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Factors affecting mortality and epidemiological data in patients hospitalised with burns in Diyarbakir, Turkey

MUSTAFA ALDEMIR, M.D.
İSMAIL HAMDI KARA, M.D.
SADULLAH GIRGIN, M.D.
CAHFER GÜLOĞLU, M.D.

Departments of Emergency Medicine, Family Practice and General Surgery, Dicle University Faculty of Medicine, Turkey

Summary

Background. Burns continue to be responsible for significant morbidity and mortality in developing countries. In this study we aimed to determine the factors affecting mortality and epidemiological data by examining the records of burned patients.

Method. The hospital records of 980 patients who were hospitalised in the Burns Unit at Dicle University Hospital (DUH) between June 1994 and July 1999 were examined for factors affecting mortality. Factors evaluated included gender, age, burn type, degree and extent of burn, prognosis and length of hospitalisation (LH). We investigated the relationship (if any) between the demographic data, degree and extent of burns and mortality and morbidity rates.

Results. The study group consisted of 325 males (33.2%) and 655 females (66.8%). Of the patients 738 (75.3%) were children (age under 15 years), 217 (22.1%) were younger adults (age 15 - 50 years), and 25 (2.6%) were older adults (age over 50 years). The mean age was 11.2 ± 14.01 years (range 15 days - 95 years). Of the burns 618 (63.1%) were scalds, 199 (20.3%) burns from a flame and 163 (16.6%) electrical burns. The mean extent of burn was 24.3 ± 14.5% (range 1 - 95%). Seven hundred and eighty-seven (80.3%) of the study group made a full recovery, 131 (13.4%) were discharged from hospital after partial recovery, and 62 (6.3%) died. The mean LH was 11.33 ± 8.8 days (range 1 - 67 days). There was a positive correlation between burn extent and mortality ($r = 0.35$, $p < 0.0001$) and between age and type of burn ($r = 0.60$, $p < 0.0001$). While scalds had the highest frequency among children, flame and electrical burns were most common in the adult and older adult groups. There was also a positive correlation between degree and type of burn ($r = 0.32$, $p = 0.0001$), scalds tending to be more superficial while flame and electrical burns were generally more serious. Deaths of patients with extensive burns usually occurred in the first 5 days following injury due to acute renal failure and hypovolaemic shock, while deaths from moderate and minor burns usually occurred after 7 days and were due to wound infection and sepsis.

Conclusion. We found positive correlations between age and type of burn, degree and type of burn, and the extent of burn and mortality. The overall mortality rate for our unit was 6.3%.

Burns are serious health problems associated with high mortality and morbidity. The causative factors and demographic features associated with burn injury differ from country to country, and for this reason it is important that every nation carry out its own epidemiological studies on burns. As an example of specific features, one significant finding in Turkey is that public hospitals are generally the first places that see patients with burn injuries.[1]

The total population of Turkey was 70 534 746 according to the 2003 census.[2] According to a 2002 study,[1] each year approximately 0.0016% of the population is admitted to burn units with severe burns. In a later study,[3] burns from flames comprised the majority of presentations and admissions (48 - 69%). Electrical burns were the next most common type of burn injury. Mortality was highest in children/students, females and retired persons. Extent and depth of burn were important predictors of patient survival. Burns from flames were not only the commonest form of burns but also carried the highest risk of mortality. Death occurred mostly from multi-organ injury due to sepsis (47.1% of deaths), renal failure (44.6%), respiratory injury (5.8%) and gastrointestinal bleeding (2.5%).[1] As a result of recent improvements in the treatment of burns, mortality rates have decreased and the victims' quality of life has improved. The extent of the burn is a major prognostic factor.[4]

In this study, we aimed to determine the factors affecting mortality by examining the records of patients who were hospitalised in the Burns Unit at Dicle University Hospital (DUH) between 1994 and 1999.

Material and methods

The records of 980 patients who were hospitalised between June 1994 and July 1999 at the Burns Unit at DUH were retrospectively examined. DUH, a tertiary referral centre and the largest hospital in south-eastern Turkey, cares for the vast majority of patients with burns referred to hospitals.

