study, burn cases observed after the Van earthquake were compared with burn cases during the same months and in the same city during the previous year. Also, the changes that occurred in the number, cause, and degree of burns and the percentage of body surface burned were analyzed.

MATERIALS AND METHODS

Patients who were admitted to the Van Region Education and Research Hospital after the earthquake, from the 23rd of October 2011 to the 23rd of January 2012, and who received in-patient treatment were categorized as Group 1; patients who were admitted to the hospital from the 23rd of October 2010 to the 23rd of January 2011, and who received in-patient treatment were categorized as Group 2. Cases were compared regarding age, sex, causes of burns, burn degree, burn percentage, hospital stay length, surgical intervention and complications. When determining the total burn surface area (TBSA) of the patients, first- and second-degree burns were noted as superficial burns, while third-degree burns were noted as deep burns. After the earthquake, only the hospital in which this study was carried out was at full capacity among the 4 state hospitals, 3 private hospitals and one university hospital. The structural integrity of the other hospitals failed. All cases of burns were monitored and treated in the hospital in which this study was conducted, which has a distinct burn unit.

Statistical analysis

The statistical significance of the data was analyzed with SPSS statistical software (ver. 9.0). A chi-square analysis and Spearman's correlation were used for comparisons. Values of $p<0.05$ were determined to be significant as a result of statistical evaluations.

RESULTS

Demographic data of the patients in both groups are provided in Table 1. There were no significant differences between the groups regarding age or sex. There were 121 patients in Group 1. Among the patients in Group 1, 16 of the cases were sent to other centers after the earthquake due to renovations of the local burn unit. Also, 42 cases received outpatient treatment and 63 cases received inpatient treatment at the burn unit. After being stabilized in our hospital, the transfer of patients whose consignment was decided was typically performed by either an air ambulance or ambulance ship between 12 and 24 hours later. There were 89 cases in Group 2; 4 of these cases were sent to other centers due to patient occupancy at the burn unit, 28

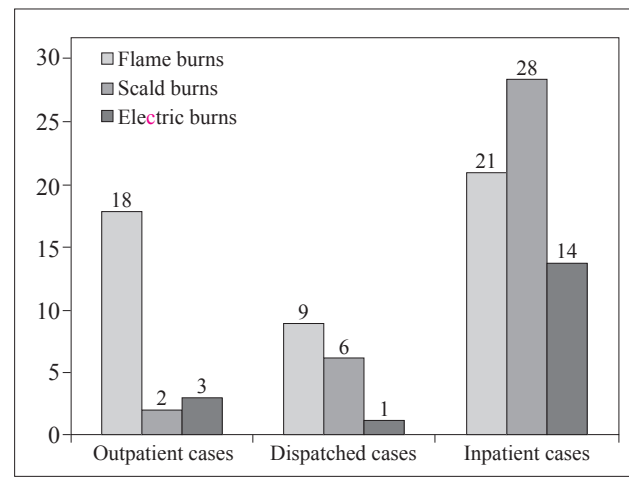

Fig. 1. Group 1: Burn cases following the earthquake.

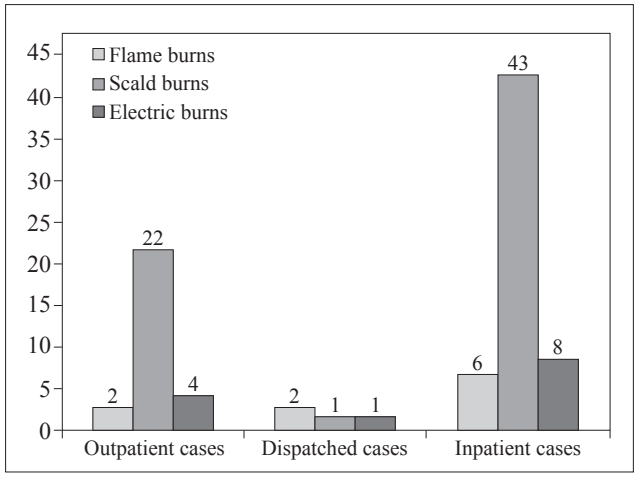

Fig. 2. Group 2: Burns cases from the previous year.

