

## Socio-Demographic Characteristics of Patients with Electrical Burns Admitted to Emergency Department

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### Abstract

**Aim:** Electrical burns may develop because of the direct effect of electric current on the cell membrane and smooth muscle of blood vessels and because of the transformation into heat energy when passing through body tissues. Electrical burns account for 3%-5% of all cases of burns.

**Materials and Methods:** A total of 213 patients with electrical burns who were admitted to our emergency department (ED) between 2001 and 2011 were retrospectively analyzed.

**Results:** The mean age of patients was 33.7±10.8 (min: 18, max: 72 years), and 86.9% (n=185) of the patients were male. The majority of patients (63.4%; n=135) were living in city centers, followed by patients in the village (22.5%; n=48) and the countryside (14.1%; n=30) respectively. The most common occurrence times of the burns were 14:00 (5.6%; n=12) and 10:00–11:00 (4.2%; n=9). Of the patients, 39.4% (n=84) were admitted to our ED between 18:00 and 24:00. Third degree burns were seen in 57.9% (n=127) patients, second degree in 39.4% (n=84), and first degree in 0.9% (n=2). Subarachnoid hemorrhage was accompanied in one patient and acute abdomen in another. Mortality was 1% (n=2) in the burn center. Electrical burns were most frequently seen in August (14.1%; n=30), June (11.3%; n=24), and July (10.3%; n=22). However, it was rarely seen during winter months (16%; n=34). The average days of hospitalization were 26.4±24.8 (min: 1, max: 141 days).

**Conclusion:** Electrical burns are not common compared with other burns and have a high percentage of third degree burns. The frequency of electrical burns increases during the summer in our region. (*JAEM 2015; 14: 26-9*)

**Key words:** Electrical burns, emergency department, degree burns, length of stay

### Introduction

Electrical injuries (EI), compared with other accidents, are seen rarely worldwide, but they are a part of traumas that can lead to high morbidity and mortality. The effect of electric current could be directly on the cell membrane or smooth muscle of vessels, or it could progress as a result of electric current transformed into heat energy as it passes through the body tissues. Mostly, children and young adults are exposed to this trauma, but people from all age groups are at risk of this type of trauma. In the United States (US), there are 52000 electrical injury admissions to trauma centers each year, and 1500 deaths have been reported as a result of these injuries. Three to eight percent of trauma-related injuries in Europe are because of EI (1). Twenty percent of these injuries are seen in children, whereas 50% of them arise from accidents in the work place (2).

Body damage due to electric current depends on various factors, such as current type, voltage intensity, exposure time, path that the

current follows, and body resistance to the current. Tissues that have maximum resistance are bone, fat, tendon, skin, muscle, blood vessels, and nerves (3).

The main cause of death is cardiac or respiratory arrest (4, 5). Deep damage of tissues and organs can lead to intensive care follow-up and secondary systemic disorders requiring surgical repair (6). Timely and effective treatment is important in preventing short- and long-term morbidity and mortality (6).

In this study, we aimed to examine the demographic information (such as gender and analysis of age, degree of burn, rate of burn, rates of burn unit admission, length of stay, and outcome) of patients who were admitted to the Department of Emergency Medicine of Ataturk University Faculty of Medicine.

### Materials and Methods

Electrical injury patients that came to our hospital's emergency rooms between 2001 and 2011 were retrospectively analyzed. Only



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those with electrical burns were enrolled in the study, and those with as lightning burn, tandir burn, vapor burn, or chemical burn were excluded from the study.

The age and gender of the patients, dates of emergency admissions, anatomical localization of burns, total surface area of burns, and outcomes were recorded. In the calculation of the degree of burns, the highest degree was taken into account (If there were two types of degrees of burn wounds such as second and third, the degree was considered as third degree burn). The anatomical localization of burns was classified as head-neck region, front side of body, back side of body, upper right extremity, upper left extremity, lower right extremity, lower left extremity, and genital area. The outcomes of patients were classified as discharged, admission, referral, and death in separate groups. The demographic, clinical, and socio-cultural characteristics of patients were recorded by an emergency physician.

### Statistical analysis

The characteristics of the patients were recorded using Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, USA) 20 for Mac program. Numerical variables were given with the median (min-max) value. Categorical variables were given as number and percentage.