The patients were hospitalised through an evaluation process adhering to the American Burn Society criteria[5] (Table I). Age, gender, type, degree and extent of burn, prognosis and length of hospitalisation (LH) were assessed. Intravenous crystalloid replacement, prophylactic wide-spectrum antibiotics and enteral nutrition were used in all patients. Patients with major burns received tetanus prophylaxis, total parenteral nutrition, cytoprotective agents (sucralphate), and H_2-receptor blockers. In all cases, closed dressing of the burn with povidone-iodine and topical antibacterial ointment (nitrofurazone 0.2%; Furacin soluble dressing) were used after the debridement of bullae and necrotic tissue. When there was a likelihood of compartment syndrome in extremity burns, fasciotomy or escharotomy was applied. All patients received diuretics, and those with electrical burns were monitored for cardiac arrhythmias. The relationship between demographic data, degree and extent of burns and mortality and morbidity rates was investigated.

Statistical analysis was done using the SPSS 7.5 computer program. Analysis of variance (ANOVA) and Bonferroni tests were used to correspond data on more than two groups. Spearman tests were used to determine relationships between the groups. Data are shown as mean ± standard deviation (SD) with $p < 0.05$ accepted as statistically significant.

TABLE I. CLASSIFICATION CRITERIA OF THE AMERICAN BURN ASSOCIATION

Major burns	**Patients treated in a burn centre** • Second- and third-degree burns on 10% or more of TBSA in patients under 10 or over 50 years of age • 20% TBSA burn in other age groups • Full-thickness burns of 5% TBSA or more • Burns of face, hands, feet, eyes, ears, or perineum that may result in cosmetic or functional disability • High voltage electric injury, including lightning injury • Inhalation injury or associated trauma • Significant chemical burns • Burns in patients with pre-existing disease that would increase the risk of dying (e.g. diabetes mellitus or symptomatic cardiopulmonary disease)
Moderate burns	**Patients treated in a general hospital setting** • Second- and third-degree burns of less than 10% TBSA in patients under 10 or over 50 years of age • Less than 20% TBSA in other age groups • Absence of significant burns to areas of special function or risk • Absence of other risk factors such as high-voltage electrical injury, inhalation injury associated trauma, or significant pre-existing disease
Minor burns	**Outpatients** • Adult patients with burns on 15% or less of TBSA • Child patients with burns on less than 10% of TBSA

TBSA = total body surface area.

Results

Of the 980 patients admitted to the Burns Unit between 1994 and 1999, 325 (33.2%) were male and 655 (66.8%) female; 738 (75.3%) were children (age under 15 years), 217 (22.1%) adults (15 - 50 years) and 25 (2.6%) older adults (over 50 years) (Table II). The mean age was 11.2 ± 14.01 years (range 15 days - 95 years). Of the burns 63.1% (N = 618) were scalds, 20.3% (N = 199) burns from a flame, and 16.6% (N = 163) electrical burns. The mean burn extent was 24.3 ± 14.5% (range 1 - 95%). Of the burns 90.3% (N = 885) were second degree and 9.7% (N = 95) third degree. The mean LH was 11.33 ± 8.8 days (range 1 - 67 days). Of the patients 80.3% (N = 787) were discharged after full recovery and 13.4% (N = 131) after partial recovery (at the request of their relatives); 6.3% (N = 62) died (Table III).

TABLE II. AGE DISTRIBUTION OF PATIENTS

	Children (0 - 14 years)	Adults (15 - 49 years)	Older adults (> 50 years)	Total
N	**738**	**217**	**25**	**980**
%	**75.3**	**22.1**	**2.6**	**100**

TABLE III. DEMOGRAPHIC DATA OF PATIENTS AND TYPES OF BURN

Mean age (range)	**11.2 ± 14.01 (15 days - 95 years)**
Gender (*N* (%))	
Male	**325 (33.2)**
Female	**655 (66.8)**
Kind of burn (*N* (%))	
Scald	**618 (63.1)**
Flame	**199 (20.3)**
Electrical	**163 (16.6)**
Grade of burn (*N* (%))	
Grade 2	**885 (90.3)**
Grade 3	**95 (9.7)**
Extent of burn (% TBSA) (mean ± SD (range))	**24.3 ± 14.5 (1 - 95)**
Outcome (*N* (%))	
Recovery	**787 (80.3)**
PR	**131 (13.4)**
Death	**62 (6.3)**
LH (mean ± SD (range))	**11.33 ± 8.8 (1 - 67 days)**

TBSA = total body surface area; PR = partial recovery; LH = length of hospitalisation.