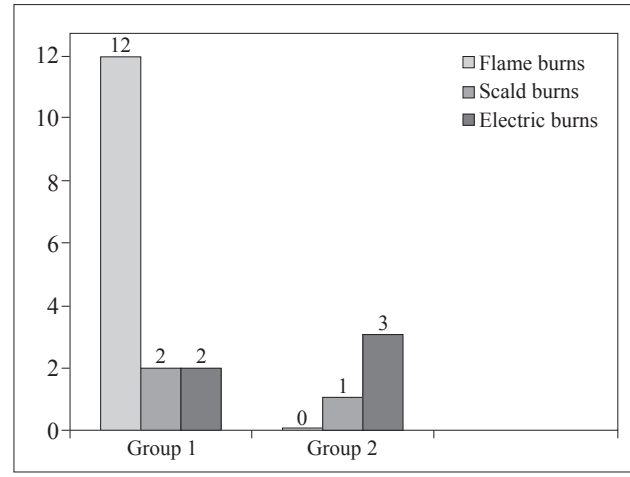

Fig. 3. Reasons for mortality among hospitalized patients.

received outpatient treatment, and 57 cases received inpatient treatment in the burn unit. It was determined that there were 36% more burn cases in Group 1 than in Group 2. Scald burns were much more common than flame or electric burns in both groups, and the rate of scald burn was statistically significant in both groups compared to other types of burns (p=0.001). Flame burns were observed 4.8 times more often in Group 1 compared to Group 2 (p=0.002) (Figures 1-3). A total of 48% (39.6%) of the burn cases observed in Group 1 occurred due to 28 tent fires. Among the patients in Group 1, there were no patients with burns after the earthquake or after being rescued from the debris. The burns on the patients who formed Group 1 were either scald burns caused by accidents that occurred as a result of aftershocks or flash burns that occurred as a result of tent fires. Electrical burns were caused by leaks resulting from electrical installations that were constructed in tents or other housing.

Both superficial and deep burns were more common in Group 1 compared to Group 2 (respectively, p=0.004 and p=0.001) (Table 2). While 86 surgical interventions were performed on 63 patients in the burn unit from Group 1, 65 surgical interventions were performed on 57 patients in the burn unit from Group 2.

Exitus was observed in 25.4% of the cases (n=16) in Group 1 and in 7% (n=4) of the cases in Group 2. There were no statistically significant relationships between mortality and age, sex, burn degree, or intervention between the groups (Table 3). While 75% (n=12) of the casualties in Group I occurred as a result of flame burns caused by tent fires, 75% (n=3) of the casualties in Group 2 occurred due to electric shock (Figure 4a-c).

DISCUSSION

It has been reported that the causes of burn cases admitted to emergency units following earthquakes are generally explosions of fuel tankers or explosions due to gas pipe leaks, which occur during the collapses of buildings and which often result in deaths.[9,10] One recent example is the earthquake in Kobe, Japan, in which 142 fires occurred on the first day. While injuries due to flame burns are very common, scalding burns are rare.[9,11] In Turkey, there were 40 burn cases admitted to the hospital after the earthquake in Düzce in 1999; 13 of them were children, and 27 of them were adults. All of the burns were scalding

Table 2. Total burn surface area of patients

	Group 1	Group 2	*p*
	Mean±SD	Mean±SD	
Superficial burns	17.44±12.14	6.86±7.92	**0.004**
Deep burns	4.52±3.08	1.76±0.89	**0.001**

Table 3. Interventions in hospitalized patients

	Fasciotomy		Escharotomy		Graft		Number of total
	(n)	(%)	(n)	(%)	(n)	(%)	
Group 1	24	52.2	37	64.9	25	52.1	86
Group 2	22	47.8	20	35.1	23	47.9	65
Total	46	38.3	57	47.5	48	40.0	151

Fig. 2. **(a)** Pictures following a tent fire believed to have been caused by stoves. **(b)** A 14-year-old patient with 75% flame burns who was brought to the hospital after a tent fire. **(c)** A 2-year-old patient with 45% flame burns who was brought to the hospital after a tent fire.

