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Original Article

Factors affecting mortality in burn patients admitted to intensive care unit

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Abstract. The aim of this study is to describe the characteristics of the patients admitted to our burn unit, and identify the factors associated with burn mortality. Between January 2000 and June 2011; Survivor group (980 control cases (Group 2)) were compared to non-survivor group (165 patients (Group 1)) to determine what factors might predict a high risk of mortality.

Mortality rate was 14%. Non-surviving patients were significantly older (22.26±1.63 vs. 15.83±1.56, p=0.000) and they also stayed shorter (13.30±1.16 vs. 21.32±0.57, p=0.000) in the Burn Unit. The total body surface area (TBSA) burned (52.35±1.82 vs. 20.56±0.43, p=0.000) was significantly higher in non-survivor group. Inhalation injuries were also significantly higher in this group (15.8% vs. 0.9%, p=0.000). With regard to the cause of burn, non-survivor suffered significantly more flame injuries.

The patients with risk factors such as older age, increasing of burned TBSA and inhalation injury should be categorized as high risk for mortality at the time of admission.

Key words: Burn injury, mortality, and risk factors

1. Introduction

Burn injury is a common type of traumatic injury, causing considerable morbidity and mortality. The patients with severe burn frequently sustain life-threatening injuries, requiring a multi-disciplinary approach providing intensive and long-term treatment (1,2).

Sepsis, inhalation injury and multi organ failure were the most causes of death in burn patients (3-5). There are extensive studies investigating the role of various risk factors for mortality following burn injury. Some demographic and injury variables such as age, gender, extent of burn, and presence of inhalation injury, have been used to predict mortality after severe burn (6-8).

The main goals of this study are to describe the characteristics of the patients admitted to our burn unit, and identify the factors associated with burn mortality.

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2. Materials and methods

Between January 2000 and June 2011, 1145 patients were hospitalized in the Adana Burn's unit of Baskent University. Data were obtained at admission and were recorded prospectively during the hospital course. The patients were followed until discharge or death. Survivor group (980 control cases (Group 2)) were compared to non-survivor group (165 patients (Group 1)) to determine what factors might predict a high risk of mortality. The following data were obtained for each patient: age, gender, type of burn, total percent of burned total body surface area (TBSA) and percent of TBSA affected by each burn degree (second- and third degree), presence of inhalation injury, procedures performed (grafting, debridement). The treatment methods were recorded in the burn treatment registry.

Inhalation injury was diagnosed on the basis of suspicion after exposure to smoke or fire, and considered proven in the presence of signs of airway obstruction or carbon particles in sputum or by bronchoscopy. Suspected and proven inhalation injuries were treated by endotracheal intubation and mechanical ventilation (9).

The data were expressed as mean±SEM. Differences between the two groups were analyzed using the independent Student's *t* test and/or its non-parametric counterpart, the Mann-

Whitney *U* test. Chi-square or Fisher's exact tests were used for the categorical variables when appropriate. The homogeneity of variances was calculated using Levene's test and the Lillefors significance correction test. Correlations between parametric and non-parametric variables were assessed by Pearson's correlation coefficients. Multiple regression analyses were used accordingly. All statistical calculations were done using the program statistical packages for the social sciences for Windows (version 16.0, SPSS, Inc., Chicago, IL, USA). Differences were considered statistically significant at levels of probability <0.05.

3. Results

During the study period, 1145 patients (763 males, 382 females) were enrolled into the study. Mortality rate was found as 14% (165/1145). A comparison between surviving and non-surviving patients is provided in table 1. Non-surviving patients were significantly older (22.26±1.63 vs. 15.83±1.56, p=0.000) and they also stayed shorter (13.30±1.16 vs. 21.32±0.57, p=0.000) in the Burn Unit.

There were no significant differences with respect to the gender, number of hospitals transferred before admission and the percentage of amputation. However; inhalation injuries were significantly higher in non-survivor group (15.8% vs. 0.9%, p=0.000) (Table 1). With regard to the cause of burn, non-survivor group suffered significantly more flame injuries (Figure 1).

The TBSA burned (52.35±1.82 vs. 20.56±0.43, p=0.000), the percentage of TBSA with second degree (35.84±2.30 vs. 18.08±2.41, p=0.000) and full-thickness burns (28.76±2.59 vs. 3.98±0.35, p=0.000) were significantly higher in non-survivors group (Table 2). Both number of graft operations and hospital length of staying were significantly decreased in non-survivor group compared to survivors (both p =0.000).

Burns including face and neck (55.8% vs. 40.6%, p=0.000) and perineum (59.4% vs. 22.8%, p=0.000) were significantly higher in non-survivor group (Figure 2).

In the Pearson's correlation analysis, mortality was positively correlated with age (r=0.125, p=0.000), the total body surface area burned (r=0.587, p=000), the percentage of TBSA with second degree (r=0.356, p=0.000) and full-thickness burns (r=-0.476, p=0.000). In the Spearman's correlation analysis; mortality was positively correlated with the types of burn (r=0.098, p=0.001) and inhalation injury (r=0.303, p=0.000).