Most of the patients who died were children (N = 44). Of the children who died, 63.6% (N = 28) had been scalded, while most of the adults who died had electrical and flame burns. Deaths of patients with burn extent over 50% were generally due to hypovolaemic shock and acute renal failure within the first 5 days (25 of 30 deaths, 83.3%), while deaths of patients with burn extent less than 50% generally took place after the 7th day (22 of 32 deaths, 68.8%). Most deaths in the latter group (N = 19) were due to infection and sepsis, and the patients had been admitted more than 72 hours after the injury (Table IV).

A positive correlation was found between the extent of burns and mortality (r = 0.35, p < 0.0001), but no relationship was found between between type of burn and LH or between degree of burn and mortality rate (p > 0.05). There was a positive correlation between the type of burn and age (r = 0.60, p < 0.0001), scalds being seen mainly in the young and flame and electrical burns being most common among adults and older aduls. There was also a positive correlation between type and degree of burn (r = 0.32, p = 0.0001). While scald and flame burns tended to be more superficial, electrical burns were often more serious.

Discussion

Burns continue to be a major environmental factor responsible for significant morbidity and mortality in developing countries. When the statistics of developing countries were examined, it was seen that the scalds were the most common type of burn. In developing countries children constitute 42 - 50% of the victims of scalds.[6-8]

In a recent study from Turkey,[1] a total of 1 083 burn cases seen between August 1988 and the end of 1997 were retrospectively analysed. Mean patient age and mean percentage of total body surface area (TBSA) burned were reported as 18.1 years and 31.2%, respectively. Children under 4 years of age were at high risk for severe burn injury. Among adults, self-employed people were the group at most risk of burn injury, and labourers were second. The home is the most frequent setting for burn injury.[1]

In the present study there was also a positive correlation between type of burn and age. While scalds were seen mainly in children, flame and electrical burns were most common among adults and older adults. Most of our patients (75.3%) were children (0 - 14 years), 62% of whom had been scalded (Tables II and III). These injuries are likely to be due to children's curiosity, carelessness and lack of awareness of danger, and their parents' failure to explain hazards and watch over their children.

In our study, a positive correlation was also found between type and degree of burn, scalds usually being more superficial and flame and electrical burns deeper. Care of patients with full-thickness burns is more difficult and takes longer than care of those with less severe burns, and the mortality and morbidity rates are also much higher.

Loss of albumin and other plasma proteins due to increased capillary permeability, decreased plasma volume, increased peripheral and pulmonary vascular resistance and decreased cardiac output are commonly observed in burn cases. Acute tubular necrosis may occur if the intravascular volume is so low that it cannot meet the deficit,[5,9] and thermal injury also impairs host defence systems and mechanical barrier functions of the skin.[5,10] Studies have found the extent and area of burn,[11,12] inhalation burns[13] and age[13,14] to be factors affecting mortality rates. Mason *et al.*[15] found the development of bacteraemia in burned patients to be the first indication of a fatal outcome. Our study found a positive correlation between extent of the burn and mortality, the mortality rate rising as the burn extent increased. Acute renal failure and fluid-electrolyte deficit occurred in patients who did not receive fluid replacement early on, especially those with major burns.

Burn patients' basal metabolic rate tends to increase due to fluid and heat loss. After arranging intravenous treatment of hypovolaemic shock, beginning enteral nutrition early decreases translocation and the incidence of sepsis by increasing mucosal blood flow and decreasing mucosal atrophy.[9,16] Complications such as early ileus, early gastritis and duodenitis, bleeding and perforation of ulcers,[5,17] and abdominal compartment syndrome[18] can result from the burn patient's increased gastric acid secretions. In all our cases early enteral (high-protein and high-calorie) nutrition was administered and gastric mucosal protective agents were used. Patients were kept in positive nitrogen balance, and duodenal gastric complications were not seen except in the case of patients who died from sepsis.