## Results

Two hundred and thirteen emergency electrical burn patients were admitted during the study period. 86.4% of these patients (n=184) were male. The average age of patients was 33.7±10.8 (min: 18, max: 72). In two cases, there were additional problems apart from burns. There was subarachnoid hemorrhage (SAH) in one case and acute abdomen in another. 48.8% of cases (n=104) applied directly to the emergency rooms, whereas 51.2% (n=109) of them came to the emergency department as a referral from other centers. 63.4% (n=135) of the patients were from Erzurum, whereas 36.6% (n=78) of them applied from other provinces in the region. Ağrı and Van were the provinces from where the most cases came, with a share of 10.3% (n=22) and 5.2% (n=11), respectively (Table 1). 63.4% of patients (n=135) were from the city center, whereas 14.1% (n=30) were from towns, and 22.5% (n=48) were from the village.

The time periods when burns occurred frequently were 14:00 in 5.6% (n=12) of the patients and 10:00-11:00 in 4.2% (n=9). Admissions to the emergency room were done between 18:00 and 24:00 in 39.4% (n=84).

When we examined the admissions according to seasons, summer had 35.7% (n=76), spring had 27.7% (n=59), autumn had 20.7% (n=44), and winter had 16% (n=34).

When we examine the admissions according to months, the most frequent admission months were August with 14.1% (n=30), June with 11.3% (n=24), and July with 10.3% (n=22), and the least frequent admission months were January with 4.2% (n=9) and December with 5.6% (n=12).

The frequency of burn rates, compared with the body parts of patients, were as follows: upper right extremity 67.1% (n=143), upper left extremity 54.9% (n=117), lower right extremity 38.5% (n=82), lower left extremity 35.2% (n=75), front of the body 34.7% (n=74), back of the body 26.8% (n=57), head-neck region 19.2% (n=41), and genital area 9.9% (n=21). The percentage of total burn of patients was 12.1%, whereas the percentages of burn ranged between 1% and 61%. Burn

**Table 1.** Provinces where the patients admitted, percentage of applicants from the cities, and the average percentage of burns of the patients

Application places of patients	Admissions rates by province (%)	Average burn percent (%)
Erzurum	63.4	6.9±8.6
Ağrı	10.3	17.7±14.9
Van	5.2	31.7±21
Erzincan	4.2	18.8±11.6
Kars	3.3	26.1±13.9
Iğdir	2.8	30.4±18.1
Hakkari	2.3	26.6±19.9
Bingöl	1.9	18.2±11.5
Ardahan	1.4	24.6±19.7
Gümüşhane	1.4	24.6±22.7
Mus	1.4	18±11
Atrvin	0.9	14.1±10.7
Bitlis	0.9	20±22.1
Bayburt	0.5	22.3±13.9

degree of patients was third degree in 59.6% (n=127), second degree in 39.4% (n=84), and first degree in 0.9% (n=2) of the cases.

The majority of our patients (51.2%, n=109) were referred to us from other centers. 25.8% of patients (n=55) were discharged from the emergency room after their treatment was completed, 59.2% (n=126) were hospitalized in the burn center, 9.9% (n=21) were referred to another medical institution because there were no place to hospitalize, and 5.2% (n=11) refused to be hospitalized. Seventy-three percent of the patients who were hospitalized in the burn center (n=92) recovered, 25.4% (n=32) refused treatment, and 1% (n=2) died.

Two male patients died while being treated in the burn center. In a 34-year-old patient, there were 61% second degree burns in total and also pelvic fracture and acute abdomen due to a fall from a height. The patient died in 4 days. Another patient, who was 44-years-old, had 17% third degree burns in total and also a subarachnoid hemorrhage due to a fall from a height. The patient died in 8 days. The median number of days that patients were hospitalized was 26.4±24.8, whereas the range of hospitalization time was 1-141 days.

## Discussion

Electrical burns may occur because of high-voltage current derived from high-voltage lines, transformers, industrial electricity and lightning-induced contact (>1000V), or usually because of low-voltage current from domestic electricity (<1000V) (7). In high-voltage EI, organ losses due to deep burns and complications, rhabdomyolysis-induced renal failure, and multiple organ failure may occur (7). In low-voltage electrical burns that are generally superficial, rhabdomyolysis and complications due to it are also rare (7). Although more common in high-voltage EI, life-threatening cardiac rhythm disorders, hidden trauma due to be launched by the electric current, and respiratory arrest are seen in both types of burns (8, 9).