Table 1. Demographic features of the two study groups

	Non-survivor (n=165)	Survivor (n=980)	p
Age (year)*	22.26±1.63	15.83±1.56	0.000
Male gender (n, %)	112 (67.9)	651 (66.4)	0.715
Hospitalization time (days)*	13.30±1.16	21.32±0.57	0.000
Number of hospitals transferred before admission*	1.76±0.099	1.60±0.038	0.145
Inhalation injury (n, %)	26 (15.8)	9 (0.9)	0.000
Amputation (n, %)	5 (3)	39 (4)	0.557

*mean± SEM

Table 2.Comparison of group data for burn characteristics, treatment and hospitalization time

	Non-survivors (n=165)	Survivors (n=980)	p
Second degree (%)*	35.84±2.30	18.08±2.41	0.000
Third degree (%)*	28.76±2.59	3.98±0.35	0.000
TBSA burned (%)*	52.35±1.82	20.56±0.43	0.000
Number of debridement operations*	0.81±0.045	0.72±0.037	0.206
Number of graft operations*	0.15±0.036	0.54±0.028	0.000
Plasma transfused (units [250 mL per unit])*	1.76±0.05	1.91±0.014	0.000
Blood transfused (units [250 mL /unit])*	1.26±0.052	1.57±0.021	0.000

TBSA: total body surface area.
*mean± SEM

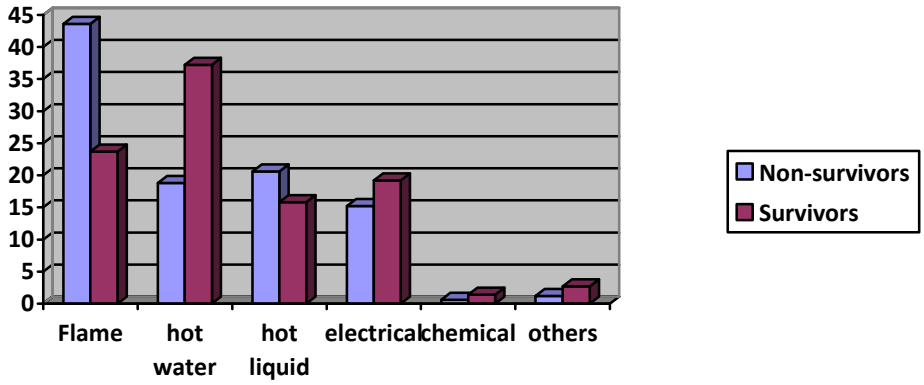

Fig. 1. Distribution of the patients according to the types of burns.

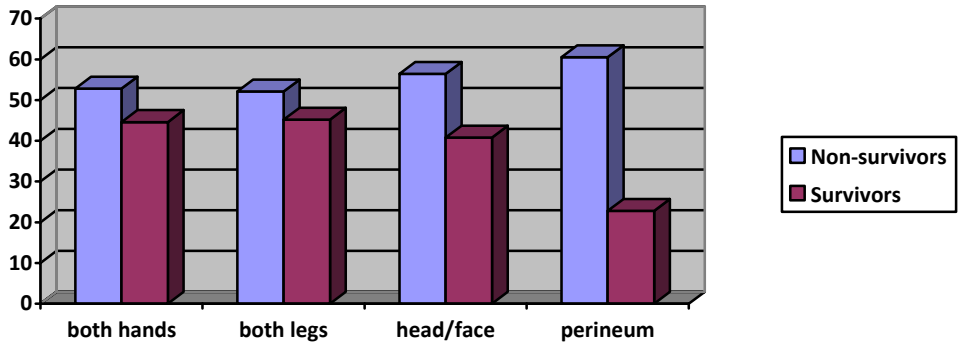

Fig. 2. Distribution of burned sites of the body among the patients.

Stepwise, multiple regression analysis was carried out using mortality as a dependent variable and several potential determinants of mortality were used as independent variables, including age, the TBSA burned, types of burn, inhalation injury. The total body surface area burned (p=0.000, 95% CI 0.010 to 0.012) was independent parameter related with mortality.

4. Discussion

The mortality rate in our series of patients was 14%, which is higher than in most of the reports from other countries (10-12). In most hospitalized populations with severe burn injuries, the mortality rate lies between 1.4% and 18% (maximum, 34%) (13,14).

Several studies showed that older age, increasing TBSA and inhalation injury are the three major risk factors for mortality, although other variables have also been associated with a higher mortality risk (4,15,16). We found an association between age and mortality in our study.

The results of the present study indicated that the TBSA burned was the most important factor related with mortality. The increasing severity of injury through more skin loss exposes the largest burns to more complications, thus increasing mortality rate.

While burn size is a key mortality risk factor, its importance is mainly due to the danger of blood stream infection and sepsis (3,17).

Besides age and TBSA, inhalation injury has repeatedly been associated with increased mortality (eight- to 10-fold higher) (18). It is important because it increases the danger that severe respiratory complications may develop. When combined with cutaneous burns; inhalation injury increases fluid requirements for resuscitation, the incidence of pulmonary complications and the mortality rate (9). In severe injuries, physiologic shunt leading to profound hypoxemia and acute micro-vascular injury with increased trans-vascular fluid flux produces a clinical picture of acute respiratory distress syndrome (19,20). Inhalation injury is due to smoke inhalation and is therefore especially

prevalent in populations with a high proportion of flame burns (6,21). Flame burns have been associated with a higher mortality rate, but flame burns have also been associated with more-extended, deeper burns and the presence of inhalation injury (6,22,23). Kraft et al. (24) showed that flame burn injury resulted in more severe clinical complications, such as multi-organ failure and sepsis.

There is controversy about gender differences in the mortality of burn patients. Some investigators have demonstrated that female gender is a risk factor for mortality in burns patients. On the other hand, some researchers have found no significant association between gender differences and mortality in burn patients (25, 26). In a larger study by Brusselaers et al., a higher but statistically insignificant mortality rate was observed in male burn patients (1.6% male, 1.1% female) (27).

In conclusion; the patients with these risk factors (older age, increasing burned TBSA and inhalation injury) should be categorized as high risk for mortality at the time of admission. These patients also need special attention and care during hospitalization.

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