(Color figures can be viewed in the online issue, which is available at www.tjtes.org).

burns; there were no flame burns because there were no explosions or house fires.[9,12] Nakamori et al.[13] reported that following the earthquake in Hanshin Awaji in 1995, 68% of the burns were scalding burns, 20% were flame burns, and 12% were other types of burns. It was noted that of the burn cases following the Chile earthquake, 78% were flame burns, 16% were scalding burns, and 6% were electric burns, and there were no differences regarding the types of burns that occurred before the earthquake.[14] It was stated that the mean age of the burn cases that occurred before and after the Chile earthquake were close to each other (respectively, 49.2±19.8 and 49.2±21.1 year old).[12] It was observed in this study that burn cases increased compared to the previous year, and many of the cases were flame burns (44.4%). The reason for flame burns being observed often following the Van earthquake was that tents were generally used for temporary shelter. Moreover, due to the earthquake having occurred in winter and the temperature falling to -20°C in the city, stoves and electrical devices were used in the tents. Heating these flammable tents with such heating techniques posed a significant risk for fires. However, the flame burns that were predominantly observed in Kobe and Chile were due to natural gas pipelines.[9,11,14] The reason for the burn cases after the Hanshin earthquake being scalding was related to the time of the earthquake coinciding with the traditional time of miso soup preparation, which is a commonly consumed food.[13] In this study, the burn cases observed both before and after the earthquake more commonly affected young people. In addition to this finding, the mean age of the cases observed after the earthquake was 4.55 years younger than the mean age of the cases before the earthquake. A total of 42.1% (n=51) of the 121 patients who were admitted after the earthquake were younger than 15 years old.

In a study by Albornoz et al.[14] that compared burn cases after the Chile earthquake over a period of 4 months to cases registered during same period in the previous year, there were no differences between burn cases and burn types; however, the mortality from burn cases in the group before the earthquake was 1.22%, while mortality after the earthquake was 0.52%. After the Northridge earthquake, which occurred in 1994, Peek-Asa et al.[11] reported 10 burn cases as a result of house fires and electric burns in the first 15 days following the earthquake, 2 of which died. Moreover, it was reported that burn cases that occur after earthquakes comprised 7.3% of all traumas and 6.1% of all deaths. In this study, 7.56% (16/121) of burn cases and 25.4% of patients following the earthquake died. Before the earthquakes, 4.4% of the patients admitted with burns and 7% of hospital patients died. The reasons for the burns being more deadly in the series of patients presented here were numerous tent fires. This cause could be related to tents having only one exit and to most of these cases being children.

Following the Hanshin Awaji earthquake, the

TBSA rate of the 34 cases (77%) who were admitted for burns was 20%, and the TBSA rate of the 10 cases (23%) who were not admitted for burns was more than 20%.[13] Following the Chile earthquake, the mean TBSA of burn cases before the earthquake was 21.7±21.9%, and the mean TBSA of deep burns was 8.4±12.7%, while the mean TBSA of burn cases after the earthquake was 16.78±14.3%, and the mean TBSA of deep burns was 3.92±7.1%.[14] In the current study, contrary to after the Chile earthquake, both the mean TBSA and deep burn TBSA of the burn patients observed following the earthquake were greater. The burn surfaces were broader for the types of burns in Group 1, which resulted from tent fires (39.6%). Moreover, the burns observed after the earthquake affected broad surfaces and were deep burns, resulting in an increase in the number of surgical interventions.

In conclusion, in the study presented here, it was found that the number of cases admitted for burns, the number of flame burns, the percentage of total body surface burned and the mortality rate were higher after the earthquake compared to the time before the earthquake. To decrease the effect of disasters, it should be compulsory to plan for disasters. Precautions could make the consignments regarding burns decrease and could result in complete and early interventions in burned patients, such as having electricity installed in the tents by experts, surrounding the warm-up tools with protected structures to prevent any cases of burns, using tents that are not easily and/or quickly flammable or that are resistant to fire; making a quick transition from tents to other housing, stockpiling containers at certain places in the country instead of producing containers, having mobile burn units and mobile intensive care units along with mobile operating rooms, and having other mobile health services.

Conflict-of-interest issues regarding the authorship or article: None declared.

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