The incidence of electrical burns differs in countries (America 3%, China 3%-5%, Slovakia 2.7%, India 3%-9%, Turkey 16%) (10). In

our study, we found that rate to be 6.2%. Compared with developed countries, the reason of the high incidence, both in our country and region, are a lack of infrastructure, inadequate education about how to be protected from EI, over-utilization of illegal electricity, rapid growth of the population, rapid development of technology, and increased utilization of electricity in daily life.

Electrical burns affect the younger age groups, as in all trauma patients. A study conducted in Australia showed that EI are seen in men three-fold more than in women, and in both sexes, the most frequently seen ages are between 20 and 30 years (11). Small children are often exposed to low-voltage electric current as a result of biting electrical cables, contacting plug sockets, and introducing conductive materials to plug sockets (12). In this age group, EI are equally observed in both sexes (12). Older children and adolescents are exposed to high-voltage lines-derived electric current outside the home or the industrial high-voltage electric current in business environment. The number of men in this age group is significantly higher than woman (8, 12).

In their study, Handschin and colleagues had found that the average age was between 29 and 34. Ninety percent of these cases were men, and 69%-75% of these injuries occurred in the work place. In accordance with literature, we also found that 86.4% of those affected by EI were men, and the mean age range was  $33.7 \pm 10.8$ . This situation could be attributed to the mainly younger age group males who work in construction industry.

In electrical burns that are in the acute period as a result of cardiac rhythm disorders and trauma-derived secondary complications and that are in the further period as a result of burn-related infections, fluid and electrolyte disorders, and organ failure, mortality is observed (10). As a result of EI, mortality rates are between 3% and 15% (13). In their study, Vierhapp et al. (6) found the mortality rates to be <5%. In our burn center, 73% of our patients recovered, 25% refused the treatment, and 1% died. One of the patients who died had subarachnoid brain hemorrhage, and the other had pelvic fracture and acute abdomen due to a fall from a height. The causes of their death may be due to additional injuries originating from the fall from height. The death rate of our patients was significantly lower than the existing literature. This could be attributed to early admission to our emergency room, as well as our highly qualified doctors and effective treatment to patients both in our emergency room and burn center.

In their study, Cander et al. (14) found the average length of stay of patients as  $7 \pm 8$  (1-25 days) days. Fifty-eight percent of patients had different degrees of burns, 9.9% had prehospital syncope, 9.9% had rhythm problems, and 6% had a broken limb. In our study, we found the median number of hospitalization days of patients to be  $26.4 \pm 24.8$  and the length of stay to be 1-41 days. One patient with burns had subarachnoid hemorrhage and another had pelvic fracture and acute abdomen. In EI, problems associated with cardiac problems are due to the direct effects of electrical energy to the heart and problems associated with burning and the launching effect of electrical energy and falls from height. It is clear that the additional problems accompanying EI both prolong the duration of hospitalization and increase the mortality rates.

One remarkable finding of our study was the rate of cessation of treatment being as high as 25.4%. We attributed this to the limited housing and food facilities for the patients' relatives who come from outside the city and to the underestimation of the problem by pa-

tients' relatives although the burn is a third degree because the burn surface was small. We believe that if there is low-cost housing where the relatives of patients can meet their daily needs in our university hospital that has a high rate of referrals from outside the province and if the severity of the treatment process is told to the relatives of patients clearly, this problem will be solved.

The type and intensity of electric current, initial burn rates, additional injuries, and experience of the hospital where patients are treated can be considered as factors influencing the medical history, duration of hospitalization, and outcome of patients.

Because electrical burns are injuries from preventive trauma group, if the risk group is identified and prevention methods are taught with regular and periodic training, these injuries can be reduced. In-house precautions, especially for children, increasing the standards and controls of electrical installations and equipment, taking electrical cables under the ground, and prohibiting the illegal use of electricity can be the measures taken to reduce such injuries.

### Study limitations

The major limitation of our study was the inability to fully access the data because it was a retrospective study. Therefore, the calculation of costs associated with electrical injury patients could not be done. We believe that there is a need to conduct a prospective study that will also cover the cost calculation on this issue.

### Conclusion

Our study has shown that our hospital rates of electrical burns half after treatment cessation of treatment after is high. Measures should be taken to prevent it.

**Ethics Committee Approval:** Ethics committee approval was not received due to the retrospective nature of this study.

**Informed Consent:** Written informed consent was not obtained due to the retrospective nature of this study.

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