TABLE IV. PATIENT DEATHS ACCORDING TO AGE AND TYPE AND EXTENT OF BURN

< 50% of TBSA (N = 32)			> 50% of TBSA (N = 30)			Total (N = 62)
Age group	Type	N	Age group	Type	N	N (%)
Child	**Scald**	**18***	**Child**	**Scald**	**10**	**28 (45.2)**
(N = 24)	**Flame**	**4†**	**(N = 19)**	**Flame**	**4**	**8 (12.9)**
	Electrical	**2**		**Electrical**	**5‡**	**7 (11.3)**
Adult	**Scald**	**1**	**Adult**	**Scald**	**1**	**2 (3.2)**
(N = 5)	**Flame**	**2**	**(N = 11)**	**Flame**	**8**	**10 (16.1)**
	Electrical	**2**		**Electrical**	**2‡**	**4 (6.5)**
Older adult	**Scald**	**0**	**Older adult**	**Scald**	**0**	**0 (0)**
(N = 3)	**Flame**	**1**	**(N = 0)**	**Flame**	**0**	**1 (1.6)**
	Electrical	**2**		**Electrical**	**0**	**2 (.3.2)**

*Delayed admission (N = 15).
†Delayed admission (N = 4).
‡Electrical plus flame.
TBSA = total body surface area.

When intensive muscle contractions in electrical burns have resulted in fractures of cervical, thoracic and lumber vertebrae, immobilisation of the patient is vital during transportation.[5] We did not see fractures related to such contractions, although there were fractures due to falls. Of our patients with electrical burns, 2 died from ventricular fibrillation and 1 from acute renal tubular necrosis.

Burn mortality rates have been reported as around 6.8 - 18.8% in previous studies.[7,8,19] Sepsis,[1,3,11] shock,[11] adult respiratory distress syndrome (ARDS),[12,14] multi-organ failure,[1,3,8,11,20,21] acute renal failure[8] and cardiac arrhythmias[5] are common causes of death after burn injury. Tang *et al.*[11] reported a 71.2% mortality rate for patients with a 70% or greater burn extent. Between 1959 and 1978 the main causes of death were sepsis and shock, but during the last 20 years, multi-organ failure became the foremost cause.[11] The mortality rate for our clinic (6.3%) was lower than rates reported in the literature. Discharging some patients after partial recovery and the precautionary hospitalisation of patients with minor burn extents may contribute to this lower rate.

In a series of 114 cases reported by Ertekin *et al.*,[22] 19 of 20 patients with burn extents of 50% or more died, 14 of them during the first 5 days due to other causes before the occurence of septicaemia. A 2-year surveillance study for the years 1997 and 1998 done by our clinic[23] showed that the nosocomial infection (NCI) rate for the first year was 54.2% and that it decreased to 21.2% in the following year. Infection of the burned area was the most common NCI, constituting 65.5% of NCIs in 1997 and 54.2% in 1998.[23] In present study, 19 of 24 children with a burn extent of less than 50% but who were admitted 72 hours after injury died from wound infection, sepsis and/or multiple organ failure. Infection may be caused by factors such as a delay in admission to emergency service, introduction of non-sterile materials to the wound, covering the patient with non-sterile sheets or blankets, or increased susceptibity to NCIs because of nutritional deficits.

In children the foremost cause of burns is scalding (Table IV). The incidence of these burns could be decreased by keeping children away from hazardous environments and a public information initiative to educate parents on the potential danger of this type of injury.

It was found that extent of the burned area and delays in admission to hospital were the most significant factors affecting the mortality rate. Rapid patient transportation, with appropriate preliminary treatment before reaching hospital, dealing with hypovolaemic shock during initial admission to the hospital, early debridement of wounds, providing protein-calorie supply during the ensuing period, and quick response to infections are very important prognostic factors.

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